



ON NEUROLAW

Essays on Behavior and Society

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On Neurolaw: Essays on Behavior and Society, by Luis Ignacio Brusco and Tomás Brusco.

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PROLOGUE

The study of neuroscience cuts across justice and the law at many points, from what we know about the civil and criminal capacity of persons (such as the cognitive ability to make short- and long-term decisions) to far more primitive matters (such as the justice-seeking systems that have been studied in animals). The need for rules can be seen in the gregarious life of the herds of many higher mammals. The situations of punishment and expulsion that arise there, and the altruistic or selfish behaviors that accompany them, depend on feelings of justice.

This need for communication within the herd deepens the social intersubjectivity of what is just, which becomes an expression of ideas. Semantic ideation will be transmitted in written or oral form so that speeches, defenses, accusations, observations and testimony can be developed. All of this implicitly requires logical cognition and complex activities such as abstraction and the making of metaphors. Belief systems, moreover, are present in every application of the law, from the cultural assumptions built into constitutions, codes and statutes to the processes of belief themselves (religious, political, cultural and so on), and they will be at work in judges, lawyers, witnesses, jurors and everyone else who takes part in judicial proceedings. Ethical and moral considerations will also come into play, and these are built into the paradigms of individuals and of the whole they form together, which is society with its own particular character.

Ethics is the branch of philosophy that studies human conduct in light of the moral ordering of human beings. From the earliest thinkers onward we find texts devoted to ethics, from Plato through Aristotle and on to Kant.¹ Today it is also studied from the standpoint of human consciousness, since it is a branch of moral philosophy that can no longer set aside

¹ I. KANT, *GROUNDWORK OF THE METAPHYSICS OF MORALS* (M. Gregor trans., Cambridge Univ. Press 1997) (1785).

what science knows about the brain and its role in moral behavior. This branch is called “experimental ethics.” Its fundamental question is whether there are universal principles in our instinctive programs that, as Kant proposed, are grounded in reason and prescribe a right way of acting for all human beings. A whole group of approaches within neuroscience has emerged as a result, investigating the neurological implications of moral conduct as well as the innate genetic features of behavior and those that are learned or shaped from outside.

This is also studied in more primitive settings. In an experiment at Emory University’s Yerkes laboratory, for example, capuchin monkeys showed their capacity to rebel when they were put through tests of equality, in which the experimenter handed an object to the primates and asked for it back in exchange for a reward, a piece of cucumber, which is a food they readily accept.² The monkeys rejected the cucumber when they saw that other monkeys received a more valuable reward (grapes) for the same work or for less effort. They compared their rewards and turned down the lesser ones whenever their companions had received something better, and this produced a context in which inequality and injustice were discovered at a basic level.

One of the main subjects that occupies scholars of neurolaw is free will in decision-making, because mechanisms have been described in the preparatory layers of the nervous system that would intervene in what we feel or how we move even before we become aware of it. Even so, conscious time remains afterward, and that time allows self-determination to be preserved, which is the key condition for sustaining free will, for being able to choose among options and for having the autonomy to decide. The belief systems that produce expectations of trust have an impact on people’s emotional, rational and bodily functioning. They form around an idea, that is, around believing in something or, conversely, around a negative idea, such as not believing that a medication will work. Such a system can form around something visible or around things that cannot be observed. These systems work above all through the amygdala, which opens

² S. F. Brosnan & F. B. M. de Waal, *Monkeys Reject Unequal Pay*, 425 NATURE 297 (2003).

the way to unconscious emotion, and through the prefrontal lobe, which allows beliefs to become conscious.

There are fundamentalist or reckless religious behaviors that can seriously mislead a community, all the more so when they come from people who speak from a position of social standing and who contaminate socially accepted matters with dogmatic positions. Empathy can have two sides where social conduct is concerned, and it is a mistake to force an equivalence between empathy and altruism. Empathy can at times be a negative process, since it can produce prejudgment, as was shown in a well-known set of wrongful convictions in the United States, where jurors acting in good faith convicted innocent people through mechanisms that ranged from beliefs to matters of race, physical appearance, religion and the like.

Some years ago a cover of *The New York Times Magazine* anticipated that neurolaw would become one of the central factors in how justice is approached.³ It was not mistaken, and new studies appear day after day that bear it out.

³ J. Rosen, *The Brain on the Stand*, N.Y. TIMES MAG., Mar. 11, 2007.

NEUROLAW: THE NEED TO REGULATE NEUROSCIENCE

There is an interesting relationship between neuroscience and law, because it is the nervous system that governs the rational and the emotional-instinctive subjective systems that lead to a system of consciousness and decision-making, which is the basis of all prosocial conduct. Functional research on the brain, which “exploded” in the second half of the twentieth century, opened the way to a series of discoveries that had a particular impact on two subdisciplines developed in the twenty-first century, “neurolaw” and “neuroethics,” which analyze how the brain makes possible ideation, subjective emotion and the decision-making that follows, producing conduct that may perhaps be predicted through the study of brain techniques.

Among the schools into which neuroethics is divided are the “neuoreductionists,” who give the brain a central role in ethical questions, the “neuroskeptics,” who place less weight on neuroscience, and the “neurocritics,” who accept that brain and environment intervene in roughly equal measure. All of these schools, which have developed over the last twenty years (especially since the “Decade of the Brain”), are concerned with the application of neuroscience to ethics and law. In other words, they are concerned with how the nervous system influences human social conduct, and also with the use of artificial intelligence to interpret conduct, judgments and case law.

A very different matter, however, is the application of ethics and norms to neuroscience, which would be a branch of bioethics, that is, the application of rules, social positions and values to the management of the scientific and philosophical revolution of neuroscience. Rafael Yuste of Columbia University, one of the scientists behind the BRAIN Initiative (Brain Research through Advancing Innovative Neurotechnologies), holds that this point must be central whenever the regulatory applications of

neuroscience for individual and social security are considered. Informed consent, the transfer of information, employment matters, legal incapacity, lack of criminal responsibility, eugenics and the handling of matters of consciousness are therefore key subjects that cannot be left unchecked.

There are many points at which the study of the nervous system can condition the way society handles central questions. There is, for example, a significant influence on human behavior that can be exerted through various neurotechniques, such as implanted brain stimulators, magnetic stimulation and different drugs or hormones. Their use can be very helpful in treating a psychopathology or a neurological disease such as Parkinson's, but it can also affect inhibitory control, emotional responses and a person's motor, sensory or cognitive capacity, among other things. This is a delicate situation that must be assessed by medical professionals under the oversight of an institutional ethics committee. The assessment matters even more in research protocols, where subjects must be capable of consenting to take part, a requirement that creates a bottleneck for studies of this kind. Such studies are essential for investigating and later approving treatments, yet in these cases they might be carried out on vulnerable patients.

Another substantial issue is the handling of the systems of consciousness. There are now intracerebral devices, neurosurgical procedures, medications and even psychotherapies that can change beliefs, sensations and thoughts, and so change the decisions people make. Internal, individual and intimate systems of thought could therefore be investigated. With a technique called magnetoencephalography (MEG), for instance, internal semantic ideas, such as a word and its meaning, could be detected, as the renowned neuroscientist Rodolfo Llinás of New York University has argued.⁴

Another very important question arises from the individual knowledge that can be obtained about people from brain imaging and from neurogenetic, electrical and magnetic studies of the brain. Such knowledge could predict, and also prejudge, information about future illnesses, about per-

⁴ R. R. LLINÁS, *I OF THE VORTEX: FROM NEURONS TO SELF* (MIT Press 2001).

sonality and even about what people think of their own capacity, as well as about risk behaviors, and this could open the door to the transfer of data and to prejudgment in courts and in the workplace, violating people's private rights.

Once the predictive factors observed in mental disorders, or simply in behavioral traits, are known, evaluative processes assign percentages of risk, which always leads to errors and may, in every case, interfere with individual rights. There are many multifactorial influences (social, environmental and biological conditions) that can produce epigenetic modifications in people's behavior.

In an article published in the prestigious journal *Nature*, Rafael Yuste proposes that "neurorights" should be included in the Universal Declaration of Human Rights.⁵ The subject is so important and so delicate that it is only now beginning to be known to the public, although it has been under discussion in the scientific world for a long time.

⁵ R. Yuste et al., *Four Ethical Priorities for Neurotechnologies and AI*, 551 NATURE 159 (2017).

PART I

The Brain

TABULA RASA

The brain could today be regarded as a blank slate, a *tabula rasa*, onto which information is written. Two parameters can be related to this idea.

In the first, the brain can be compared with a computer, in which memory becomes essential when it comes to valuing the machine, since the more memory it has, the more complex and costly it will be. Different programs (software) are then added to that memory, constituting, for example, cognitive functions such as language, learned motor practices (praxes) or sensory recognition (gnoses), and emotional phenomena that will modify how the intellect works are also recorded there (emotional memory).

The other comparison with the development of the human brain returns to the Aristotelian idea of the *tabula rasa*, although perhaps the one who was most right was Immanuel Kant.⁶ The German philosopher held that human beings are born with a basic brain that nonetheless has a certain functionality, to which the functions learned over time are added. This is quite similar to the first comparison. We must bear in mind, however, that for Kant, as for neuroscience today, we are also born with primitive instincts. These innate premises would be drives present in higher animals and in humans alike, serving the survival of the fittest. Instinctive functions such as fear, aggression, sexuality, feeding and the control of temperature (as a decision, for example to move into the sun or to migrate) are thus the functions that have preserved the species that survived.

When a human being is born, the brain is full of neurons, although they are very immature and poorly connected. In the first six months of life, however, the number of connections per neuron multiplies several times over, and the brain reaches 70 percent of its adult weight early on

⁶ ARISTOTLE, DE ANIMA bk. III, ch. 4 (C. Shields trans., Oxford Univ. Press 2016).

(by the age of two). Some cognitive neurologists believe that the most basic functions we come into the world with are pairs of opposites, pretty and ugly, good and bad, which over time would become the ethical and the aesthetic. For a baby, then, an ugly face deserves something bad, which is crying, while mother's pretty face deserves a smile. The importance of early childhood for the development of the human psyche has been confirmed neurologically.

This confirms the Freudian view of the importance of this stage of life, which points to the structural and functional explosion the brain undergoes in that brief moment of existence. To this must be added the importance of the second half of the first year for acquiring the phonemes of language, and the development in early infancy of key human senses such as vision, which means that we are macro-optic beings. The construction of semantic ideas, moreover, explodes at twenty-five months of age, giving ideational substance to the grammatical and phonetic language the child has learned.

There is, however, a process in childhood that remains strange until about the age of three, which is lasting conscious memory. For some functional reason the memories formed before that age are not retained, since, as a matter of description, our first memories date from around that time. Studies of mice in which neuronal reproduction was artificially increased in the gateway to memory (the hippocampus) have found that these animals do not learn.⁷ If an animal is taught to run mazes, which it would remember under normal conditions, it stops remembering them when its hippocampal cells reproduce rapidly, which is to say that it fails to record the information as the cells renew themselves.

It is thought that in the first years of life a process of neuronal reproduction probably takes place that would prevent memories from being retained. This may be necessary because the child needs other kinds of unconscious learning, such as first emotions, motor acts and language, among others.

⁷ K. G. Akers et al., *Hippocampal Neurogenesis Regulates Forgetting During Adulthood and Infancy*, 344 SCIENCE 598 (2014).

SENSORY SUBJECTIVITY

Few things are as abstract, and at the same time as present in every-day life, as sensory stimuli. Although there is broad agreement about what we feel, it is hard to say precisely what sensations are. It would be difficult, for instance, for different people to agree on what they really see when they describe a color or a scent, or on exactly what they feel when they are pricked by a needle. Pain, for example, is a normal (physiological) mechanism that defends us against every aggression our body suffers, whether internal or external. If we hurt a foot, the pain system triggers a bodily defense mechanism and we lift the foot off the ground. If we do not feel the pain, we may be injured, as happens to many people with diabetes who, because a disorder of their peripheral sensation keeps them from feeling pain, can hurt themselves without noticing.

This complexity and subjectivity often create a bewildering context when a person has to describe a sensory problem, or when someone has to decide how to treat it. Although we know that several neurobiological modulators of sensation are involved (forming a true neurological language) in which neurotransmitters and different areas of the nervous system take part, it would still be hard to define each sensation exactly, and harder still to define its qualitative variants, because the senses are the expression of a very complex neurological language. This “neurological language” is made up of only a few neurotransmitters and receptors, but they are multiplied millions of times, which produces something highly individual. The process is comparable to DNA, in which four substances are enough to generate the most complex processes of information transmission.

The brain's neural system, with some eighty-six billion neurons,⁸ each connected thousands of times, gradually produces a tangled internal system that nonetheless communicates with the outside world. It generates complicated processes for any sensation, yet these are such abstract matters that they tend toward subjectivity in its fullest expression. We often do not believe, for example, the pain reported by patients who have no concrete disease, even though they report it and very likely feel it. There is thus a concrete pain in response to an injury to the skin (nociceptive pain), a pain produced directly by our nerves, which can be affected in diseases of the peripheral nerves (polyneuropathies), and a somatic pain that is deep and hard to locate, associated with midline pain, generally in the pelvis or abdomen.

It often seems as though pain factors fire for no reason, and the cause may be neurological or psychological. Fortunately, there are brain mechanisms of sensory control, that is, an internal control exercised by systems that descend from the brain and regulate the perceptual system, inhibiting erroneous sensations such as hallucinations. In the case of pain, internal analgesic systems have been described that resemble opioid painkillers, which means that the sensory information we receive is filtered by a large system that controls our conscious grasp of reality. This system can fail and lose control of incoming information, either because too much information is produced or because the thalamus and the cerebral cortex do not filter it properly. Somatic pain could generally be explained by an interplay of two factors, psychological and biological, which often cannot be told apart. Touch or water, for example, can mask pain from a functional point of view, because they stimulate parallel pathways that compete with the pain and so cancel it out, although psychological anxiety can, at the same time, make it worse.

There are also psychotic patients in whom auditory, visual or bodily sensory perception spins out of control, producing hallucinations (even painful ones), that is, the perception of a reality that does not exist. There

⁸ F. A. C. Azevedo et al., *Equal Numbers of Neuronal and Nonneuronal Cells Make the Human Brain an Isometrically Scaled-Up Primate Brain*, 513 J. COMPAR. NEUROLOGY 532 (2009).

is little we could say about the truth of these sensations, knowing that although they do not exist outside the patient, the patient experiences them as real. This can happen when the system of sensory control becomes unbalanced, whether in schizophrenia, in certain stages of Alzheimer's disease, in developmental delays or with the use of drugs and some medications, among other problems.

Many studies suggest that in these patients there is activity in the area of the brain related to those functions. These are plainly subjective and abstract matters, yet they have a neurological basis, since they are the source of a symptom as personal as it is impossible to verify.

THE PREDICTIVE BRAIN

The brain minimizes prediction error in order to carry out all its perceptions and actions correctly. Thought and the multiple streams of sensory information the brain receives work in an interlocking way. Thinking about and perceiving the world make it possible to minimize errors, although only up to a point, once the many activities become excessive or must be carried out in a short time. In this way we unconsciously correct our acts, our decisions (above all short-term ones) and even our inner thought, that is, our consciousness.

There are illnesses in which the fastest acts are disrupted, such as tics and obsessive behaviors. These offer a clear example of disturbed corrective thinking in people who have no serious disease and can apprehend reality (unlike psychosis, in which judgment is lost), but in whom the function our brain performs is clearly altered. Two things take part in these processes, subjectivity, which provides inference (the possibility of generalizing from a single fact), on the one hand, and on the other the incorporation of new data arriving through all the senses, which makes it possible to know phenomena outside the mind (from the outside world or even from our own body, as with pain).

A new area of study within neuroscience, or neurophilosophy, has therefore developed in recent years under the name of “predictive neuroscience.” It holds that the brain works as a sieve that purifies sensory information, reducing to a minimum the errors in the information that comes from the outside world. In a certain sense these systems are thought to generate awareness of the situation, because they can distinguish erroneous information from information close to what we actually perceive. In the final stages of serious mental illnesses such as dementias, psychoses and even severe neuroses, errors arise in this information as a result of errors in the predictive neural networks. The mechanism used to make this prediction resembles that of a computer and rests on a statistical system the brain operates continuously, which allows the hypotheses

that enter the brain as sensory information to be tested immediately, with the aim of reducing error.

Obviously we do not all perceive the same thing, but despite certain differences produced by subjectivity, similar criteria arise about what, for example, is being observed, even though people may hold different opinions about what they perceive. We may disagree about the shade of a car's color, but no one can say that it is an airplane. This would be a constant mechanism of comparison in which attention, perception and action are bound firmly together.

Some scientists and philosophers (neurophilosophers) argue that phenomena of the cerebral cortex are involved together with the subcortex, where a subcortical structure called the thalamus acts as a filter for the sensory information (from all the senses) that reaches the cerebral cortex. It is the cortex (above all the prefrontal cortex) that will generate recognition and awareness of what is perceived, but it is the thalamus that selects what reaches it. In this sense, what Kant proposed in 1781 is to some extent confirmed, namely that the brain has prior instinctive categories, which the sensory stimuli we receive then reach and by which they are organized.⁹

Intuition does not work without contents, and in this Immanuel Kant was ahead of what neuroscience proposes today, since scientists now even draw comparisons with the computer (much like hardware and software). We can think only through contents that have entered our innate intellect. Working in this way, the brain generates a predictive method that compares multiple simultaneous hypotheses and produces a conclusion, which results in an immediate decision. This is an unavoidable function, because avoiding it would amount to making another decision. Some argue that talent and, above all, creativity in areas such as sport, art, science or economics rest on this predictive function, which compares millions of variables in milliseconds. It gives rise to different aptitudes suited to different functions, depending on which network or area of the brain has been developed.

⁹ I. KANT, *CRITIQUE OF PURE REASON* (P. Guyer & A. W. Wood trans., Cambridge Univ. Press 1998) (1781).

BETWEEN THE UNCONSCIOUS AND CONSCIOUSNESS

Reaction time is a key process in the workings of the mind, since it conditions the brain's capacity to respond. It is at work when a police officer fires, when a driver avoids a collision or when an animal escapes a predator, among countless other possibilities. It is the basis of short-term decision-making, and it most often has an unconscious beginning and a conscious, controlling development that will determine whether the act is inhibited or carried out. A reaction often begins as an unconscious process and only later becomes conscious. The time it takes for an event to become conscious also determines how much free will, or responsibility, can be attributed for what happens.

The unconscious reaction process, however, also plays a critical part in solving many problems. Very often there is very little time to avoid a crash, to keep from falling when we trip or to score a goal in a sudden, unplanned play. It is generally accepted that in our conscious constructions we operate through selective attention, which draws on billions of neurons and networks that regulate the systems of awareness of reality. Selective attention concentrates on a single focus, and it takes two forms. One, very frequent and probably almost constant, runs from the unconscious to the conscious and from the simplest to the most complex (*bottom-up*), as when we come across a familiar name in a newspaper without having looked for it. If, on the contrary, it were a name we were looking for, the process would run from the complex to the simple (*top-down*). In both cases, however, regulation by the prefrontal lobe has been described.

Rita Carter offers an interesting account in her *Brain Book*, where she shows how a goalkeeper reacts to a penalty kick.¹⁰ She describes the functional structures involved and shows how the brain responds to the dif-

¹⁰ R. CARTER, *THE HUMAN BRAIN BOOK* (Dorling Kindersley 2009).

ferent contingencies. A penalty kick serves as the example because it demands a very rapid response that calls on the fastest reflexes. Consciousness plays no part at first, and the goalkeeper would become conscious only at the end of the response, when the act is about to be completed (while the ball is in flight).

The author uses the chronological sequence of the brain processes and functions of a goalkeeper making a save as a model of conscious and unconscious reaction. It begins with a slow process of assessment that uses consciousness, in which the cortex and the thalamus work first, as parts of global conscious cognitive function. The goalkeeper will assess who is going to take the kick, the kicker's characteristics, how both of them feel that day, how the kicker and he himself will position themselves, the features of the stadium and the crowd, and other matters that are at first conscious. Once this environmental frame has been set, the task continues as an unconscious process in which activity centers on making the save (although he will remain alert to secondary disruptive matters, which must not interfere with his focused attention).

The nonconscious motor programs are then activated, and the supplementary motor cortex switches on, allowing all the kicker's movements and positions to be assessed. This involves the goalkeeper's previous experience, accumulated in his memory, which becomes present unconsciously at that moment. Next the premotor frontal cortex switches on and prepares the sensory and motor variables he needs in order to move. The goalkeeper will have a series of alternatives generated from all the movements and speeds his motor system can achieve, some innate (the naturalist version) and others learned over time (the constructivist version) in his procedural memory, which is also unconscious. This memory is the basis of all practices, or praxes, from the most common and everyday to the most complex. Only after this process, once 0.28 seconds have passed since the stimulus began, does a conscious motor program begin as the save is executed and the ball reaches the goal. In this case, in other words, there is a delay of a little more than a quarter of a second between the programming of the act and its entry into consciousness.

In this process it is important to consider the significance of attentional capacity and of distinctive external effects. Attention is a key function of the cognitive system and is highly developed in the adult human. Its capacity is lower in animals and in children, and it is reduced in diseases that affect the frontal lobe, such as developmental delays, Alzheimer's and frontal dementias and Parkinson's disease, among many others.

Attention involves fixing concentration on a single point while inhibiting peripheral or external stimuli. This function involves the suppression of distractors, which means not only that attention must be fixed on one area but also that it must cut off, and not give way to, interference from outside the central stimulus. This point is critical, because a middle ground must be found, and that middle ground is "divided attention," since if the external stimulus is very important (if the person's life is at risk, for example) the action must be interrupted. This last capacity is very complex, and it gives rise to the ability to turn away from one point and come back to it later, which produces "alternating attention," a key capacity in athletes.

Healthy older adults have greater difficulty with attention, apparently because they are more easily distracted by external events. A study by the neuroscientist Adam Gazzaley of the University of California, San Francisco, published in *Neuron*, puts forward this hypothesis and finds that, with training that teaches them to reduce external interference, older people can improve their performance until it resembles that of the young.¹¹ One could say, then, that younger and better-trained adults have greater, more sustained, divided and alternating attention, which allows them to notice another important event because an active attentional capacity remains directed toward other areas.

Attention may be regarded as containing an unconscious system that makes it possible to locate objects, such as a face among strangers in a crowd. It then also has a conscious component, since once the face has

¹¹ J. Mishra et al., *Adaptive Training Diminishes Distractibility in Aging Across Species*, 84 NEURON 1091 (2014).

been located, the process of recognizing it begins. This is the system of external attention, while internal attention concerns the processes of one's own body. Attention must be regarded as the great gateway into the process of awareness of reality. It is a complex cognitive process that allows us to take in knowledge of ourselves and of what surrounds us.

FREE WILL

Philosophy, law, neuroscience and psychology have long been engaged in a debate about free will. In cognitive neurology this could be described as the cognitive capacity and freedom to make decisions. Decisions can be short-term, as when we quickly choose an exit at a highway roundabout; medium-term, as when we choose a dish in a restaurant; or long-term, as when we decide, for example, to marry or to buy a property. These different time frames involve different brain processes, since the short term is far more reflexive and motor (premotor cortex) and the long term far more planned and conscious (prefrontal cortex). In every case, however, the view is that people without mental disorders retain the capacity for consciousness even in the briefest decisions. They therefore retain knowledge of, freedom over and responsibility for their decisions, both as to authorship (the capacity to choose) and as to autonomy (the absence of coercion).

Some authors have proposed a kind of determinism in human behavior, understood as a sequence of reacting neurons that would lead to planned or predetermined conduct. The idea can be dangerous, since it would remove responsibility for any act, including a punishable one. It also falls into the error of overlooking the thousands of variables that steer a choice.

A well-known study from the 1980s set off a major debate among philosophers and neuroscientists. Benjamin Libet, a neurophysiologist at the University of California, studied consciousness by stimulating the brains of patients undergoing brain surgery, who were awake and felt no pain.¹² He observed that when he stimulated the sensory cortex of these patients, it took them more than half a second (500 milliseconds) to be-

¹² B. Libet et al., *Subjective Referral of the Timing for a Conscious Sensory Experience: A Functional Role for the Somatosensory Specific Projection System in Man*, 102 BRAIN 193 (1979).

come conscious of the stimulus. In other words, they took longer to become aware of the stimulus than when it arose from a real peripheral site such as the skin, which became conscious in about 200 milliseconds.

He also observed what appeared to be a preparatory electrical activity that runs ahead of the arrival of consciousness.¹³ This would happen both in motor acts and in sensory ones, which only become conscious afterward. This subconscious stage comes first, and Libet regarded it as anticipatory. He nonetheless rejected the idea that the preparatory phase cancels out conscious factors, because even if consciousness learns of predetermined acts only after the fact, part of the decision would still be controlled by the human capacity for inhibition, understood as the ability to inhibit and steer instincts that were initially generated unconsciously.

This is not at all illogical, and it is consistent with later studies such as the one carried out by Christoph Herrmann of the Carl von Ossietzky University of Oldenburg in Germany, who used newer electromagnetic recording techniques and again observed similar preparatory subconscious milliseconds before a motor act reaches consciousness.¹⁴ Herrmann holds that in the cases studied free will is preserved, since autonomy and the absence of coercion are maintained despite a certain neurological determinism, which works as a kind of preexisting functionality. The possibility of controlling a decision, whether fast, intermediate or slow, is therefore not invalidated.

We now know that we respond emotionally before information reaches the conscious cortex (vision, for example, produces an emotional response before anything is perceived). Motor activity, moreover, is set in

¹³ B. Libet et al., *Time of Conscious Intention to Act in Relation to Onset of Cerebral Activity (Readiness-Potential): The Unconscious Initiation of a Freely Voluntary Act*, 106 BRAIN 623 (1983); but see A. Schurger et al., *An Accumulator Model for Spontaneous Neural Activity Prior to Self-Initiated Movement*, 109 PROC. NAT'L ACAD. SCI. U.S. E2904 (2012).

¹⁴ C. S. Herrmann et al., *Analysis of a Choice-Reaction Task Yields a New Interpretation of Libet's Experiments*, 67 INT'L J. PSYCHOPHYSIOLOGY 151 (2008).

motion before movements are carried out, because the cerebral cortices that plan the movement switch on first. Physiologists regard this as a function needed to get started that does not determine the final behavior. It happens both when we think about a movement and when we watch one, and in the latter case it occurs through the activity of mirror neurons, which copy the other person.

We live in the age of artificial intelligence and of neural networks. We know that there are clear electrochemical components that follow standard physical laws, but neurons and their networks work in a far more complex way. Physics itself, moreover, no longer ventures to predict predetermined outcomes, particularly as it studies newer and less predictable matters such as quantum physics.

Still less can anything unmodifiable be asserted about the nervous system, given its complexity. Physics and chemistry apply to it first, and its functioning then becomes far more complex in the mapping of neurons. There would thus be preparatory nervous mechanisms that intervene in what we feel or how we move even before we become aware of it, but conscious time remains afterward, and that time allows self-determination to be preserved. This is the key condition for sustaining free will, so that we can choose among options and have the autonomy to decide.

THE AWARENESS OF REALITY

When we construct our sense of reality, processes of subjectivity are intrinsically at work. As Immanuel Kant proposes in the *Critique of Pure Reason*, objects are constructed from the mental self, that is, from our psychic apparatus.¹⁵ There must be a stimulus, such as a sound, but there must also be a self to receive it and turn it into hearing. Kant calls this duality the “unity of apperception.”

The mental apparatus is made up of thought, emotion, will and sensory perception, but it is supported by experience and by what we take in from the subjectivity of others. Every phenomenon of subjectivity may be thought to carry intersubjectivity within it as a condition for conceiving reality.

The field of consciousness ranges from the simplest processes, such as knowing our own name, to metaphysical processes, such as complex questions, desires, the meaning of life or the ability to make long-term decisions. It would involve knowing oneself in all one’s complexity, which is called “metacognition.” Any interference in this domain, from the simplest to the most complex, can of course modify the metacognitive processes of self-recognition.

The concept we have of others, called social cognition (also known as “theory of mind”), also plays its part in conscious function. There is thus an *input* of sensory information that allows information to be perceived, and a higher *input* acquired through learned experience, which eventually makes up a person’s social, cultural and ethical values. In this sense one could say that the representation of what we perceive takes bodily form upon consciousness. Metacognition, social cognition and the decisions that follow are built in this way. Any circumstance that affects one of the afferent signals arriving at the battlefield of consciousness alters how consciousness functions.

¹⁵ Kant, *Critique of Pure Reason*, *supra* note 9.

One mechanism now being studied is whether the conscious process begins as an automatic and unconscious one. Several functional neuroimaging studies show, through functional resonance imaging, that when a person makes a simple choice between two options (for example, pressing a button with the right hand or the left), the unconscious process appears in the brain up to seven seconds before the person makes the conscious decision.¹⁶ In these studies the pattern differed depending on whether one side or the other was chosen, which suggests that at first there would be an unconscious position in the simplest acts that conditions the decision. This raises a question about the vulnerability of a person's free will. Thousands upon thousands of later learning experiences, however, will bring control to bear on that decision, especially as an act becomes more complex. Social learning, moreover, probably exerts its influence from childhood, even if the act is unconscious at first. It would be hasty, in other words, to conclude that because a simple behavior shows brain activation before it becomes conscious, it will not be influenced from its very beginning by a system that is in some way controllable.

Once the information has reached consciousness, consciousness can give it the status of reality. There will be a battlefield between primitive emotions and instincts, on the one hand, and cultural influence on the other. The chosen site of this struggle is a large nucleus of the subcortex, the "thalamus," which filters all sensory information, both external and internal. A kind of sieve (the reticular nucleus) surrounds this whole large structure, auditing and controlling the information that reaches consciousness. There is also a structure that supplies information from our most complex cortices, which communicate learned processes and influence the information. This thalamic nucleus is therefore the battlefield chosen by our nervous system, a struggle between raw sensory and affective material and higher control, which is exercised through millions of neural networks conditioned by learning.

¹⁶ C. S. Soon et al., *Unconscious Determinants of Free Decisions in the Human Brain*, 11 NATURE NEUROSCIENCE 543 (2008); but see Schurger et al., *supra* note 13.

This system is also influenced by two smaller nuclei that act as buffers and guard the gateway of incoming information like watchdogs, the nucleus accumbens and the ventral tegmental area. Any imbalance in these nuclei, or in the neurotransmitters through which they work, produces disturbances in the system of reality. A disturbance in the higher information system, as occurs in frontal dementias, can also modify the system of reality, either because the input of information has slipped out of control or because the store of learning has been affected by neurological problems. In both situations the battlefield of reality is affected, and this may be due to contingent causes, such as a medication or an illegal drug, or may be secondary to diseases such as schizophrenia or Alzheimer's.

The awareness of reality will thus depend on a system, subject to multiple biological and environmental influences, that we are only beginning to know and unravel. It is related not only to particular areas of the brain but also to other bodily functions or regions that we do not yet understand.

INTELLIGENCE

Although the concept of intelligence may seem easy to define, there is no general agreement on how to describe this function. For many researchers it is the opposite of the instinctive functions, which are far more primitive and dependent on genetics. For these researchers, intelligence would be implicit in the cognitive functions, also called “associative” functions, which were the last to develop both in the evolution of the human species (phylogeny) and in that of the individual (ontogeny). They are located in the newest parts of the cerebral cortex (the neocortex), but also in the hippocampus (the old cortex, or archicortex), through which conscious memory enters.

Cognition performs functions that range from abstract thought, complex motor practices (praxis), language, the recognition of what we perceive (gnoses), memory and the capacity to pay attention, with decision-making aimed at adapting to the environment as the final cognitive function. This general concept of intelligence, however, would imply that these structures work together, even though they are separated arbitrarily.

The neuroscientist Alain Prochiantz argues that intelligence turns out to be a process that accounts for the better adaptation of each living being to its environment, which makes the differences between the instinctive and the intellectual less clear.¹⁷ This holds even for lower living beings, such as plants. As purely instinctive examples, Prochiantz cites the sunflower turning toward the sun and the squid releasing its ink in self-defense. Each living being, in its own way, has some singular adaptive process. The more complex the adaptive instincts are, the more particular phenomena are probably added to them, acquired on top of their genetic base, giving rise to singularity in animals and subjectivity in human beings.

¹⁷ A. PROCHIANTZ, QU'EST-CE QUE LE VIVANT? (Seuil 2012).

For most cognitive neurologists, however, there are clear components that make up intelligence, and some also express doubts that there is only one form of intelligence. The renowned Harvard cognitive psychologist Howard Gardner argues that there are multiple intelligences, which obviously operate within a single person and in that person's decisions, and this makes intelligence very hard to measure as a whole.¹⁸ Some of these intelligences are already well known, such as linguistic and logical-mathematical intelligence. Others are much less widely known, such as inter-subjective empathy and intrapersonal intelligence, musical and spatial intelligence, bodily skill and even the capacity to assess nature, which has been shown even in animals that recognize not only their own kind but can also tell reptiles from mammals.

Intellectual processes, then, are much newer and more idiosyncratic. They influence people's epigenetics, that is, genes that are expressed in response to environmental stimuli. We are born with a genomic endowment, but genes are also expressed over time in the nervous system and the rest of the body. This later expression of genes will open the way to different personalities and intelligences and will make people different even when they share the same genetics, such as identical twins, who are obviously influenced by the environment and culture in which they are immersed, and these bear directly on the process of each person's cognitive and emotional development.

Another criticism many people make concerns the historical systems for measuring intelligence, such as measurements of the intelligence quotient. Some scientists argue that not all intelligences can be measured by a single quotient. And although these intelligences share decision-making for the sake of adaptation as their final process, each intelligence has its own evolutionary process and its own particular development. Evolutionists, neuroscientists and scholars of artificial intelligence share this view. The connections among the structures of the human brain also have an influence, and these are studied through the human connectome, which reveals the patterns of connection where these intelligences proba-

¹⁸ H. GARDNER, *FRAMES OF MIND: THE THEORY OF MULTIPLE INTELLIGENCES* (Basic Books 1983).

bly intertwine, in turn, with consciousness and with knowledge of oneself and of others.

There are other intellectual functions, called “executive” functions, which are like the engine of intelligence and which are very limited in animals and in children whose brains are not yet developed. They allow us to pay attention and to have flexibility, speed and inhibition with respect to what interests us. Several of the intelligences thus combine and interact through this engine (which depends largely on the prefrontal cortex).

Some doubts remain about processes that, while primarily instinctive, may grow more complex and become intellectual functions. Communication, altruism, copying and gregariousness could be regarded as instinctive. These functions probably begin as instincts and are later modified by evolutionary development, becoming more complex. Communication would thus become language, copying would become learning, altruism morality and gregariousness social life, among others.

The concept of emotional intelligence has been put forward as a highly influential factor in human behavior, especially since the work of the psychologist and science journalist Daniel Goleman.¹⁹ Implicit in this function are probably motivation and its opposite, apathy (the lack of an inner drive, which occurs in depression or in neurological diseases). Some argue that this function is nothing more than what the cognitive sciences call emotional memory. A disorder of the emotions, such as the well-known phobias, might thus prevent even Albert Einstein from presenting the theory of relativity. These social fears could be a good example of how this kind of intelligence can be impaired, and of the consequences.

¹⁹ D. GOLEMAN, *EMOTIONAL INTELLIGENCE* (Bantam 1995).

PART II

Deciding

DECISION-MAKING

Our behavior may be seen as the outcome of a struggle between emotion and reason. The cognitive neuroscientist Michael Gazzaniga says that the nervous system is a system built to make decisions for survival.²⁰ Although this definition errs on the side of reductionism, it rests in the end on an implacable logic, since all of us mammals try to survive through our instincts, and so, in Darwinian fashion, the fittest survive.

In *Homo sapiens*, however, that is, in us, other functions have been added through the development of the cerebral cortex, and these allow control to be brought to bear on long-term decisions, refining them and reducing the likelihood of behavioral errors. This is what forensic physicians call the capacity to understand and direct one's acts. Nothing comparable happens to the same degree in our mammalian relatives with smaller brains, such as chimpanzees, much less in rats or cats.

With that said, we can consider instinctive and emotional function to be regulated mainly by our limbic system (described by the neurologist James Papez), which controls our emotional system.²¹ This system lies in the inner part of the brain, called the subcortex, which is very primitive and ancient (the archicortex). It generates the instinctive motivations for survival, which over the course of evolution came to be surrounded by the cerebral cortex (the neocortex), and the neocortex gives us the ability to control them to a moderate degree.

These instinctive functions can be summed up in five basic drives, which are eating, fleeing (fear), fighting, mating and the behavioral control of temperature (as when we move into the sun when we are cold or into the shade when we are hot). Any living being in which these functions are impaired will have a serious problem surviving and therefore

²⁰ M. S. GAZZANIGA, WHO'S IN CHARGE? FREE WILL AND THE SCIENCE OF THE BRAIN (Ecco 2011).

²¹ J. W. Papez, *A Proposed Mechanism of Emotion*, 38 ARCHIVES NEUROLOGY & PSYCHIATRY 725 (1937).

also leaving offspring. But, as has been said, in human beings these functions come under the control of the cognitive cortices, which were the last to appear in the evolution of species and are the last to mature in the development of each individual. We have thus developed new weapons such as language, complex skills, a very active memory, the capacity for abstraction and, above all, the ability to inhibit instinctive behaviors, which allows us to make fairly sound decisions in the short and long term. The fact is that these final decisions are the last vectors between emotion and reason. More than that, they are the struggle between instinct and reason, which ends in a behavioral phenomenon, the final act.

This function can be measured with complex neurocognitive tests of decision-making, such as the Iowa Gambling Task developed by Bechara and Damasio at the University of Iowa.²² It is a gambling test that makes it possible to assess people's decision-making capacity, above all in the long term. It can even be used to help determine the legal capacity to carry out civil acts, such as buying or selling, or whether a person can be held criminally responsible for an offense.

Not only do different areas of the brain take part in choosing among options, moreover, but several neurotransmitters are involved as well. Dopamine is one example, and when it is prescribed as treatment for patients who need it, such as those with Parkinson's disease, it strongly increases motivation and creative decisions. As we can see, these definitions are very complex and hard to assess, but they are fundamental to understanding human behavior.

What is certain is that making a decision cannot be avoided, and even if we tried to avoid it we would still be making one, perhaps a more decisive one than it would otherwise have been. If our excuse is to stay out of the decision and we try to evade responsibility, we may well produce more consequences, because we will have made one of the most important decisions of all, which is the decision not to decide.

²² A. Bechara et al., *Insensitivity to Future Consequences Following Damage to Human Prefrontal Cortex*, 50 COGNITION 7 (1994).

INTUITION

Instincts are regarded as subconscious processes that govern decision-making for the purpose of survival. They rest mainly on the nervous system, and the more developed that system is, the more complex the instincts will be and the harder it will be to understand them. Instincts exist both in humans and in animals with moderately evolved brains, and in humans they grow more complex under the influence of our great cortical and cognitive capacity.

Many unconscious instincts can be described. Sigmund Freud relied above all on the “drive of desire,” mainly the sexual drive. Contemporary cognitive psychology and experimental neuroscience, however, question this simplification, because functional neuroimaging and evidence-based experimental studies have made the study of survival functions far more complex. This has led some authors to speak of an adaptive unconscious in place of the Freudian unconscious.

Many more instinctive behaviors for survival could be described, such as the awareness of space and time, copying, feeding, fear, aggression, caregiving, sexuality, cooperation, autonomy and intuition, among others. The capacity for intuition is thought of as a process below the threshold of consciousness, and a key one in evolution. One of the first ideas to note is that although intuition corresponds to an unconscious mechanism, it is nonetheless strongly influenced by conscious activity.

Intuition can also be modified by emotion and by the level of stress. The experimental psychologist Thomas Goschke of the Dresden University of Technology observed that people produce better and more efficient intuitions when they are calm.²³ He describes how, in various experimental tests, low stress and a good mood produce efficient intuitions, which

²³ A. Bolte et al., *Emotion and Intuition: Effects of Positive and Negative Mood on Implicit Judgments of Semantic Coherence*, 14 PSYCH. SCI. 416 (2003).

translate into sound decisions. In games of chance that call for intuition, for example, anxious or depressed people make more mistakes, taking more risks and losing faster.

The Nobel laureate Daniel Kahneman calls these unconscious intuitive mechanisms “System 1,” in which unconscious procedural areas of the cortex work together with emotional areas (the amygdala) and anticipatory ones (the right temporal lobe and the insula).²⁴ Memory and learning processes are also activated, producing an automatic route of thought.

Kahneman calls the other route, the “conscious rational” one, “System 2,” and it corresponds to associative rational functions (especially neocortical ones), which nonetheless involve interaction with and control over intuition. In other words, it is a set of functions that makes up this last talent. A goal-scoring footballer, for example, guesses where to position himself before the decisive pass is made, and an electrician finds a short circuit sooner than a layman.

Intuition is generally regarded as a fast process, yet it can also apply to slower processes, such as the “clinical eye” of a good diagnostician or a sound military strategy. Today we can see intuition developing in *millennials*, who guess which step comes next in the algorithm of a basic computer program. This shows that new instinctive processes can arise depending on the environment, and it also shows how important it is to learn this trait in childhood.

There is no doubt that acquired information must be added to talent. On the established base (genetic and constitutional), what accumulates through experience and constant *training* is added, and this produces a highly variable intuitive talent that can even be improved. Empathy cannot be left out of this, nor can the working of the neurons that switch on when we watch another person act (mirror neurons), in emotional as well as motor terms. Neuroscientists accept that this function activates areas of the brain that regulate emotion, producing a very fast automatism that must be controlled intellectually. One study shows that we can tell how a person will act after watching them for just six seconds, and others show

²⁴ D. KAHNEMAN, THINKING, FAST AND SLOW (Farrar, Straus & Giroux 2011).

that a quarter of a second is enough for someone's face to influence our idea of them, even triggering involuntary prejudices (racist ones, for example), which are later corrected by reason and in what we say. It is thus possible to understand the other through intersubjectivity and very often to guess their intentions, but it is also possible to prejudge them. Several studies show that women have greater social skill than men at intuiting what others feel and intend.

Instinctive processes are very complex and involve many functions that can later be brought into consciousness. They can be improved with practice and with knowledge of the instinctive activity to be perfected. Scientifically they could be broken down into the many functions and areas of the brain involved in each subconscious talent. Animals, too, have this process, since the hunter guesses where its prey will go and the prey does the same in reverse, and whichever does it better will survive.

Intuition is an automatic process, often useful for survival, but it cannot work alone, without rational control, because it could then become very dangerous, since it is not prudent to assess complex decisions by intuition alone. Intuition is a key function, in the short and the long term, in the survival of the fittest. In everyday activities, moreover, it opens up new possibilities that serve a person's success in his environment.

UNCERTAINTY

There is a permanent struggle between uncertainty and the decisions people make. Deciding could be regarded as the final cognitive function, the result of the many intellectual, emotional and instinctive activities that take part in human behavior, which is to say that every decision is a multicausal process, both conscious and unconscious.

Two groups can be distinguished, the first being the immediate decision, with a high unconscious component, and the second the long-term decision, with a greater conscious component. Every resolution generates uncertainty, because we will never have complete information about the variables that condition an event. Often, moreover, we must act quickly, without any absolute certainty that our actions will prove sound. Our thinking will therefore be subject to two important biases, as Joachim Funke, a psychologist, philosopher and researcher on “problem solving” at the University of Heidelberg, maintains.²⁵ He speaks of “confirmation bias,” through which we judge as more accurate whatever fits our prior thinking, and of the “law of small numbers,” when we draw general conclusions hastily and inductively from very little data. It is, incidentally, a very common failing.

Decision-making, then, incorporates instinctive processes. Funke proposes that these mechanisms require reason, but also basic instinctive survival functions. Logical reasoning has been found to be far more effective in everyday decisions of moderate complexity than in those of extreme complexity, and in the latter, according to many research studies, it would be more effective to give instinct a freer rein.²⁶ In very difficult

²⁵ J. FUNKE, PROBLEMLÖSENDES DENKEN (Kohlhammer 2003).

²⁶ But see M. R. Nieuwenstein et al., *On Making the Right Choice: A Meta-Analysis and Large-Scale Replication Attempt of the Unconscious Thought Advantage*, 10 JUDGMENT & DECISION MAKING 1 (2015).

situations the information to be weighed is probably so complex that instinct prevails over rational, comparative processing.

Fluency, and the control of excessive thinking, are important for reaching a good resolution. Such excess occurs both in conscientious logical (normal) personalities and in people with obsessive disorders. These personalities may ruminate over what would have happened if the decision had been different (what psychologists call counterfactual thinking), which is not advisable either. Obsessive people often overdo their analyses and bring action to a halt, flooding their thought with information and never letting it rest (there is no fluency).

Rest helps the process of generating ideas and sets to work areas that become active only when thought flows freely (such as the precuneus of the cortex), which help integrate ideas with the senses. The key, then, and the most successful method, is to think, then to rest, and only then to solve problems. We can never be one hundred percent sure when we make a decision. Learning to tolerate uncertainty will be another cognitive lesson, and it will make our decisions sounder.

SELF-CONTROL

Decision-making is the final function of our behavior. It can, in fact, be assessed, and it is considered to operate in the short and the long term, becoming more complex and more developed at the end of a person's development, which is after the age of twenty. We should remember that behavior is inhibited mainly through the prefrontal lobe of the brain, while instincts are controlled or produced in our subcortical limbic system. Long-term decisions are harder because they involve more variables and a certain projection in time. Our final behavior is regarded as the outcome of a struggle between the rational and the instinctive, and if the primitive survival instincts overcome control, our primitive brain takes a larger part. The result can range from addictive and impulsive behavior to aggression, fear, uncontrolled sexual impulses or abnormal eating, and instinct then prevails over reason.

Several studies now suggest that self-control outweighs the other intellectual functions in determining success at different tasks. Walter Mischel (of Columbia University) observed that some children could control their appetite and turn down a treat when it was first offered, in order to obtain a larger reward on a second occasion (that is, they could delay gratification).²⁷ Followed over time, these “waiters” achieved greater “success” (at least by Western standards) in adult life than those who lacked that capacity for self-control.²⁸ It is therefore thought that, contrary to what was once believed (that success is a consequence of ego), it is control over our impulses that produces the success from which ego then derives. Some studies show that a large ego is not a factor related to success, but

²⁷ W. Mischel et al., *Delay of Gratification in Children*, 244 SCIENCE 933 (1989).

²⁸ But see T. W. Watts et al., *Revisiting the Marshmallow Test: A Conceptual Replication Investigating Links Between Early Delay of Gratification and Later Outcomes*, 29 PSYCH. SCI. 1159 (2018).

that people who can control their impulses when provoked, and are able to sustain that self-control, will find greater satisfaction in a given task.

We should be aware that the self-control of our drives is one of the vectors of decision-making, the final function of our behavior. Those who study these final cognitive functions observe changes related to disorders in their control, as well as disturbances in reward, among them various addictions (whether to legal or illegal drugs or to other things, such as gambling or sex). The question that science and legal medicine ask is which of these addictions impair control over our decisions, preventing us from freely deciding whether to consume or, further still, altering consciousness secondarily and producing a cognitive toxicity that prevents us from deciding on other key matters, such as civil or criminal acts. It is thought that Sigmund Freud may have been prejudged when his concept of “ego energy” was dismissed. We now know that the brain is a structure that depends on energy, which is what it uses most, and that this capacity for control can in some sense become saturated or narrowed in response to different stimuli.²⁹

An interesting study by Kathleen Vohs (of the University of Minnesota) observes that this energy may not run out (or at least that we are more inclined to make a greater effort of control) when we are paid or when we are offered a rise in rank within the structure in which we work.³⁰ One may think that in both cases primitive questions of power are at stake, whether in the form of food, a word or any other factor that lowers our capacity to restrain our behavior and leads us to an action regarded as inappropriate within the culture that surrounds us and of which we are part.

²⁹ But see M. S. Hagger et al., *A Multilab Preregistered Replication of the Ego-Depletion Effect*, 11 PERSPS. ON PSYCH. SCI. 546 (2016).

³⁰ K. D. Vohs et al., *Motivation, Personal Beliefs, and Limited Resources All Contribute to Self-Control*, 48 J. EXPERIMENTAL SOC. PSYCH. 943 (2012).

RISK AND PREVENTION

The decision to take risks in the present in order to satisfy a desire can harm us in the future. It is an attitude that will define the protective behavior we adopt in any matter, all the more so during the pandemic, and it is equivalent to the stance of a smoker who chooses immediate satisfaction over future risk, of a person with high blood pressure who salts his food or of a driver who goes faster than the speed limit, among other examples. The problem is that these people take risks for themselves, but they also often put others at risk.

The Nobel laureate in economics Gary Becker, who focused on the sociological side of the discipline, devoted part of his research to explaining the economic reality of decision-making and formulated what is known as the “theory of rational addiction.”³¹ He studied the priority given to immediate desire over later prevention, which he framed in terms of an “intertemporal” tradeoff, as with people who prefer present pleasure at the cost of a future risk and who therefore take on that risk. It has been shown empirically that these individuals’ greater exposure to risk generally extends to other behaviors as well, such as not keeping to a diet, not maintaining a regime of physical activity or having an addiction.

The cognitive process of decision-making involves a function that some authors call “hyperbolic discounting.”³² People who decide, at a given moment, between two behaviors that compete with each other in their future consequences assign a value to each present behavior and to each future consequence, but they tend to choose the one that brings the greatest well-being in the present. Not wearing a face mask or not keeping physical distance would be decisions of this immediate kind, which put

³¹ G. S. Becker & K. M. Murphy, *A Theory of Rational Addiction*, 96 J. POL. ECON. 675 (1988).

³² D. Laibson, *Golden Eggs and Hyperbolic Discounting*, 112 Q.J. ECON. 443 (1997).

people at risk, especially those with the highest fatality rates, such as older adults, harming the individuals themselves but also the community, by increasing the costs of the health system, whether because they fall ill themselves or because they infect others.

We should be aware that decisions, whether immediate, deferred or long-term, are controlled by the will. Although immediate decisions are more unconscious, all of them are subject to volitional control, and every decision is subject to a person's free will. There are, then, people who take more immediate risks and have weaker preventive instincts, and there are those who prefer to take greater precautions and not put their own future or that of others at risk. The instinctive processes of desire and of protection struggle against our rational cortex, producing a final decisive vector.

We find that part of the young population runs a much smaller risk of being seriously affected by COVID-19 than older adults do. It is as though there were two different diseases, one with very low mortality and the other with very high mortality. Yet it is the same germ and the same society, facing a problem that is also unified in time and space. The elderly are many times more likely to die. If life expectancy had not been extended, this pandemic would probably not have the social and cultural impact it has.

Social awareness of this dichotomy calls for solidarity and cooperation in a society in which the young are put to the test, looking after the community, not only because many of them are doing essential work but also because they must take care not to become infected and not to infect others. On September 21, Student Day in Argentina and a day of celebration, we saw generally very good behavior from our adolescents, which should make us proud, as we have also seen in their compliance with preventive measures. There are always exceptions, though they are few, especially among adults and a handful of leaders. These attitudes can be seen mainly in three types of personality, the narcissistic, the Machiavelian and the psychopathic. This is the dark triad of personality, made up of people who are moved only when they themselves are harmed and not when harm befalls others.

This kind of trait translates into someone manipulative, untrustworthy and indifferent to the feelings of others. People with these traits do not hesitate to invent lies or ruses. They nonetheless have certain important weaknesses, since they tolerate criticism far less well and become distressed by it, although they generally do not change their decisions. Personality is formed in adulthood through various inputs, among them the social, educational and cultural features that will sustain and modify its basic biological components. Personality, then, shapes people's preventive characteristics and the resulting social responses of protection.

PART III

Knowing Oneself and Others

JUDGING ONESELF: METACOGNITION

Several decades ago the cognitive theorist John Flavell, of Stanford University, described metacognition as a process that makes it possible to judge oneself.³³ Long before that, however, neurologists had already observed patients who were unaware of part of space, of their own body or of their own illness. Many of these disorders corresponded to concrete causes, such as parietal lesions, especially in the right side of the brain. In other words, specific disorders can be observed in centers that, it is inferred, generate specific functions. These activities, however, are always meshed with the network of the brain and the body, which makes self-recognition a very complex function. Areas of the nervous system that weigh costs (the insula) and emotional areas (the limbic system) also play their part, and they influence every judgment we make about ourselves.

It is impossible to think of oneself without thinking of the other, because we must take into account the space around us and, specifically, intersubjectivity, since one cannot think of oneself without projecting oneself onto otherness. The phenomenologist Edmund Husserl described this process as *Einfühlung*, or empathy, a way of perceiving oneself after which comes the perception of the other, which influences subjectivity but cannot be immediate.³⁴ Children begin to recognize themselves as their brains mature. At one year of age, for example, a child cannot identify itself in a mirror and perceives instead that it is looking at another person. Something similar happens in the advanced stages of Alzheimer's disease, when patients do not recognize themselves and even struggle to understand a television program, because they think it is speaking to them (*misidentification*).

³³ J. H. Flavell, *Metacognition and Cognitive Monitoring: A New Area of Cognitive-Developmental Inquiry*, 34 AM. PSYCH. 906 (1979).

³⁴ E. HUSSERL, *CARTESIAN MEDITATIONS: AN INTRODUCTION TO PHENOMENOLOGY* (D. Cairns trans., Martinus Nijhoff 1960) (1931).

Metacognition may be regarded as the basis of the awareness of reality, which is affected in conditions such as the psychoses, as in schizophrenia, or in serious neurological disorders such as frontal dementia (atrophy of the frontal lobe). The problem seems to express itself in an alteration of the prefrontal lobe, whether through a functional failure or because the lobe is damaged.

Many studies approach this capacity through decision-making. Metacognition would thus be the basis of the capacity to decide, in the short term as well as in the long term, and perhaps even more so in the latter. It is described as a function that depends on the degree of self-assessment people carry out. It would implicitly include a probabilistic assessment, for example of whether one path is better than another or whether a decision is the right one, and in this way our brain assesses the risks of an action.

Some ethologists describe a primitive decision-making process in certain animals such as dolphins, and other groups have observed the same in chimpanzees. In some tests, when these animals cannot settle on an act because it does not convince them, they adopt a third behavior associated with uncertainty, and the researchers link this to a primitive process of metacognition. The assessment of one's own judgment has a subtler stage, which involves realizing that one is failing. Some people become aware that they are not using a function properly, even a complex cognitive one (generally when the processes involved are very localized). Other patients, however, show no self-criticism at all about their behavior, as happens in schizophrenia or Alzheimer's disease. When lesions of the hippocampus that affect memory are isolated, patients realize they have amnesia, but when the prefrontal lobe is affected they will not recognize the problem and will fill in their memories with inventions. This is known as "confabulation," a condition described in chronic alcoholics (Korsakoff syndrome) that becomes far more frequent in Alzheimer's disease. In both cases memory is affected by changes in the hippocampus, and the anterior prefrontal cortex is also damaged, which disrupts recognition of the problem.

Being able to measure metacognition can be a very useful tool for assessing the potential for psychosocial rehabilitation in mental health problems, and it has also been proposed for education, as a way of assessing students' capacity for self-criticism and their knowledge of what they know (knowing that they know). These cognitive processes could be linked to the way we test our decisions, when we try to turn them into precise conduct on the basis of the risk assessment our nervous system carries out, a procedure in which consciousness and conduct sit in judgment on themselves.

SELF-AWARENESS

Self-awareness could be described as the intellectual elaboration of who we are, where or when we are and, in general terms, what we are doing. It also implies the possibility of discovering ourselves, of sitting in judgment on ourselves and of changing our decisions accordingly.

The human psyche works as though the brain were innate “*hardware*” and the learned cognitive and emotional information were “*software*.” That *hardware* starts working very early in the infant through basic activities, absorbing a body of information that is applied epigenetically to the base of our brain, as the philosopher Immanuel Kant proposed, and as did the Argentine psychiatrist Juan Carlos Golder. This is the so-called Kantian blank slate, which comes with certain primitive functions (pretty and ugly, good and bad, which later become the ethical and the aesthetic), to which new information and the maturation of the nervous system are added, brought about by the large genetic, neurochemical, protein and neuroplastic changes that follow.

It has been shown that the people who make the soundest judgments are those whose anterior frontal cortex is most developed. Stephen Fleming and his group at the neuroimaging center of University College London describe the importance of this large brain structure, which is highly developed in evolutionary terms in *Homo sapiens* and finishes maturing only in the third decade of life.³⁵ They observed that better self-assessment correlates with (anterior) frontal volume, mainly because of the size of the neurons’ cell bodies but also because of an increase in their connections. It has also been observed that people with frontal brain lesions show a marked decline in metacognition. Areas involved in memory retrieval and orientation are also thought to take part, such as the hip-

³⁵ S. M. Fleming et al., *Relating Introspective Accuracy to Individual Differences in Brain Structure*, 329 SCIENCE 1541 (2010).

pocampus, which supplies the information the brain needs in order to assess whether a decision is right or wrong.

This capacity to judge ourselves is impaired in illnesses such as schizophrenia, when people do not realize that they have a disorder in their perception of reality. It is also impaired in Alzheimer's disease, in which patients often do not recognize that they are losing their memory. There are, moreover, people who suffer from a neurological disease (such as paralysis) and do not notice it, failing to recognize their own illness (anosognosia). This "failure to recognize oneself" can be observed in tests with young children, who do not recognize themselves when they look in a mirror and act as though another person were looking at them. The same can happen when a person has serious cognitive disorders.

It is also thought that the growth of the superior parietal lobe in *Homo sapiens* produced one of the most highly developed areas of the human brain, the precuneus, which would distinguish us functionally from the other primates and also from one another. It would be a crossroads and a special point of communication between time and space, giving independence to the self, and a key area for evolution. It is impossible to think of oneself without thinking of the other, because we must take into account the space around us and, specifically, intersubjectivity, since one cannot think of oneself without projecting oneself onto otherness.

The phenomenologist Edmund Husserl described this process as *Einfühlung*, or empathy, a way of perceiving oneself after which comes the perception of the other, which influences subjectivity but cannot be immediate. The problem seems to express itself in an alteration of the prefrontal lobe, whether through a functional failure or through a lesion. The neuroscientists Shimamura and Squire, of the University of California, San Diego, were among the first to link the frontal lobes with metacognition.³⁶ Later studies explored further the relationship between this area and the processes of self-knowledge. It has now been described that the

³⁶ A. P. Shimamura & L. R. Squire, *Memory and Metamemory: A Study of the Feeling-of-Knowing Phenomenon in Amnesic Patients*, 12 J. EXPERIMENTAL PSYCH.: LEARNING, MEMORY & COGNITION 452 (1986).

anterior prefrontal area is larger in people with greater metacognition, and that if this area has more connections with the subcortex, the person will be better able to recognize critically the failures of his own self-awareness.

Measuring social cognition and metacognition can be a very useful tool for assessing the potential for psychosocial rehabilitation in mental health problems, and it has also been proposed for education, as a way of assessing students' capacity for self-criticism and their knowledge of what they know (knowing that they know). Self-awareness, however, has two weak points. The first is that it can be mistaken and needs others to correct it. The second is that the brain can remain fixed in a survival function, because it keeps us alive, but its ultimate purpose is not happiness, as the Argentine biologist Estanislao Bachrach argues.³⁷ This is probably why the interweaving of metacognition (the capacity to judge oneself) and social cognition (the empathic assessment of others) forms the best functional system of consciousness, which also allows us to know ourselves and to assess others and, on that basis, to make decisions.

Nothing guarantees happiness with an organ like the brain, joined to our influential body, which cushions itself against survival imperatives and grows used to them, though they may not be entirely healthy for our quality of life. This will be all the more marked in a self-sufficient frame of mind in which we neither receive nor listen to criticism from outside. Even the best player in the world needs a coach to assess him and correct his position in time and space and the decisions he makes.

³⁷ E. BACHRACH, *ÁGILMENTE: APRENDÉ CÓMO FUNCIONA TU CEREBRO PARA POTENCIAR TU CREATIVIDAD Y VIVIR MEJOR* (Sudamericana 2012).

HOW EMPATHY WORKS

Empathy is a function that makes it possible to understand intersubjective relationships. It could be partly likened to altruism or to emotion directed toward the other, but empathy involves far more complex processes. It is studied through a function called “social cognition,” which is the capacity to understand the other, as distinct from metacognition, which is the capacity to understand oneself.

In order to relate to other members of its species in such complex ways, *Homo sapiens* had to develop highly elaborate cognitive processes, which would have contributed actively to interpersonal impact, to “understanding what is happening to the other.” This would be an “intersubjective metacognition,” also called “theory of mind.” Knowing the other may have led humans to associate, to cooperate and to let themselves be copied, that is, to be altruistic. Avoiding the other, by contrast, breaks the social bond, and rests on another primitive function, selfishness. Altruism and selfishness would seem to be two instinctive orders that regulate social life, already observed in lower animals.

Learning, copying and the creative innovation that followed led hominids to feed themselves better, selecting and refining the ways they gathered food. Their capacity for digestion and the proportion of calories and protein they consumed thus improved, setting off a positive feedback loop. The more learning, the larger the brain, and the larger brain in turn generates more learning and cognition. This learning rests on a primitive instinct that also occurs in animals such as birds and lower mammals, “copying,” which produces a new behavior in its wake. In primates, however, and even more in hominids, copying gave rise to more precise gregarious behaviors that also included a capacity for innovation, which produces knowledge of a higher quality.

This hypothesis is put forward by the behavioral biologist Kevin Laland of the University of St Andrews, who thinks that *Homo sapiens* de-

veloped the capacity for social transmission through a more refined form of copying, both in the ability to transmit and in the later reproduction of what has been learned.³⁸ To become social, the brain must not only abstract but also be able to communicate, handle tools and use symbolic forms, such as drawings or music that represent practical or religious matters.

Some scientists argue that the use of technology went hand in hand with the development of language, pointing out that Broca's area of expression is not only a linguistic area but essentially a praxic and intersubjective one. It is no coincidence that mirror neurons (which copy the other) were described in this area's counterpart in the macaque brain, since the instinct to copy is essential to the development of both. Language, musicality and the use of instruments may therefore have been part of the same evolutionary process, which increased human empathy.

Language as an intersubjective process uses much more than speech, since it is also gestural and musical, and this serves both to transmit information better and to negotiate possible agreements or disagreements. Realizing what is happening to another person sounds like a variable and difficult task. Since 1992, however, when Giacomo Rizzolatti of the University of Parma described mirror neurons, various neurological activities have begun to be explained that can help us understand the activity of watching another person.³⁹ This task is described as "social cognition," which consists in feeling, and then being able to become conscious of, what is happening to another person.

Mirror neurons generate a primitive activity in response to what is observed, which is probably carried out unconsciously at first and only later becomes thought. The Parma researchers studied neurons in the motor cortex of macaques and noticed that they fired when the monkey ate grapes, but also when it watched the experimenter perform a similar

³⁸ K. N. LALAND, *DARWIN'S UNFINISHED SYMPHONY: HOW CULTURE MADE THE HUMAN MIND* (Princeton Univ. Press 2017).

³⁹ G. di Pellegrino et al., *Understanding Motor Events: A Neurophysiological Study*, 91 *EXPERIMENTAL BRAIN RSCH.* 176 (1992).

task, without the monkey moving at all. This happens because in one area of the frontal lobe (the premotor area) there are nerve cells that plan movement and become active when they see another individual moving in a similar activity. This area can therefore be compared with the area of motor language (Broca's area) in humans, which gave rise to several proposals on the subject. Language turned into dialogue provides an instrument of social life, and it is a key and universal human process. It is an unconscious social understanding, since through it ideas, thoughts and hidden premises can be drawn out, which are set in the context of the need and the moment of transmission. It serves both agreement and disagreement and the transmission of culture, and it is a central component of gregarious behavior.

INTERSUBJECTIVITY AND MIRROR NEURONS

Realizing what is happening to another person sounds like a variable and difficult task. Since 1992, however, when Giacomo Rizzolatti of the University of Parma described mirror neurons, various neurological activities have begun to be explained that can help us understand the activity of watching another person. This task is described as “social cognition,” which consists in feeling, and then being able to become conscious of, what is happening to another person. Mirror neurons generate a primitive activity in response to what is observed, which is probably carried out unconsciously at first and only later becomes thought. The Parma researchers studied neurons in the motor cortex of macaques and noticed that they fired when the monkey ate grapes, but also when it watched the experimenter perform a similar task, without the monkey moving at all. This happens because in one area of the frontal lobe (premotor area F5) there are nerve cells that plan movement and become active when they see another individual moving in a similar activity.

This area can be compared with the area of motor language (Broca’s area) in humans, which gave rise to several proposals on the subject. Researchers began to conjecture, by analogy, that in humans observed activity can activate the cortex not only in the person who performs an act but also in the observer. The discovery of mirror neurons has even been compared with the discovery of DNA, and it has opened a debate on the importance and the understanding of the concept of intersubjective cognition expressed in theory of mind (which is understanding what is happening to the other). Moreover, because in humans this area is related to expressive language, it was associated with the ability to understand what is happening to another person and to grasp the gestural pantomime that someone else uses. There are doubts, however, about the role of these cells in language. The same has been proposed for autism, in

which the person loses the ability to know the intentions of others, but in this case no conclusive association has been established.

Although the role of mirror neurons may have been overstated, no one today denies that they exist in mammals. Roy Mukamel, of the University of California, has detected them in the human hippocampus (the area that stores and retrieves memories) and in the human supplementary motor area.⁴⁰ This includes the possibility that motor neurons fire both when we think about a movement and when we watch someone else make it, and it would also explain certain imitative behaviors that we carry out unconsciously in a process of identification. We could include here the explanation of processes of emotional empathy, such as those involving touch (when we meet a person). Mirror neurons could likewise account for the processes by which we understand what another person feels, as when a teacher notices a bored audience and speeds up the class. These neurons have also been proposed as fundamental to the capacity for complex learned motor functions (praxes). In some very well-known studies, infant macaques learned to imitate researchers who stuck out their tongues.⁴¹ On this basis, therapeutic programs were developed in which patients watch therapists move in order to improve their motor recovery through imitative behavior.

It is true, nonetheless, that mirroring can sometimes be problematic. In some competitive sports, for example, an expert who watches a beginner may suffer a drop in *performance* (our system would imitate a less skilled motor act). One may think, then, that through motor identification, imitation or empathy, these mirror neurons influence and determine many of our affective patterns and future motor decisions.

⁴⁰ R. Mukamel et al., *Single-Neuron Responses in Humans During Execution and Observation of Actions*, 20 CURRENT BIOLOGY 750 (2010).

⁴¹ P. F. Ferrari et al., *Neonatal Imitation in Rhesus Macaques*, 4 PLoS BIOLOGY e302 (2006).

FACE RECOGNITION

It was discovered not long ago that the brain contains neurons that respond selectively to particular faces, and so the concept of the Jennifer Aniston neuron was born, a nerve cell that fired whenever the person was shown that actress, as described by the neuroscientist Rodrigo Quian Quiroga.⁴² Although this important localizationist concept of visual function and face recognition may hold certain truths, the recognition of faces seems to be a more complicated mechanism.

Recognizing the thousands of faces we memorize over a lifetime is a very complex function, related to facial memory through a breakdown of the parts of faces carried out algorithmically by neurons that memorize faces. There is, in other words, an area in the cortex of the brain (the superior temporal sulcus) containing neurons that report on different parts of the face in an organized and economical way, since they work on neighboring parts of it. Each facial representation exists in the cerebral cortex, a function called faciotopy. Some neurons will thus serve to recognize the areas around the eye, nose and mouth and the parts adjoining them. From there the information is organized, building up the overall information that allows us to see a face, recognize it and distinguish it from another among millions.

This mechanism does not differ from the general functioning of the nervous system, which usually has a structural organization. It organizes almost all functions, and the motor system, hearing and pain also have this kind of structure. In vision this ordering is known as retinotopy, since it is organized from the retina, and colors, too, follow an order from the retina to the cerebral cortex. It was discovered that faces are ordered through an algorithmic mechanism based on the distribution of cortical neurons. These neurons fire electrically in cycles, and the information is

⁴² R. Quian Quiroga et al., *Invariant Visual Representation by Single Neurons in the Human Brain*, 435 NATURE 1102 (2005).

then routed along nerve pathways. They begin in an area of neighboring neurons and travel in parallel from the retina to the brain. The group of researchers was able to identify different faces from this coding, which would be like a mirror of the face we are looking at, recording each one as though building a central archive of faces.

The researcher Doris Tsao and her team at the California Institute of Technology described a possible neural code for face recognition.⁴³ There is, then, a specific area for faces in the inferior temporal lobe, where faces are constructed algorithmically so that they can be related, recognized and given emotional meaning (other studies mention other areas that collaborate in this function, the superior temporal lobe and the occipital face area). This construction is bilateral, although it would be the right cerebral hemisphere that ultimately makes the final decision when a face is recognized. Seeing faces is thus a submodality of visual recognition that adds complexity to the system, and there is, moreover, a specific area devoted to it.

Human beings developed vision, unlike the lower mammals, which were mainly olfactory (macrosmatic), and later became macro-optic. But seeing the face and eyes of another involves a more complex phenomenon. It is one of the foundations of intersubjectivity, of connection with others and of social skill, as well as of language learning. Neurobiologists at Harvard University led by Margaret Livingstone described how the face recognition area develops in the first 200 days of life.⁴⁴ It holds a potential activity, but it would not be an innate function, since it must be developed after birth. The group studied this in newborn macaques, some raised by their mothers and others by humans wearing masks. The face recognition area did not develop in the animals that were not raised with their families, and this showed in the difficulty these primates had in looking at faces, directing their gaze to other areas, such as the hands. Something similar occurs in autism and in visual agnosia for faces (prosopagnosia).

⁴³ L. Chang & D. Y. Tsao, *The Code for Facial Identity in the Primate Brain*, 169 CELL 1013 (2017).

⁴⁴ M. J. Arcaro et al., *Seeing Faces Is Necessary for Face-Domain Formation*, 20 NATURE NEUROSCIENCE 1404 (2017).

The existence of a specific area for recognizing faces shows how important this function is in animals with highly developed brains, such as monkeys and humans. It confirms the need, in the first year of life, to watch faces in order to learn a language, since if babies are taught a second language through videos rather than by people actively engaging with them, they do not learn it.⁴⁵ We are born, then, with neuronal hardware that has to be filled, as with the capacity to recognize and memorize faces, and in both cases this happens during a specific period at the beginning of life. It is probably necessary first to recognize faces and only then to learn a language. Face recognition makes it possible to tell apart the different features of people among millions, and we can pick out the face of a friend, a relative or an acquaintance in a crowd in milliseconds. Some studies describe this activity as a talent, and there are, for example, “super-recognizers” with a great visual memory for faces.⁴⁶

The other activity involved in recognizing faces is the empathy that faces produce. Empathy conditions intersubjective relationships, gregarious behavior and a person’s social success, which confirms the importance of this function as the basis of gregarious behavior, allowing people who know one another to group together. This function can fail in disorders such as psychosis, in which interpersonal empathy is severely affected. There are several tests of facial emotion recognition in which subjects are asked to say what the face of a person in a photograph expresses, with faces that vary among sad, happy and angry. Patients with schizophrenic psychosis clearly fail to recognize the type of facial expression.

There are functional brain imaging studies of patients as they look at these faces, which make it possible to see how these patients’ brains respond. In schizophrenia, the emotional response of the amygdala reacts abnormally to the emotion of the other. At the same time, the brain’s resting systems do not rest in these patients. This happens in the pre-

⁴⁵ P. K. Kuhl et al., *Foreign-Language Experience in Infancy: Effects of Short-Term Exposure and Social Interaction on Phonetic Learning*, 100 PROC. NAT’L ACAD. SCI. U.S. 9096 (2003).

⁴⁶ R. Russell et al., *Super-Recognizers: People with Extraordinary Face Recognition Ability*, 16 PSYCHONOMIC BULL. & REV. 252 (2009).

cuneus, which should become active at rest, and the fact that it stays active suggests that the person remains in a permanent state of alert. Faces, then, occupy a central place in people's sociocultural relationships. They are key to interpersonal dealings and to the identifying, social and emotional recognition of the other, processes that are fundamental to survival.

NEGATIVE EMPATHY

Empathy is a function that helps explain different aspects of subjective relationships. It could be partly likened to altruism or to benevolence toward the other, but empathy involves far more complex processes. Above all, it entails distinct activities. The first, “cognitive empathy,” the basis of rational knowledge of the other, works through the complex association cortices of the brain, such as the prefrontal lobe, the temporal cortex and the areas where the parietal and temporal lobes meet. The second, “emotional empathy,” is related to emotional sensitivity, which is unconscious at first and only later becomes conscious. It is located in deep areas of the cortex, especially in two important structures, the anterior cingulate and the insula, unconscious areas that make us feel what the other feels. Empathy could be interpreted on the basis of theory of mind, which involves understanding the other person intersubjectively.

This theory rests on mirror neurons, described several years ago by the neurobiologist Giacomo Rizzolatti of the University of Parma.⁴⁷ They are neurons that fire in response to what another person does, both in motor acts and in affective matters. Empathy may not be exactly the same as theory of mind, because it involves the more complex subjective feelings of these processes. It can even have paradoxical aspects. In the relationship between a physician and a patient, for example, a highly empathic doctor may be drawn into an emotional expression of excessive force, which can be counterproductive. An excess of empathy would be harmful, because some people are found to be worthy of empathy and others are not, and this can lead to an unconscious need to discriminate against those who do not elicit it. As the Yale psychologist Paul Bloom argues, we can empathize with immediate, nearby matters and not with deferred ones of greater consequence, such as climate change.⁴⁸

⁴⁷ *But see* G. HICKOK, *THE MYTH OF MIRROR NEURONS: THE REAL NEUROSCIENCE OF COMMUNICATION AND COGNITION* (W. W. Norton 2014).

Empathy is a process that can be modified by various external influences, since groups can be stirred by different occasions and influences. Empathy can thus produce a positive feeling, but that feeling can also involve inner conflict. It could lead to problems such as depression or extreme anxiety in the face of failure, as happens with health sciences students who invest a relationship with extreme emotion. In this sense, some studies show that when people observe a single individual, a direct empathy arises that leads to a positive empathic reaction. When the processes involve groups, by contrast, emotion would lean toward structures bound up with our own identity. The empathic process might at times become counterproductive, in the sense that it would be related far more to discrimination against the other group, with which one does not empathize.

In the eighteenth century Adam Smith anticipated that the basis of social theory lies in putting oneself in the other's place in order to understand oneself.⁴⁹ In this sense, empathy would be an epiphenomenon of that process. The empathic process, which has to do with the emotion of the other, should be distinguished from the process of positive benevolent meditation, which involves meditating on the emotional well-being of the other. The empathic process can lead to distress and confusion, unlike benevolent meditation, which always has positive effects. The phenomenologist Edmund Husserl took a different approach, speaking of a process distinct from empathy in the ordinary sense, which he called *Einfühlung*. *Einfühlung* involves first identifying oneself and only then being able to take in the other. This process suggests that we must first think of ourselves in order then to grasp the other.

Empathy can be a double-edged sword, since several studies show how a person can be manipulated into not feeling empathy. In this way the scales can be tipped strongly toward a group or a person, propping up a possible ideological capture. This can happen with social ideas based on post-truths. Quick persuasion, sustained by the weight of numbers or by

⁴⁸ P. BLOOM, AGAINST EMPATHY: THE CASE FOR RATIONAL COMPASSION (Ecco 2016).

⁴⁹ A. SMITH, THE THEORY OF MORAL SENTIMENTS (D. D. Raphael & A. L. Macfie eds., Oxford Univ. Press 1976) (1759).

repetition, can produce empathy or, on the contrary, “inverse empathy.” An interesting example of the management of empathy can be seen in the cinema, where we will feel differently about a character depending on whether we watch him from the outside or the camera shows us what he sees. Sympathy can even be produced for violent or corrupt characters.

A very suggestive experiment carried out by Tania Singer of the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig showed that people who appeared aggressive elicited neurological responses of lower empathy.⁵⁰ Most of the subjects who watched them were thus not distressed by the harsh punishments inflicted on them. In this study, lower empathy predominated in men as compared with women, in whom empathy was harder to break quickly. Perhaps women are harder to deceive.

Altruism and selfishness would be two simpler, opposing aspects of a society’s behavior. Empathy, being more complex, could also be pathological. Some researchers argue, in broad terms, that it may be regarded as the pathophysiological basis of antisocial personality disorders, as would be the case with criminals. At this point, as some studies show, the neural circuitry would not be affected; what might be found instead is a disturbance in the pathological emotionality that empathy produces. The distress of another person could produce sensations of pleasure. This shows clearly that, in such cases, empathy and altruism are not the same thing.

Political operations of hatred may be regarded as work that manipulates empathic processes, both the consequence and the cause of post-truths that can produce emotional behavior in society. At that point, what is most likely is that the population will take its stand against a group of people, strengthening its bond with its own group.

⁵⁰ T. Singer et al., *Empathic Neural Responses Are Modulated by the Perceived Fairness of Others*, 439 NATURE 466 (2006).

NEGOTIATION

Negotiated processes form an interesting chapter in neuroscientific research. It could be said that almost every interaction between human beings requires a tacit agreement reached through negotiation of this kind. Parents and children, authorities, lawyers, couples, politicians and, of course, business, among many other settings, all depend on processes in which one party makes an offer and another accepts it or not, opening a stage of proposals and dialogue that may or may not lead to a new agreement. Several tests consist of a negotiation game with an offer followed by acceptance or rejection, and one of the most widely used is the so-called ultimatum game.⁵¹ In it, the physiological processes of the players can be measured. These are generally easy to study with functional neuroimaging and electroencephalography, which shows differentiated activation, especially in the prefrontal and temporal lobes. Several studies have thus observed that accepting an agreement produces alpha waves in the prefrontal cortex, while rejecting it produces theta waves.

Negotiation implicitly involves dialogue, intuition, empathy understood as an intersubjectivity that entails knowing oneself (metacognition) and knowing the other (social cognition), beliefs and, finally, decision-making, both immediate and deferred. Dialogue, then, is an instrument of social life. It is a key and universal process of *Homo sapiens*, a kind of unconscious group agreement. Through it, ideas, thoughts and hidden premises can be drawn out, although they are always set in the context of the need and the moment of transmission. It serves both agreement and disagreement, and the transmission of culture, since it is a central component of gregarious behavior.

⁵¹ W. Güth et al., *An Experimental Analysis of Ultimatum Bargaining*, 3 J. ECON. BEHAV. & ORG. 367 (1982).

The group led by Tanya Stivers (also at the Max Planck Institute, working with Nick Enfield) argues that dialogue requires timing.⁵² Conversations are made up of interventions that rely on temporality, waiting and turn-taking to establish each exchange, fulfilling a tacit social function of language that appears to be universal and recurs across languages and peoples, since it is found in dozens of languages, regions, ethnic groups, continents and grammatical structures. These are universal processes which, although learned, seem to come as a common functional foundation in human beings. As for the wait before a reply, it is striking that it lasts on average 200 milliseconds (that is, 0.2 seconds to answer), as a normal structural component. During this very short interval we are already working out our answer, which means that we think of the reply while the other person is still speaking. But if those 200 milliseconds become 500 (half a second), the answer may be suspected of reflecting some doubt or lack of sincerity.

This has been tested in different languages, where similar features are found in the subjective perception of how long a reply takes during a conversation. Mark Dingemanse and Nick Enfield, of the Language and Cognition Department of the Max Planck Institute for Psycholinguistics in Nijmegen, argue that “turns” (thinking, waiting to speak and anticipating what we are likely to be told), “clarifications” (requests for clarification) and “repairs” (the corrections we make to keep what we say in line with what we mean) are needed for us to make ourselves understood and to negotiate. Dingemanse and Enfield find that, on average, a dialogue is interrupted once a minute.⁵³ Temporality is thus a very important instrument within the structures of dialogue. Questions of timing are central to understanding the other, so that a silence only slightly longer than usual between question and answer may signal disapproval or anger.

⁵² T. Stivers et al., *Universals and Cultural Variation in Turn-Taking in Conversation*, 106 PROC. NAT’L ACAD. SCI. U.S. 10587 (2009).

⁵³ M. Dingemanse et al., *Universal Principles in the Repair of Communication Problems*, 10 PLOS ONE e0136100 (2015).

Belief systems also bear on negotiated processes, since religiosity, placebo and tribalism will influence possible agreements positively or negatively.

Decision-making, then, incorporates instinctive processes. Some mechanisms require reason, but others draw on basic instinctive survival functions. Logical reasoning has been found to be far more effective in everyday decisions of moderate complexity than in those of extreme complexity, and in the latter, according to many research studies, it would be more effective to give free rein to instinct.⁵⁴

Reaching an agreement requires bringing a negotiation to a close, but for it to end well there must be some concessions and tolerance on both sides. Consensus will always be necessary, in the simplest negotiated agreements as in the most complex. It will therefore be important to build consensus on what sustains the social capacity of individuals and of whole populations.

⁵⁴ *But see* Nieuwenstein et al., *supra* note 26.

PART IV

Norms, Conflict and Punishment

INSTINCTS

Human beings possess basic survival instincts that they share with the higher mammals, and this has been known since the beginning of the last century. It is taught, accordingly, that we have basic emotions, which many people memorize as five fundamental drives: fleeing (fear), fighting (aggression), mating (sexuality), eating (feeding) and the behavioral control of temperature (for example, putting on or taking off clothing in the cold or the heat). These functions are essentially subcortical. They have allowed survival from humans down to lower mammals such as mice, and also in our cousins the chimpanzees, bonobos and orangutans (whose genomes are nearly identical to ours).

Other instincts essential to survival have since been described. One example is the spatial recognition carried out by certain neurons (which we might call a primitive awareness of space), described by the winners of the 2014 Nobel Prize in Medicine as an internal GPS.⁵⁵ Spatial navigation abilities are found not only in mammals but also in insects, which means that many basic instincts go much further back in evolution. Bees can thus find their way back to the hive while avoiding collisions, and birds anticipate a migration very early on, preparing themselves for journeys over great distances. The assessment of time in animals is also being reconsidered. Learning a particular route (as birds do), for instance, involves a very elaborate long-term decision, which also requires a complex spatial as well as temporal program. Nomadic movement, which accounts for 95 percent of our species' time on earth, may therefore have been related to spatial ability. The programming of time and space is thus added to the five basic instincts described long before by cognitive neurologists.

⁵⁵ Press Release, Nobel Assembly at Karolinska Institutet, The Nobel Prize in Physiology or Medicine 2014 (Oct. 6, 2014), <https://www.nobelprize.org/prizes/medicine/2014/press-release/>.

The loss of any of these instinctive functions can bring about the disappearance of a species. Evolutionists hold that the dominant species has been wiped out five times in the history of the world (some four and a half billion years) by different events. The best known is the disappearance of the dinosaurs, over whom we mammals won the evolutionary struggle. *Homo sapiens* has been in the world for a very short time, equivalent, on a proportional scale, to only a few hours. If the universe were fourteen years old (it is in fact 13.7 billion years old), the earth would be about four and a half (its actual age is about 4.5 billion years). We are, in other words, a very recent species, with very little evolutionary time and experience. We are by no means in command of our environment, and perhaps only slightly in command of our own instincts. In fact, one species of human has already vanished from the face of the earth. Neanderthal man, a thinking being similar to us and, like us, a descendant of *Homo erectus*, appeared in Europe, unlike *sapiens*, which arose in Africa, and later became extinct. We nonetheless shared several thousand years with Neanderthals in Europe and Asia after we migrated to those lands.⁵⁶ Neanderthals had a symbolic capacity, language and manual dexterity, as well as the capacity to mate and reproduce with humans, although with some difficulty (which might perhaps lead us to regard them as the same species). This is why about two percent of the genome of present-day non-African humans comes from them.⁵⁷ *Homo sapiens*, descended from *Homo erectus* like the Neanderthal, ended up winning the evolutionary competition against it, whether because the Neanderthals were less sociable (less gregarious), because they could not hunt prey as well as *sapiens* (they came too close to wounded animals and were injured), or simply because they lost the evolutionary war (a contest that may not have been entirely metaphorical) with humans. Whatever the evolutionary reason, it was the key to surviving over the Neanderthals. Sociability may well be another instinctive function, since gregarious behavior seems to have helped us hunt, defend ourselves, endure the ice ages and prevail in war over other species of humans.

⁵⁶ T. Higham et al., *The Timing and Spatiotemporal Patterning of Neanderthal Disappearance*, 512 NATURE 306 (2014).

⁵⁷ K. Prüfer et al., *The Complete Genome Sequence of a Neanderthal from the Altai Mountains*, 505 NATURE 43 (2014).

One might think that the empathic capacity to come together socially (empathy) could have been our eighth instinct. Through gestures, laughter, music, weeping and primitive language, the possibility of bringing small groups of humans together gradually took shape in the earliest Stone Age. These were small communities of twenty or thirty people, and they would have been essential to the process that allowed us to outlast other hominids.

These eight basic instincts would, in the beginning, have been what allowed us to survive. But we should be careful, because some of them may be paradoxical (useful at first but harmful later), especially the instinct to fight (aggression), since overpopulation and sedentary life have led us to the domination of territory, which is the basis of property and of the wars that follow from it. This could lead to yet another extinction of a dominant biological being on earth.

EXPERIMENTAL ETHICS

Ethics is the branch of philosophy that examines how human behavior is formed and regulated from a moral point of view. Today the field has expanded to include the understanding of human consciousness, becoming an integral part of a moral philosophy that brings in scientific knowledge about how the brain works and how it affects moral conduct. This area of study is known as experimental ethics. One essential question is whether there are universal principles in our instinctive nature that, according to Kant, are grounded in reason and define a right way of acting for all human beings. A set of approaches has emerged in neuroscience as a result, investigating everything from the neurological bases of morality to the innate genetic aspects of behavior and those that are learned or shaped by the environment.

The expression of genes could be a starting point for thinking about innate behaviors that are modified by biological processes in the environment, resulting in a being whose basic behaviors are controlled by the sociocultural normative order that acts on conduct. Three different factors would influence moral conduct: behavioral preformation, individual biological and psychological factors, and sociocultural factors. We could say that our final behavior is a contingent decision shaped by four vectors, reason and emotion on one side and motivation and inhibition on the other, and that its end point is the decision that determines our conduct. We must be careful not to fall into reductionism and so arrive at mistaken ideas about specific areas of the brain. There are, however, areas clearly linked to functions involved in ethics, such as the orbital and ventromedial regions of the prefrontal cortex and the nucleus that regulates emotion and empathy, called the amygdala. Although there are indeed very specific areas for these functions, we cannot forget that the brain works as a network.

There are substances, such as serotonin, that make us more sensitive toward others. Molly Crockett of the University of Cambridge observed

more cooperative behavior when antidepressants that raise levels of this substance were used, and the same happens with the hormone oxytocin.⁵⁸ This carries the risk, however, that attempts may be made to modify people's behavior by direct intervention. Another point of interest is how people with antisocial personality disorder lose empathy, as a study by Jean Decety of the University of Chicago shows, describing reduced social emotion in these individuals together with altered prefrontal function.⁵⁹ The same happens in patients with schizophrenia or frontal dementia, who have lost inhibitory control over their instinctive behavior. Kant, for his part, also proposed that the proper way to act morally would be for our conduct to become a universal norm, and in this he anticipated, in a way, the principles of mirror neurons, which unconsciously make us feel empathically what another person feels.⁶⁰ This may be what is missing in people who act antisocially and cannot understand the other as they understand themselves, since they may lack an empathic mirroring mechanism in their neurons.⁶¹

We may therefore consider that there are preconceived ethical intuitions (the genotype), which are nonetheless influenced by later biological factors and, above all, by sociocultural norms, creating a gap between what is and what ought to be according to the moral norms of each society. Neither one choice nor the other will always bring us safely into port, since these are complex decisions tied to our subjectivity. Cognitive neuroscience has no definitive answers.

⁵⁸ M. J. Crockett et al., *Serotonin Selectively Influences Moral Judgment and Behavior Through Effects on Harm Aversion*, 107 PROC. NAT'L ACAD. SCI. U.S. 17433 (2010).

⁵⁹ J. Decety et al., *Brain Response to Empathy-Eliciting Scenarios Involving Pain in Incarcerated Individuals with Psychopathy*, 70 JAMA PSYCHIATRY 638 (2013).

⁶⁰ *But see* Hickok, *supra* note 47.

⁶¹ Kant, *Groundwork*, *supra* note 1.

THE ORIGINS OF MORALITY

Morality points to group processes that become established as a cultural model and that bear on individual ethical precepts, which is to say that a group's social rules about belonging and respect for norms are what make individuals belong to it. There is a postulate in cognitive neuroscience according to which the larger the brain, the greater the social capacity. Intellectual complexity creates needs that call for cooperative work, and such work requires the other as part of a functional group bound by a shared agreement.

This cooperation gives rise to premises of functionality and joint work, which in turn produce reciprocity together with belonging and with rights and obligations toward the group. The other is then recognized as part of the same culture, at first through basic markers in early humans, such as eating the same food, living in the same place, sharing rituals or looking alike physically. These markers provide the signal of belonging, which of course grew more complex over time. Morality would thus be a key functional precept in the gregarious construction of the human being. Empathic agreements and basic social criteria for feeling like “us,” and not “I,” gradually built the foundation of morality in *Homo sapiens*. Although there are group interactions among developed animals such as chimpanzees, which work together to hunt or gather fruit, their group agreement lasts a very short time, because they then fight and scatter to get the best share, abandoning any organizing criterion. The best example of collective construction is that of African termites, which build very complex mounds with very small brains. These, however, are matters confined to gregarious instincts tied to a habitat, which do not involve complex individual cognitive functions.

In *Homo sapiens*, the first moral processes are basic cooperative principles that can be broken. Failing to honor them could lead to exclusion from the group, which is regarded as a failure of psychological morality. The neuroscientist Michael Tomasello, of Duke University and the Max

Planck Institute, holds that if a human being manages to produce a moral justification for breaking a group norm, such as setting aside an agreement because of an emergency, a moral identity grounded in reason comes into being. This function would require a very elaborate cognitive skill for abstraction and metaphor, found only in the genus *Homo*.

Tomasello, author of *A Natural History of Human Morality*, observes a behavioral change in moral matters in the *Homo* lineage some 400,000 years ago, when a “joint intentionality” emerged in which the “I” became subordinate to the “we,” which he calls “second-personal morality.”⁶² This intention would rest on a sense of group competition first observed in our immediate ancestor, *Homo heidelbergensis*. Paradigms of mutual benefit thus took shape, and they are the basis on which both psychological morality and gregarious life were built.

Building this social morality requires a complex function called metacognition, a process that allows us to judge others (social cognition) and ourselves within the group (metacognition in the strict sense), that is, to judge how others see us. Morality was constituted over millions of years through cultural accumulation, which produces the selective influence of social learning. Yet barely ten thousand years ago human beings became sedentary farmers and were also exposed to a great demographic explosion. Moral paradigms that had been formed over hundreds of thousands of years then suddenly met new tensions and conflicts that were hard to foresee.

⁶² M. TOMASELLO, *A NATURAL HISTORY OF HUMAN MORALITY* (Harvard Univ. Press 2016).

ALTRUISM

The feeling of altruism is the motivation to help others. Even at the cost of losing what is one's own or of risking one's life, it is a function that has served, and still serves, social cohesion. It is probably a basic instinct, the instinct to associate with others. Groups of animals, such as flocks of birds or troops of chimpanzees, make use of it because it is key to their survival. They would never have survived or left offspring without the attraction between members of the same species that produces communal and cooperative behavior, which has served for defense, for finding food and for migrating, among other things.

For altruism to come into play there must be empathy among members of a species, that is, a special form of communication that leads them to relate to one another. But altruism also brings benefits to the altruist, such as being recognized by the rest. The members of the group place the generous individual in a position of superiority and of competition for leadership, and this also feeds his ego. There are, in fact, processes in which a lack of solidarity provokes a later reproach from the herd toward the one who failed to help. This can be observed in groups of chimpanzees that recognize the "friends" with whom they have carried out tasks in common (grooming, for example), and these friends are later favored when food is shared out. They are not necessarily relatives, and it has been found that many of the primates that act together are bound not by kinship but by empathy.

Altruism, then, requires recognition from others, as when people in a test of solidarity are made to feel that they are being watched. These people become more generous and, for example, donate more money in a game. Altruism was also necessary in teaching. Such systems make learning easier, and they were very probably key to the survival of the primates that preceded us. The ability to handle fire, build tools or make weapons would not have been possible without transmission and learning. Teaching is a process in which one agrees to be copied (a very important mech-

anism for passing on information, both within a species and across generations). Allowing oneself to be copied implies a great capacity for altruism toward others, but it made possible the development of a primary culture that was indispensable for survival.

Animals, too, show processes of cooperation, as when birds instinctively spread out to hunt their prey. Such matters may be the basis of the first (almost instinctive) languages, which are indispensable for cooperation among peers. Altruism probably involves matters that have been bound up with primitive language since its beginnings, because besides making possible the cumulative transmission of learning, it produces a kind of supersociability in human beings, as Mark Pagel of the University of Reading argues.⁶³ It also creates the possibility of a social agreement, so that there are no misunderstandings between the one who gives and the one who receives, for example in the process of copying.

Pagel describes birds (corvids) that, when they are watched while hiding their food, come back later and move it elsewhere, which is to say that they do not tolerate imitation. This behavior would be the opposite of what the altruist tries to bring about. The matter is one of balance, because some individuals may take advantage of the kindness of others. Language made it easier not only to transmit complex information but also for human beings to reach agreements and avoid misunderstandings. Several neuroimaging studies have examined the areas of the brain involved in altruism, and Ernst Fehr, for instance, describes an area of greater activity between the temporal and parietal lobes in altruistic people.⁶⁴

Altruism also involves, on the other hand, the shame of not being altruistic. This is related to areas that produce shame or the fear of not being recognized. This inhibitory social behavior is developed in areas of

⁶³ M. PAGEL, *WIRED FOR CULTURE: ORIGINS OF THE HUMAN SOCIAL MIND* (W. W. Norton 2012).

⁶⁴ Y. Morishima et al., *Linking Brain Structure and Activation in Temporoparietal Junction to Explain the Neurobiology of Human Altruism*, 75 NEURON 73 (2012).

the prefrontal lobe (the orbital prefrontal cortex), which clearly contributes to establishing social control according to culturally established parameters. Empathy, moreover, involves mirror neurons, which allow us to grasp what is happening to another person, what neurobiologists call theory of mind or social cognition. It would be a kind of primary diagnosis of the situation, which then leads us to feel and to reason through the alternatives for altruistic decisions.

It has been described that in its beginnings, some 200,000 years ago, humankind was organized in groups of hunter-gatherers of no more than twenty-five members. These small groups are thought to have been the best suited for transmitting cultural information and evolutionary genetic change. Altruistic behavior thus gave a reputation to the one who practiced it and also created imitative behavior in the rest of a small community, since information was passed on directly.

It has been said that both groups of higher mammals and humans base their progress on competition with their fellows, even if it is only a motivation for individual development (something that may perhaps be reconsidered in modern man). Altruism is a mechanism for obtaining a good share of the spoils of cooperation, and it places the one who shows solidarity in a position of high reputation. Humans are recognized as the only species that can be altruistic spontaneously outside its own group, and even toward other species. The development of the brain may have produced this broader capacity for solidarity.

Altruism, then, is not a simple function, and it is not only kindness. It involves processes of cooperation, and it is the basis of a gregarious system of learning, communication and also competition.

COOPERATION

The human being is the only living creature that has managed to conquer all five continents. The capacity for cooperation, even with strangers, is thought to have played a part in the survival of our species. Like the capacity for abstraction, it was achieved through the growth of our brain, and the two functions are clearly linked. Some neurobiologists posit a rule according to which the larger the brain, the greater the capacity for social life, so that the more brain mass, the larger the cities. To become gregarious, the brain must not only abstract but must also be able to communicate. It must be able to handle tools and use symbolic forms, such as drawings or music, that represent practical or religious matters.

These cooperative attitudes seem to be related to the survival of our species, unlike another human who inhabited the world alongside us, the Neanderthal. The Neanderthal seems to have been less sociable and not to have formed, or adapted to, large groups capable of facing different adversities, and so to have become extinct. The use of long-range weapons, the making of two-sided spear points (bifaces) and the use of fire for cooking, for example, were among the most important technological advances of our hominid predecessors. This transformation is related to improvements in diet, with a higher yield of calories, and to the growth of the brain.

There are hormones, such as oxytocin, that are related to social affection, and oxytocin is in fact called the cuddle hormone. The response to this hormone promotes group cohesion, as has been observed experimentally in prairie voles, which remain faithful to their families, unlike montane voles, which do not and which respond less to the hormone.⁶⁵ This hormonal response, however, is clearly observed in the West, whereas in

⁶⁵ T. R. Insel & L. J. Young, *The Neurobiology of Attachment*, 2 NATURE REV. NEUROSCIENCE 129 (2001).

Eastern communities it does not occur or even occurs in reverse.⁶⁶ Genetic ancestry and social learning probably condition the response, which is expressed in association with each culture. An interesting meta-analysis of functional brain imaging studies agrees that in Eastern populations the activation of areas of social empathy takes priority, whereas in Western brains areas of individual thought are activated.⁶⁷

Genes that lead us to adaptive behavior have also been described. Shinobu Kitayama and his group at the University of Michigan showed that the gene for one type of dopamine receptor (DRD4) helps people adapt better and become more independent in the West, but produces cooperative interdependence in Eastern subjects, which is to say the opposite.⁶⁸ The same gene thus produces two different behaviors depending on ethnicity or culture, which shows that it has more to do with social adaptation than with the expression of a behavior. It should be stressed that every effect produced in a process of gene expression will be influenced by the environment, but also by other idiosyncratic polygenes in each population that will modify its phenotype.

It is important to realize that cooperative societies, as happened with *Homo sapiens*, are the ones that survive. It would be important for the capitalist West to become aware of the importance of altruism. Allowing oneself to be copied and cooperating are processes necessary for the survival of a species. Savage, selfish capitalism that advocates individualism can cause more serious social problems than is commonly believed.

⁶⁶ H. S. Kim et al., *Culture, Distress, and Oxytocin Receptor Polymorphism (OXTR) Interact to Influence Emotional Support Seeking*, 107 PROC. NAT'L ACAD. SCI. U.S. 15717 (2010).

⁶⁷ S. Han & Y. Ma, *Cultural Differences in Human Brain Activity: A Quantitative Meta-Analysis*, 99 NEUROIMAGE 293 (2014).

⁶⁸ S. Kitayama et al., *The Dopamine D4 Receptor Gene (DRD4) Moderates Cultural Difference in Independent Versus Interdependent Social Orientation*, 25 PSYCH. SCI. 1169 (2014).

PROPERTY

Homo sapiens has existed for more than 200,000 years, yet it began to settle down less than 10,000 years ago, turning from hunter-gatherer into farmer and herder. Whether nomadic or sedentary, human beings have always been accompanied by a social instinct, also called the “gregarious” instinct, which is the need to associate with others, whether relatives or acquaintances, in order to build a clan or a herd. One hypothesis holds that “the greater the gregarious capacity, the more brain mass.” It may be, then, that this capacity, instinctive at first, later evolved into a cognitive one, making social cognition, which consists in understanding others, more complex. This means that urban man would be a consequence of our cognitive development. Social behavior, however, exists necessarily and instinctively in animals and in the most diverse species, from insects, fish and birds to the primates that preceded us.

There is, however, a great variety of possible behaviors, depending on the species in question. Our cousins the chimpanzees and gorillas, for example, live in troops, unlike orangutans, which are solitary and seek a mate only to reproduce before going on with their lives alone. Human beings, nomadic or sedentary, behave gregariously. Sedentary life, however, will be the fullest expression of communal life, creating large agglomerations, and it will gradually add the need to take possession of territory, since human beings, having moved from hunting and gathering to settled life, now devoted themselves to their land and their livestock.

It is interesting to note that some of the few hunter-gatherer tribes that survive in Africa today, such as the Hadza of central Tanzania, who have no concept of territorial property, manage to settle their differences with less violence.⁶⁹ In conflicts that generally arise from family, sexual or food disputes, the seriousness of the quarrels and of the acts of revenge is

⁶⁹ F. W. MARLOWE, *THE HADZA: HUNTER-GATHERERS OF TANZANIA* (Univ. of Cal. Press 2010).

minimal compared with that of sedentary peoples. At times they are symbolic or ritual fights that simulate a dispute without causing serious injury.

The concept of structural war arose in association with the sedentary farmer and with the formation of settled groups that took possession of territories. No wars or conquests are known before *Homo sapiens* became sedentary, and they are first described in various settlements of the Middle East, especially in Mesopotamia.⁷⁰ Territorial wars and the plundering of neighboring groups' harvests (which were their greatest wealth) followed as a consequence. The first historical example is Sargon the Great, of the city of Akkad, who built the first empire in history. It is probably when gregariousness reaches its fullest expression in human beings that territoriality arises, giving concrete form to feelings of property and to the wars that follow. The awareness of finitude, its relationship with religiosity and the burial of ancestors probably fostered sedentary life, adding something extra that strengthened the subjective instinct of possession.

These groups have rules that involve other complex instincts. Depending on the character of the group, "altruism" will come into play in order to teach and protect, but also in order to secure a role within the herd. There is "copying," which involves learning, and also "communication" and "cooperation," but there is "selfishness" too, in order to expel unwanted individuals or intruders. Many of these instincts seem elaborate, but they exist in much more elementary animal communities, from birds to termites or ants and, of course, in lower mammals. Many neuroscientific hypotheses support the gregarious instinct. Areas of the brain that distrust the other, such as the insula or the anterior cingulate lobe, reject other groups. Areas such as the posterior cingulate lobe and the anterolateral prefrontal lobe will be the ones that bring us closer to the other in order to analyze him and socialize with him, as the neuroscientist Michael Gazzaniga argues in his book *The Social Brain*.⁷¹ But socialization and the development associated with such marked territoriality exist only

⁷⁰ But see M. Mirazón Lahr et al., *Inter-Group Violence Among Early Holocene Hunter-Gatherers of West Turkana, Kenya*, 529 NATURE 394 (2016).

in human beings, whose complex association cortices modulate the more primitive areas.

Mirror neurons, located in different parts of the cortex, become active with empathy, which is the basis of sociability. They “switch on” when we act together with another individual, so that if another individual moves, these areas are activated even if we perform no concrete act ourselves. Many researchers argue that these neurons play a substantial role in sociability. Emotional areas, likewise, such as the amygdala, a more basic subcortical site that stores emotional memory, trigger responses of fear, strangeness and fight in the face of unknown or dangerous things. It would be a key area in the management of social emotional memory. The hippocampus, in turn, stores the declarative memory that allows later recall. Other biological factors related to gregariousness are the hormones oxytocin and vasopressin, as well as neurotransmitters such as dopamine, which contribute to attachment to others and the care of offspring and of the nest.

Marketing has applied some of these ideas by exploring the individual’s social drive, which leads people to buy where others buy rather than make a decision on their own. The crowd gives security, confidence and familiarity in use, and what is established is safer. In evolutionary terms, after all, an unknown fruit, however colorful, carries a greater risk. Mass appeal draws people in, and what the other has is what we desire. The need to own an object or a piece of land is implicit in animals and more complex in human beings. It is heightened by the gregarious instinct and by sedentary life, and especially by the cognitive development that gives an extra charge to our instinct for possession.

⁷¹ M. S. GAZZANIGA, *THE SOCIAL BRAIN: DISCOVERING THE NETWORKS OF THE MIND* (Basic Books 1985).

CROWDS AND VIOLENCE

In the face of atrocious acts of mass violence, we should ask which behavioral processes (of the brain and of the body) give rise to them and how they might be corrected. Processes of group violence depend on certain conditioning factors, among them tribal feeling, the priority of violence over altruism, the loss of subjectivity (of both attackers and attacked) and a sense of anonymity. This last factor, incidentally, has been considerably weakened by technological progress, for example by the arrival of cameras, social networks and the advance of forensic science (something the public is not yet fully aware of and which could be used as an educational deterrent).

As for “tribalism,” these behaviors contain instinctive impulses that we share with animals and that grow more complex in *Homo sapiens*, which adds rationality, inhibitions and cognitive controls that nonetheless do not bridge differences that are irreconcilable and at times even dangerous. These differences may concern territory (property), beliefs (religiosity) or group belonging (nationalism, a football club, a kind of sport and so on), and they can be called up as occasions for tribal identification, producing distorted decisions (immediate and deferred) that are often unjust or violent, or that betray ideas and feelings that cannot be restrained, which can lead to wars or to their sublimation (in a sporting contest, for example, or a competition for some prize).

As for the dominance of “violence over altruism,” the human being is a permanent battleground between altruism and the violent instinct. Depending on which wins, either social cohesion or aggression toward others will take priority. The “loss of the subjectivity” of the other, marked by a group attack and by a disregard for the other as a subject, entails the loss of dialogue. Dialogue is an instrument that, through intersubjective language, serves as the basis of human social conduct. Dialogue is not only speaking. It is looking one another in the eye, listening and understanding silences, and regarding the other as an equal, as another subjectivity.

Dialogue slows the workings of thought and allows ideas to mesh through the specific codes of each language together with other, universal components that give us subjectivity and a sense of intersubjective equality. When the victim is recognized as a subject, many aggressive feelings may diminish considerably.

“Anonymity” makes possible the dissolution of the individual into the mass, the sharing out of guilt and the absence of judicial reproach. It is reasonable to think that if the criminals who act in a mob had to act alone, most of them would very probably not act at all, because they would be exposed to the individual conditions of criminal proceedings. It would be enough to look at the aggressor, call him by his name and separate him from the group for the burden of violence to fall significantly.

It is true, however, that for a person to commit aggression of this kind he must have antisocial traits. Delroy Paulhus and Kevin Williams group narcissism, Machiavellianism and psychopathy together as “dark personalities” that characterize such individuals.⁷² They show traits marked by very little intersubjective empathy and pose great risks to society, from serious conflict to the possibility of crimes with a clear antisocial component. The narcissist overvalues himself greatly, is frustrated by criticism and always tries to please, but without caring about others; Machiavellianism is the manipulation of others for one’s own benefit; and psychopathy characterizes antisocial, amoral and impulsive behavior, with no interest in others and no remorse. In 1998, McHoskey, Worzel and Szyarto argued that these traits (narcissism, Machiavellianism and psychopathy) are more or less interchangeable.⁷³

People with antisocial personalities have impaired social empathy, and this is thought to be associated with a disconnection in the brain. Using functional magnetic resonance imaging, Jean Decety of the University of

⁷² D. L. Paulhus & K. M. Williams, *The Dark Triad of Personality: Narcissism, Machiavellianism, and Psychopathy*, 36 J. RSCH. PERSONALITY 556 (2002).

⁷³ J. W. McHoskey et al., *Machiavellianism and Psychopathy*, 74 J. PERSONALITY & SOC. PSYCH. 192 (1998).

Chicago observed a lack of communication between the ventral frontal cortex (which abstracts and thinks) and the subcortical amygdala, which handles emotion.⁷⁴ This makes it hard to feel and perceive what is happening to someone else, and for this reason these people feel the mishaps of others less than their own. It has also been described that neurotransmitters such as serotonin produce emotional well-being and make it easier to bear situations of conflict. The hormone oxytocin, likewise, is secreted in response to positive emotion, such as receiving a hug or an affectionate look, or feeling a positive emotion oneself. Other substances (CRH), however, increase fear in situations of risk. These substances would be altered in people with psychopathic personalities (for example, in prison populations, in association with the altered brain structures mentioned above). Even people with these characteristics, however, can become less aggressive and can often be brought under control once they leave anonymity behind and an individual, subjective bond is established. Everyday experience suggests, after all, that a driver who puts a hand out of the window to signal a turn is far more readily respected than the mere mechanism of a turn signal.

Preventive campaigns may need to bear these matters in mind. Excessive crowding without respect for bodies and identities, as happens in packed stands or in dance venues that pack people tightly together and increase their contact, provokes four of the conditioning factors described above, namely intensified tribalism, increased violence, diminished subjectivity and anonymity. It is the perfect storm for interpersonal aggression. As a preventive measure, crowding at concerts, nightclubs or sporting events may need to be reduced, so as to avoid the anonymity of the crowd and preserve respect for each person's bodily space, strengthening people's subjectivity and thereby weakening tribal, selfish and aggressive instincts.

⁷⁴ Decety et al., *supra* note 59.

REVENGE

The brain produces several instinctive defense mechanisms, and revenge appears to be one of them. It could be a feeling that has allowed our species to survive, organizing gregarious groups in particular, not only as a defense against other species but as a way of structuring group systems, which must maintain an ecology among their members. Three categories of group members thus mesh together, the “cooperators,” accompanied by the “enforcers,” who keep in check the third set of actors, the “free riders.” This maintains the functioning and survival of the group, probably not only in humans but also in more primitive herds, since altruism, aggression and selfishness are observed as instincts in different species, including species more primitive than mammals, such as birds.

The researcher David Chester of Virginia Commonwealth University says that revenge is, in a sense, a subtype of aggression.⁷⁵ It is therefore not only a feeling, as it might seem, but something that can lead to action. Animals that fail to catch their prey or to defend themselves can give others an impression of weakness. They must make a show of defending themselves, because the capacity to counterattack can often be used as a deferred act, which in the most serious cases may be direct and forceful. The enforcers are probably the ones who apply it directly, although many of the cooperators in the group would feel satisfaction at seeing or learning of punishment as revenge. Several scientific studies describe how many serial killers or people who commit serious crimes excuse their act as revenge against society, blaming it for having excluded or punished them socially. Perpetrators of crimes of passion would act in the same way.

⁷⁵ D. S. Chester & C. N. DeWall, *Combating the Sting of Rejection with the Pleasure of Revenge: A New Look at How Emotion Shapes Aggression*, 112 J. PERSONALITY & SOC. PSYCH. 413 (2017).

Reward is a necessary fuel for revenge, which both motivates vengeful acts and allows them to be justified as a reaction, but for revenge to occur as a behavioral process there must be some instinctive reward that relieves the reactive distress caused by an injustice the person or the group has suffered. The ideal is a balance among the members of a collective, in which the enforcers will be the active ones, although not the ones who benefit from the revenge. Without the balanced collaboration of its members, a group is destined for extinction. Free riders, then, cannot be too numerous, nor can everything be left to the enforcers, and a substantial number of altruistic cooperators is essential. It seems, then, that revenge rests on an instinct reinforced by several brain systems, especially by pleasure mechanisms, which is to say that this dangerous instinct may be grounded in satisfaction. It must therefore be kept to its proper measure, since an excess would wipe out the group, but its absence would also put the group in grave danger. This is currently being studied in very serious research based on game theory.

A well-known study by Tania Singer and her team at University College London shows that when a member who has cheated is punished, the brain's reward structures light up, such as the nucleus accumbens and orbital areas of the prefrontal lobe, as though the carrying out of deserved justice produced an emotional compensation.⁷⁶ When, however, cooperative and altruistic people were punished unjustly, functional magnetic resonance imaging of the brain showed other structures lighting up, those related to one's own pain and to the empathic distress of seeing another suffer unjustly. These areas were the insula and the anterior cingulate gyrus, which are closely related to pain, disgust and withdrawal.

Another study, at Goethe University in Frankfurt am Main, showed that more pragmatic punishment activates areas of the motor system, such as the caudate, a subcortical nucleus of the brain, and the operational areas of decision-making (the dorsolateral prefrontal cortex). The more deserved the revenge, the greater the activation of the caudate, both in the one who punished and in relation to the one punished. In both cases there was a direct relationship with the intensity of the revenge.

⁷⁶ Singer et al., *supra* note 50.

When human beings were hunter-gatherers (for most of our existence on earth), before cities were founded and legal and social rules were laid down, as happened in Babylonian Mesopotamia, disputes were not settled through established procedures but directly by the law of the strongest. In those settings, processes of revenge would have played a major regulatory role, producing social fear and a preventive respect in the face of life's various vicissitudes. Aggressors took the necessary precautions against the possibility of retaliation.

Various studies show an improvement in post-traumatic stress among people who have suffered serious harm, such as victims of rape or of state terrorism. The punishment of the guilty party, or simply the abuser's acknowledgment of guilt, together with a request for forgiveness, eases the victims' negative emotion. Conversely, prolonged negative feeling and the need to take justice into one's own hands will become more and more harmful to the victim over time, increasing the symptoms of post-traumatic stress. The different cases must therefore be handled so as to prevent people from taking revenge into their own hands. Processes regulated by the judiciary must be put in place and the archaic processes of revenge brought into order. Men have been described as more prone to revenge. Revenge is also found at the root of the personality behind most mass killings, which are, moreover, committed mostly by men, as Jack Levin, co-director of the Brudnick Center on Violence and Conflict at Northeastern University in the United States, describes.⁷⁷

David Chester raises something more alarming. He observes that revenge is used not only to obtain satisfaction in the face of an injustice, but that this instinct can apparently be triggered in human beings as a purely pleasurable phenomenon, which is truly problematic. Justice in today's society may be the sublimation of revenge, but we must bear in mind that these are complex feelings in *Homo sapiens*, and they can turn into serious vengeance, as in the Middle Ages, satisfying the cruelest instincts of our species.

⁷⁷ J. A. FOX & J. LEVIN, *EXTREME KILLING: UNDERSTANDING SERIAL AND MASS MURDER* (3d ed., Sage 2015).

This is no small problem. The risks of archaic feelings of revenge must be channeled. If this archaic feeling is not properly contained and channeled, deviations may then occur, such as excessive revenge or, on the contrary, its complete absence. Both have serious consequences for the victims themselves and for society.

ANGER

Some researchers regard anger as beneficial to the brain, since as a moderate emotional phenomenon it can strengthen memory of the event in question. This is a rather reductive view, because every positive and negative emotional stimulus reinforces memory and can bring an episode back into consciousness. Getting angry, however, would be far from beneficial, since it produces a series of counterproductive effects for several reasons. First, it worsens quality of life. Second, it causes a release of norepinephrine, which raises blood pressure and heart rate in people with heart conditions, with the consequent cardiac and cerebrovascular risks. Third, it could even impair memory if the anger were very severe, to the point of psychogenic amnesia. Fourth, if the episode is repeated it could produce chronic stress, with secondary depressive and cognitive disorders. Fifth, it could trigger post-traumatic stress. Sixth, it can lead to unpredictable interpersonal problems. And seventh, it can produce vengeful behavior that ends in mental health problems.

Rage must be managed so that people do not take revenge into their own hands. Processes regulated by the judiciary must therefore be put in place and the archaic processes of revenge brought into order. In its acute phase, anger involves a sudden surge in the sympathetic nervous system, increasing the neurotransmitter norepinephrine, which leads to high blood pressure and a faster heart rate, especially when anger turns into fury or rage. It also produces dopamine, which reinforces reward mechanisms, and this is quite dangerous, because it can give rise to the pleasure of revenge or of anger and to its repetition, as though it were addictive. It is counterproductive in the medium and long term, but it brings satisfaction in the very short term, with addictive components.

During anger, serotonin falls, and serotonin is what produces emotional well-being and makes situations of conflict easier to bear. The hormone oxytocin, which is secreted in response to positive emotion, such as a hug or simply an affectionate look that produces a positive emotion,

may also be affected. Other substances, however, such as the hormone CRH (corticotropin-releasing hormone), increase fear in situations of risk. These substances would be altered in people with psychopathic personalities (for example, in prison populations, in association with impaired emotional brain structures such as the limbic system). If episodes of anger persist over time, a chronic rise in cortisol will follow, producing a syndrome of reduced capacity to fight, reduced immunity and reduced motivation, which can even lead to depression and associated cognitive disorders. Cortisol also affects the hippocampus, a structure related to recent and conscious memory.

The impact of these events can in turn lead to serious health problems, such as heart attacks. Of the heart attacks that occur without prior coronary obstruction, many are associated with an intense emotion beforehand. Something similar can be seen in strokes, which are strongly associated with high blood pressure and cardiac arrhythmias.

Anger calls for an intelligent response based on language and on saying things, but without resulting in noradrenergic surges, fury or rage. Nor will processes of revenge be good for people or for their nervous systems. Anger will mostly be counterproductive, except in very specific matters that call for it, and then only in moderation. Getting angry sets off a process that requires self-control, intelligent dialogue and a limit in time.

PEACE AND WAR

There is a fine line of balance between violent and peaceful behavior in human beings. Incredible as it may seem, we are less violent today, and the statistics show it. In the Middle Ages, for example, the average risk of dying by homicide was almost sixty times higher (one in every thousand people) than it is today in the same developed countries. The aggressive response is an adaptive function that serves the survival of the higher animals and of *Homo sapiens*, that is, of us. The human species developed this defensive or predatory process and applied it to territorial struggle and to hunting, and it learned to master it and to interpret it culturally. It is a necessary function, but one that must be regulated and adapted to the situation. It generally appears in moments of self-defense, but also in pathological situations, such as sporadic impulsive emotions or antisocial personalities (where it recurs). It also increases abnormally in illnesses such as schizophrenia, where it can be a significant risk. The most common source of increased violence is occasional impulsiveness, which accounts for approximately sixty percent of violent episodes. It is a reactive response to circumstances in the environment, such as a violent and disproportionate reaction to an unexpected fight.

Steven Pinker, the well-known Harvard psychologist who specializes in this subject, argues that the arrival of a structure of state control, such as the Leviathan proposed by the philosopher Thomas Hobbes, would be one of the factors that keeps violence in check.⁷⁸ Hunter-gatherer societies were much more violent than today's societies, but because of individual homicides, since wars require structures of command. Nobles and kings thus preferred their subjects to be working rather than fighting or killing one another, because they were more useful that way, and this led to a reduction in social violence at the price of tyranny. Liberal democracies

⁷⁸ S. PINKER, *THE BETTER ANGELS OF OUR NATURE: WHY VIOLENCE HAS DECLINED* (Viking 2011); T. HOBBS, *LEVIATHAN* (R. Tuck ed., Cambridge Univ. Press 1996) (1651).

would face a challenge on this point, which is the importance of establishing a rule of law with a separation of powers that keeps interpersonal violence in check. Perhaps individual and tribal violence should be distinguished from the violence structured by large states and cities.

With the cognitive development of *Homo sapiens*, capacities for inhibiting violent action emerged, especially with the development of the orbital region of the prefrontal lobe, which controls the emotional limbic system. It would seem that the social, administrative and commercial organization of societies, with their social agreements, made this inhibition easier and reduced intersubjective conflict, while also producing a cultural accumulation over time. Pinker says that commerce, with its long-term agreements, and the printing press, which allowed people to communicate and become literate, would have contributed to the decline of violence and war. The ability to read, moreover, may have produced elements of empathy and identification with the suffering of others, for instance by allowing a reader to put himself in another person's place metacognitively, a possibility that probably continued with cinema and now with social networks.

The urge to make immediate and generally emotional decisions could thus be inhibited in the hope of obtaining long-term benefits, and long-term decisions, with a greater rational than emotional component, won out. Pinker also argues that violence in society would have declined as women came to play a more active role and gained greater rights, since young men are, statistically, far more violent. The containment of men through couple relationships, family and fatherhood thus lowers testosterone and the aggressive potential associated with sex and with this hormone.

War is defined as planned and organized violence, unlike spontaneous individual violence involving few opponents. War, then, is not the individual accumulation of violent acts in a community but has a logic of its own, as Jürg Helbling, an ethnologist at the University of Lucerne, puts it.⁷⁹

⁷⁹ J. HELBLING, *TRIBALE KRIEGE: KONFLIKTE IN GESELLSCHAFTEN OHNE ZENTRALGEWALT* (Campus 2006).

Helbling has also studied other nomadic but archaic groups in which there are no wars, only sporadic and spasmodic individual incidents. In this sense we could be optimistic about human violence, since it was not human beings as such who produced wars. Wars took shape culturally once humans became sedentary, which happened only in the last five percent of human history.⁸⁰

Nomadic groups, which were generally small (around twenty-five people), could move away from a territory, since land was generally plentiful, and they had a greater capacity for negotiation. They could thus resolve matters such as adultery through ceremonial duels, or the parties were pacified under pressure from their community, and in this way more serious violence could be avoided. This is also connected with the need for couples to live together, which made possible the symbiotic arrangement between the male hunter and the female gatherer. Any breakdown of this arrangement strongly affected the group, which is why the group apparently tried to press for peaceful behavior.

The human being may be the only living creature that wages war. Although animals do fight one another, in no case do they do so with the planning, the scale and the duration needed for it to count as an act of war. Theirs are simple, spontaneous and impulsive skirmishes that reduce social or territorial conflict, and they take place on a much smaller scale. They could also be described as short-term decisions, whereas war is a planned, long-term decision. At first sight it might seem that violence has not declined today, but compared with other wars, the Second World War would rank ninth among the causes of death from war in world history.⁸¹ First place goes to the internal revolt led by An Lushan in eighth-century China, which, at today's population scale, would have killed 429 million people, compared with the 55 million who died in the Second World War.

⁸⁰ But see Mirazón Lahr et al., *supra* note 70.

⁸¹ But see P. Cirillo & N. N. Taleb, *On the Statistical Properties and Tail Risk of Violent Conflicts*, 452 PHYSICA A 29 (2016).

Proximity and the repeated mention of events would also bear on the subjective assessment we make of violence. The process of inhibiting aggression could be shaped by learning. A statistical study that Pinker presents in his well-known book *The Better Angels of Our Nature* describes how the prevalence of homicide fell from primitive societies and the Middle Ages to the present day. Yet the technological capacity to produce ever more powerful weapons of mass destruction, in a society that has shown it can reduce individual conflict, warns us that states have played very active roles in the making of wars. The transformation of warfare that began with the First World War, when the technological, tactical and strategic paradigms of war changed radically, and that continues in today's conflicts, is a cause of deep concern. The danger shifted from the individual to the social and geopolitical sphere, especially once *Homo sapiens* became urban and states took ownership of conflict.

PART V

Technology and the Mind

THE TRIBALISM OF TRUTH

Several authors observe that the objectivity of ideas is now going through a very critical moment with regard to truthfulness. Political polarization is taking place on a large scale. In Argentina it is called *la grieta*, “the rift,” but it exists to a great extent in countries such as the United States, the United Kingdom and Italy, among others. As extreme positions are defended, arguments are produced that ultimately endanger the subjective understanding of truth. A form of relativism thus arises, which some cognitive scientists call the “tribalism of truth.”

At this stage of the discussion two attitudes can be distinguished. The first is “debating to learn,” something close to a dialogue, which reinforces the relativist ideas that make it possible to accept the other and ends in a convergence of ideas leading to an agreement within a consensus. The opposite attitude is “debating to win,” whatever the truth may be. It is perhaps the more common of the two today, and it produces great polarization and great risks, because it can convince anyone in an almost religious way. This attitude very often shows itself in the media and on social networks, giving rise to so-called “post-truth.”

Post-truth could be described as the repeated lie that tries to persuade people of something its authors know to be unreal. It is a widely used practice today, but not a new one. The saying “Lie, lie, and something will stick; the bigger the lie, the more people will believe it,” often attributed to the dreadful Nazi propaganda minister Joseph Goebbels, was not his invention either, since it is attributed in the first instance to the Greek philosopher and historian Plutarch.⁸²

Many questions have been raised about the international “truths” behind preventive wars, justified by doubtful chemical arsenals of which nothing was later proven. In many recent presidential elections, too, these

⁸² PLUTARCH, *How to Tell a Flatterer from a Friend*, in 1 MORALIA (F. C. Babbitt trans., Harvard Univ. Press 1927).

“truths” have been frankly influential. Such manipulation becomes far more intense with the increasing use of social networks, structures with little fact-checking that can “report” any falsehood without control and amplify it immeasurably and very quickly.

To this must be added the unstoppable growth of population. For hundreds of years the world’s population grew little by little, but today it multiplies steadily, and there are now more than eight billion people in the world, who intensely amplify any piece of news.

The term post-truth gained momentum from a speech Angela Merkel gave in 2016, in which she said that “lately we live in post-factual times.”⁸³ In the same year the Oxford dictionaries chose post-truth as their word of the year, understood as a “negotiable truth,” although in reality it is a lie or a half-truth, used above all on the political agenda.⁸⁴ From then on the term took hold with great force, helped along by the various social networks. There are media powers that replicate these truths in conventional outlets and online forums, and there are trolls on Twitter and Facebook who, seeking the impact that follows, may spread inaccurate data that take effect immediately and, because they are very hard to check, appeal to an ever more anxious online community. Political parties and corporate media know very well how to exploit the phenomena of post-truth through social networks, knowing in advance the impact it will have on the opinion of unwary people.

Our brains are offered an abundant and heterogeneous mass of specific information, scattered across a great many subjects, in a very short span of time. This “cognitive dispersion” makes it hard to take a specific position on contradictions, especially those that agree with the thinking of the person who receives them, because people are less critical of them. Their cognition will often treat the news kindly, more out of emotional familiarity than out of reason, and a large part of the population is left

⁸³ A. Merkel, Statement to the Press Following the Berlin State Election (Berlin, Sept. 19, 2016).

⁸⁴ Oxford Dictionaries, *Word of the Year 2016: Post-Truth* (Nov. 16, 2016), <https://languages.oup.com/word-of-the-year/2016/>.

unprotected. Post-truth is said to operate through “motivated reasoning,” which could be likened to the workings of belief systems, that is, ideas that contain some reason but also emotional components such as partisan or religious identification, or identification with other matters such as politics, sport or ecology.

A “partisan bias” then appears, which would be a cognitive deviation in favor of the group with which a person identifies. There is consequently what scholars of the subject call “confirmation bias,” a tendency to interpret things according to one’s own expectations and one’s own ideology, as the social network researcher Michela Del Vicario explains. In a well-known study, her group describes how a lie on social networks can spread rapidly in a few hours, with one particular feature, which is that it is spread by groups that share an ideology or a group of reference.⁸⁵

This has been studied in the human brain by Drew Westen of Emory University in Atlanta, who observed how the voters of a political party reacted to the candidates’ speeches.⁸⁶ He assessed how their reactions differed depending on whether they heard contradictions from their own candidate or from the opponent. When a person heard a contradiction in a candidate’s speech, functional magnetic resonance imaging of the brain showed activation of the anterior cingulate cortex and the ventromedial prefrontal lobe. These cortical areas become active when negative emotions of pain or stressful situations are processed, which explains in neurological terms how the opposing candidate’s statements provoke people, whereas similar controversies involving their own candidates are forgiven because they are perceived as less serious.

People are thus exposed to post-truth in situations that seem to agree closely with their own views. The premises may be loaded with false assertions and still be masked by the emotional context of those individuals

⁸⁵ M. Del Vicario et al., *The Spreading of Misinformation Online*, 113 PROC. NAT’L ACAD. SCI. U.S. 554 (2016).

⁸⁶ D. Westen et al., *Neural Bases of Motivated Reasoning: An fMRI Study of Emotional Constraints on Partisan Political Judgment in the 2004 U.S. Presidential Election*, 18 J. COGNITIVE NEUROSCIENCE 1947 (2006).

or groups. It is difficult to act against belief systems, which are known to include political, religious and placebo-type ideas that make us trust or distrust according to our affinity with the argument or with the person who makes it. It is just as difficult to go against ideas that are emotionally rooted in the subcortical emotional limbic system, and more difficult still given the rapid flood of information per unit of time, its covert repetition and the varied complexity of the subjects to be analyzed.

Very often, the more forcefully one tries to convince people, the more likely it is that a paradoxical or rebound effect will be produced against the idea one is trying to promote, generating strong resistance to change. The maxim “the more, the less” would apply here. Forceful campaigns that try to change people’s positions often produce positions of resistance instead. Changing a belief, even with rational arguments, can be very difficult, because those arguments are set aside once emotion takes over rational thought. This creates fertile ground for post-factual positions, which take hold among people who believe in something emotionally or who identify with a reference group.

When people “debate to win,” objectivist ideas prevail, with their arguments grounded in emotion and in beliefs that are hard to refute, because what matters is winning. People generally end up convinced that the idea is the truth, even when it contains errors as clear as a wrong result in a mathematical formula. This happens above all in discussions and forums on networks such as Twitter, Facebook, YouTube and Instagram. Virtual networks are gaining ground in online forums that reaffirm ideas which, even when mistaken, could change the criteria of truthfulness grounded in belief systems, that is, criteria based more on faith than on evidence-based truth.

THE MEDIA

One of the newest processes in neuroscience, and one that is now widely studied, is the influence of the media on the human brain, that is, how the environment influences the nervous system and, more specifically in this case, how the media created by human beings to communicate information to their own species do so. A discipline called “media psychology” investigates the behaviors related to these processes and their impact on the brain. One of the points worth stressing is that we should not generalize, a rather common and mistaken habit in media research, whether out of ignorance or out of bad faith.

The first media were probably the cave paintings of prehistory, followed by language, writing and art, down to today’s internet, online search engines and social networks, which have created these new paradigms. Some media, such as social networks, are often prejudged as sources of aggression or of confused mental processes. The World Health Organization has now classified the excessive use of electronic games as an addiction, generalizing to excess and lumping it together with serious substance-use disorders (such as heroin addiction), giving it the status of a disease with classificatory misgivings and thereby inviting possible prejudgment, at the risk of “pathologizing” technological advances.⁸⁷

To see the confusion this can cause, consider that something similar, incredibly, happened with books. In the eighteenth century reading was considered addictive, especially for women, because it “had negative effects on the mind and on virtue.” Scholars of media psychology, such as Markus Appel, argue that the media produce a mechanism by which the person is extended, and that, just as the train or the airplane extends our body to places that were once unthinkable, the media extend the body

⁸⁷ World Health Org., *International Classification of Diseases, 11th Revision*, 6C51 (Gaming Disorder) (2019), <https://icd.who.int/browse/2024-01/mms/en#1448597234>.

deep into the world.⁸⁸ The existentialists would say that they help to “throw us upon the world,” but without the risk of exposing ourselves bodily (although we are exposed psychically). This reduction in bodily tension is probably what produces greater empathy with the media, since the body is left out and the mental, emotional and cognitive load increases.

According to a theory proposed by Edward Deci of the University of Rochester and Richard Ryan of the Australian Catholic University, successful media such as television or social networks appeal to the satisfaction of basic instincts, although not always the same ones.⁸⁹ Among them are the needs for autonomy, for relatedness and cooperation, and for competence. Autonomy would be more closely related to print media, and cooperation and competence to social networks such as Twitter and WhatsApp or to online games. It has not been clearly shown, however, that these games increase aggression. They have, on the other hand, been found to improve attentional *performance*, intellectual speed and reaction time, so they could potentially be used in rehabilitation and in training athletes.

Much has also been said about subliminal processes associated with messages lasting only a few milliseconds, which are now known to have been overstated. There are, however, other subliminal effects through which “silent” messages are transmitted. One of them is the association of rational events with emotional ones, whether negative or positive. This link affects unconscious activity, because it reinforces a concept or an idea emotionally. A product associated with a beautiful landscape or the latest model of car, for instance, can make anything at all be valued positively.

⁸⁸ M. Appel & J. Retzbach, *Hier und doch woanders*, GEHIRN & GEIST, no. 11, 2015, at 38.

⁸⁹ R. M. Ryan & E. L. Deci, *Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being*, 55 AM. PSYCH. 68 (2000).

Mirror neurons are involved in this process. When we watch a person driving, smoking or drinking, our mirror neurons fire for that action, producing a similar feeling and a much stronger identification, which adds to the unguarded emotion that arises on its own. This kind of learning is called “association by reinforcement.” It can be positive if pleasure is associated with a stimulus or idea, or negative if what is associated is unpleasant. The latter can be seen in very common examples such as a photograph of a politician with an unpleasant expression, in which a conscious phenomenon, the recognition of the face, is associated with an emotional and unconscious one, such as the feeling his expression produces because it frightens or repels us. This simple example can be made more complex by using more than one associative process in the same scene.

Another phenomenon used in learning is reinforcement by repetition, that is, studying a lesson more than once in order to learn it. What happens here is the accumulation of the same information across different scenes (which is the basis of “lie, lie, and something will stick”). Another form of repetition is the use of many voices in the same scene sharing the same ideological leaning. This reinforces a concept and also creates the idea of a majority in our brain. The media, in other words, release our bodies, lowering the tension of self-regulation (our control over ourselves), producing empathy and identification and stimulating a system of rest or mind-wandering, which leads to a greater identification with the sender. Media psychologists refer to this last process as “transportation” (that is, immersion in the medium being watched).⁹⁰ It would be similar to the avatar phenomenon found in online games in which a character is represented, at which point sensory areas of the brain are activated, so that the character’s body (and also the *mouse* or *joystick*) is felt as an extension of one’s own body, producing great emotional empathy (in the parietal sensory area and the amygdala, respectively).

⁹⁰ M. C. Green & T. C. Brock, *The Role of Transportation in the Persuasiveness of Public Narratives*, 79 J. PERSONALITY & SOC. PSYCH. 701 (2000).

The observation of a product or an idea, however it is presented, is always charged with emotion, creating a need to possess and activating areas of pleasure and reward (the nucleus accumbens). Or, on the contrary, it may activate areas of distrust and of resistance to believing or consuming (the insular lobe). The struggle between the possibility of trusting a promise that is made and distrusting that it will be kept is what will end in a decision.

Another very important phenomenon is media competence, which is the capacity to make informed choices. Cooperation between parents and teachers is very important in helping children make the right choice in something as complex and multiple as today's social networks or television. Competence may be more complex than that and may have to be taken on as a learning process for all citizens, because it is essential to understand the media as one of the most influential factors acting on the brain and on human behavior.

BIG DATA

For years, scientists from many fields have been warning that the handling of big data, cybernetics and social networks can put the democratic system at risk. This is not only because companies and states can handle personal information, but because they could influence citizens' decisions unconsciously, steering the behavior of individuals and of society in the short and the long term. Specialists call this influence “*nudging*.”⁹¹ Information can be manipulated and can also rebound cybernetically, feeding back into a repetitive group response that will encroach on citizens' instinctive functions.

This feedback can destroy something as important to society as biodiversity is to ecology, namely “social diversity,” which brings heterogeneous ideas, informational self-determination and new minority positions. Suppressing social diversity would open rifts in societies, which would lead to disagreement among people and social groups on substantial points of the social structure, would reinforce polarized, disconnected and often fundamentalist ideas and behaviors, and would also drive political parties away from a social and workable consensus. In other words, networks reinforce the divisive aspects of society, “disaggregating” it. Artificial intelligence (AI), by contrast, increasingly reinforces the joint cybernetic work of computer systems in networks.

The brain is still more powerful than the internet and has more capacity than the largest server, but the amount of information in cyberspace doubles every year, so that, according to some estimates, the information produced in a single year equals everything generated since the beginning

⁹¹ D. Helbing et al., *Will Democracy Survive Big Data and Artificial Intelligence?*, SCI. AM. (Feb. 25, 2017), <https://www.scientificamerican.com/article/will-democracy-survive-big-data-and-artificial-intelligence/>.

of humankind.⁹² It is also estimated that within ten years the amount of information will double every twelve hours, supplied by 150 billion sensors connected in networks. The doors are thus opened to artificial intelligence (AI), which tries to emulate the human brain and has become a matter of state. Hence the creation of the Human Connectome Project and the BRAIN Initiative in the United States, the Human Brain Project of the European Union and the China Brain Project.⁹³ AI raises ethical, bioethical and practical dilemmas that will be very hard to foresee in the future, once it becomes an “artificial superintelligence.” AI is not empathic. It makes economical, efficient and independent decisions, yet it is hard to think of it as ethical, even though it controls societies, weapons and military intelligence.

The cybernetic information system uses the internet, from which it draws macro-information, and this has an intense influence on society. The human brain has some eighty-six billion neurons, each connected between five and ten thousand times, which still gives the brain an astronomical capacity, greater than that of current systems. There are, however, already programs that seek to copy the brain, such as the Blue Brain Project, which tries to emulate it. Its founder, the neuroscientist Henry Markram, estimates that the memory needed to simulate the brain is 500 petabytes.⁹⁴ A Chinese trial of “social credit,” aimed at computerized control of the civilian population, is one of the most questionable of these programs, because people will be scored according to the clicks they make.⁹⁵ This would condition access to visas, credit, education and the

⁹² Helbing et al., *supra* note 91.

⁹³ D. C. Van Essen et al., *The WU-Minn Human Connectome Project: An Overview*, 80 *NEUROIMAGE* 62 (2013); T. R. Insel et al., *The NIH BRAIN Initiative*, 340 *SCIENCE* 687 (2013); K. Amunts et al., *The Human Brain Project: Creating a European Research Infrastructure to Decode the Human Brain*, 92 *NEURON* 574 (2016); M. Poo et al., *China Brain Project: Basic Neuroscience, Brain Diseases, and Brain-Inspired Computing*, 92 *NEURON* 591 (2016).

⁹⁴ H. Markram, *The Blue Brain Project*, 7 *NATURE REV. NEUROSCIENCE* 153 (2006).

other benefits the country provides. A controlling state of this kind would carry out an outright invasion of its citizens' civil rights.

All these programs try to obtain information for supposedly laudable purposes, but with very risky applications, ranging from collecting information from big data to processing it, evaluating it and generating feedback. That feedback can exert a subliminal influence on people of different ideologies. Often it provides nothing more than repeated information about the same thoughts, performing an “anti-gregarious” function. At other times, worse still, it produces persuasive information in favor of the government or its projects. The vast amount of information makes it possible to use data mining and to exert “*big nudging*,” an influence produced through superintelligent analysis of data that takes effect through the growing social power that networks have over us. This happens with networks such as Facebook, which obtain a great deal of information and can exert influence on the basis of it. The state must regulate them to prevent abuses, which may range from unfair effects on consumption to influence on political decisions. This happens above all in election campaigns, as was confirmed by the Cambridge Analytica case in 2016, a “breach” acknowledged by Facebook, which manages a staggering two billion users or more (a quarter of the world).⁹⁶

The problem arises when the companies are the state, because then there is no one to control them. Civil rights, and ultimately democracy, are put at risk. The handling of macro-information comes to produce a kind of hierarchical state monopoly, which European Union researchers call “feudalism 2.0.” In 2016 Cambridge Analytica carried out psychographic studies based on a test it administered to unsuspecting users. It thereby gathered a body of private information that it apparently used for elec-

⁹⁵ State Council of the People's Republic of China, *Planning Outline for the Construction of a Social Credit System (2014–2020)* (June 14, 2014) (R. Creemers trans.), <https://digichina.stanford.edu/work/planning-outline-for-the-construction-of-a-social-credit-system-2014-2020/>.

⁹⁶ M. Schroepfer, *An Update on Our Plans to Restrict Data Access on Facebook*, FACEBOOK NEWSROOM (Apr. 4, 2018), <https://about.fb.com/news/2018/04/restricting-data-access/>.

toral purposes in several countries. In other cases, the loopholes in the system through which information leaks out were exploited directly.

Even social research studies to which people have consented should be reviewed by an ethics committee and by the state, in order to detect any functional or moral problem with the research. The influence exerted by AI appeals to primary instinctive functions such as feeding, aggression, fear, intuition, altruism and sexuality, among others. These are all unconscious mechanisms that can be manipulated by *big data* systems. Disinformation, the splitting of groups, the concealment of data and the production of sophistries and post-truths break the social bonds that tie dissenting groups to a government or a company.

We are still a long way from understanding the whole human brain, given the complex system of networks of millions of neurons of which it is made. This neuronal swarm is called the connectome, and mapping it would require approximately 1,000 exabytes of information (a gigantic unit of computer storage), more than all of Google's servers store, which means that analyzing the nervous system is harder than investigating the largest search engine on the internet.⁹⁷ Yet light-years of progress have been made in the study of how neurons work, and computing will soon surpass us. We are subject to invisible powers that are revolutionizing information, and the quantity of big data keeps growing. It will make jobs and companies disappear, including some of the largest companies that bless *big data* today. Within a decade, it has been projected, 40 percent of the largest companies will have disappeared and half of today's jobs will be at risk.⁹⁸

It is no coincidence that experts and geniuses in the field, such as Stephen Hawking, Elon Musk, Bill Gates and Apple's Steve Wozniak, as well as a group of European scientists (the latter brought together in a "digital manifesto"), warn of the risks of the indiscriminate handling of

⁹⁷ J. W. Lichtman et al., *The Big Data Challenges of Connectomics*, 17 NATURE NEUROSCIENCE 1448 (2014).

⁹⁸ Helbing et al., *supra* note 91.

data, a superintelligence that many of them helped to create.⁹⁹ It is something like the relationship of Einstein or Oppenheimer to the risks of nuclear energy.

Today *big data* is used at their discretion by states and companies, but the hope is that this information will not overtake us as a species. It is to be hoped that artificial intelligence, which can already learn from experience, will not become independent and end up directing our future and even that of states and their organization.

⁹⁹ Future of Life Inst., *Research Priorities for Robust and Beneficial Artificial Intelligence: An Open Letter* (2015), <https://futureoflife.org/open-letter/ai-open-letter/>; Helbing et al., *supra* note 91.

READING PERSONALITY FROM DATA

Artificial intelligence (AI) is growing at an incredible pace. Although it was created by human beings, it can take its own course and teach itself. The algorithms that work toward a diagnosis of personality from big data do not, in fact, reveal how the process that produces that knowledge works. It is, on the contrary, an empirical process, in which AI draws conclusions from millions of data points. All these programs try to obtain information for supposedly laudable purposes, but with very risky applications, since they collect information from *big data*, process it, evaluate it and generate feedback. This is what happens when the five major personality types of internet users are studied.

There are constituent elements of personality, which many authors call “traits,” that is, a set of characteristics that add up and overlap to different degrees to form a type of personality, whether normal or pathological. One of the leading figures in the study of the psychic makeup of personality was Hans Eysenck, a German-born psychologist who did his work at the University of London and who proposed three basic, constitutive and measurable personality traits, neuroticism, extraversion and psychoticism.¹⁰⁰ Extraversion is a personality trait that marks sociability and creativity, neuroticism a trait that involves anxiety and insecurity, and psychoticism a pattern of aggression and distrust.

We must understand that the traits Eysenck described can vary in intensity between two poles (extraversion and introversion, for example), since they are engraved in the normal personality, and that the mixture of them probably shapes each person’s particular character and individuality. They are, in other words, traits that are present and stable in conscientious personality types, but they could run out of control and turn into

¹⁰⁰ H. J. EYSENCK & S. B. G. EYSENCK, *PSYCHOTICISM AS A DIMENSION OF PERSONALITY* (Hodder & Stoughton 1976).

a disorder, in people who will probably have difficulty, for much of their lives, in adapting to the sociocultural structure.

These three traits were later modified by different schools, such as Goldberg's, and two more traits were added. These traits are called the big five personality traits, as established by Robert McCrae and Paul Costa, namely openness to experience, conscientiousness, extraversion, agreeableness and neuroticism.¹⁰¹ This five-trait model (the "Big Five") is also called the "five-factor" model.

A group of researchers at the University of Cambridge led by David Stillwell measured personality characteristics, and even traits such as substance use, from the information supplied by big data, in this case by measuring the Facebook likes of tens of thousands of people.¹⁰² With as few as 300 likes, they were able to predict the big five personality types more accurately than a person's spouse could, and with 70 likes, as accurately as a friend.¹⁰³ In another study, likes combined with facial features from personal photographs yielded information about personality characteristics and intimate details of behavior. The group that runs a website called Apply Magic Sauce, moreover, claims to be able to analyze the personality and characteristics of the people studied from a text of only 200 words.¹⁰⁴ There are health programs installed for people with bipolar disorder that can analyze prodromal symptoms of suicide risk, always with the authorization of the person concerned.

¹⁰¹ L. R. Goldberg, *An Alternative "Description of Personality": The Big-Five Factor Structure*, 59 J. PERSONALITY & SOC. PSYCH. 1216 (1990); R. R. McCrae & P. T. Costa, *Validation of the Five-Factor Model of Personality Across Instruments and Observers*, 52 J. PERSONALITY & SOC. PSYCH. 81 (1987).

¹⁰² M. Kosinski et al., *Private Traits and Attributes Are Predictable from Digital Records of Human Behavior*, 110 PROC. NAT'L ACAD. SCI. U.S. 5802 (2013).

¹⁰³ W. Youyou et al., *Computer-Based Personality Judgments Are More Accurate than Those Made by Humans*, 112 PROC. NAT'L ACAD. SCI. U.S. 1036 (2015).

¹⁰⁴ Univ. of Cambridge Psychometrics Ctr., *Apply Magic Sauce*, <https://applymagicsauce.com>.

The brain is still more powerful than the internet and has more capacity than the largest server, but the amount of information in cyberspace doubles every year. This exponential expansion of online information reflects how artificial intelligence and large data stores are progressively affecting every aspect of society. The growth of data represents both an opportunity and a challenge for understanding and analyzing the complexities of human personality through the lens of big data.

This progressive accumulation of digital data brings us to a point where information is not only stored but also used to actively influence human decisions and behavior. In this context, big data becomes a powerful tool for analyzing and predicting patterns of behavior based on personality. Several studies even show how a group of analyzed subjects can be influenced, through influence that rests on simple consumption choices but uses different strategies. Depending on the characteristics of the group, aggressive campaigns are aimed at extroverted people and a discreet silence at introverted personalities, all on the basis of information obtained from Facebook *likes*, producing results far more faithful than expected.¹⁰⁵

This vast knowledge creates a dangerous situation, because although it can be used for good, its use so far has proved quite problematic, as the course taken in the Cambridge Analytica case shows, where voters' profiles were analyzed and they were influenced secretly and surreptitiously. This road is by no means at its end, and its consequences are truly unpredictable.

¹⁰⁵ S. C. Matz et al., *Psychological Targeting as an Effective Approach to Digital Mass Persuasion*, 114 PROC. NAT'L ACAD. SCI. U.S. 12714 (2017).

THINKING MACHINES

There are several definitions of artificial intelligence (AI). It is generally regarded as a function that tries to imitate human intelligence, since it involves memorization, learning, problem solving and decision-making, and it even tries to surpass the intelligence of *Homo sapiens*. Its forerunner was the first electronic brain, ENIAC (Electronic Numerical Integrator and Computer), built for the United States Army in 1946. It is a highly complex and interdisciplinary undertaking in which many professions take part, from computer engineering to biology, medicine, psychology and philosophy, among others. Artificial intelligence takes the human brain, with its cognitive and behavioral functions, as its model and tries to surpass it. The first studies used the game of chess as their paradigm, in the research of Warren Weaver and Claude Shannon.¹⁰⁶ Alan Turing's famous work from the same period deciphered a language created by human beings and drew an analogy between a machine and the mind.¹⁰⁷

AI involves a process of artificial reasoning, but today the aim is also for it to be able to grasp human empathy and represent it. AI seeks to develop problem solving, but with creativity and decision-making, and with ever more information in less material and less time. At first it used inorganic materials, such as silicon, as the material best suited to developing artificial neural networks. Molecular biologists, however, have argued that the best structure for storing information is DNA, that is, a similar biological material (materials of this kind have already been synthesized). Everything from a book to a film has thus been copied into the DNA of a bacterium.¹⁰⁸

¹⁰⁶ C. E. Shannon, *Programming a Computer for Playing Chess*, 41 PHIL. MAG. 256 (1950).

¹⁰⁷ A. M. Turing, *Computing Machinery and Intelligence*, 59 MIND 433 (1950).

¹⁰⁸ S. L. Shipman et al., *CRISPR–Cas Encoding of a Digital Movie into the Genomes of a Population of Living Bacteria*, 547 NATURE 345 (2017).

This memory-storing material has the potential needed to record information and then to run *software* on it. Different forms of AI thus become possible, from robotics to large networks or intelligent nanotechnology, among others. There are robots that work alongside human beings and others that direct them outright. There are also mixed systems in which a brain-computer connection has been achieved, such as occipital implants that enable sight, and motor and auditory implants. Mini-drones have been built, such as robot bees designed to pollinate or to spy, and these AI bees have even been made to work as a team, with a kind of working interrelationship. Stranger still are the hybrid structures combining real insects and robots, in which devices are inserted into the insects and communicate with them. Because drones run out of power very quickly, insects have been developed with built-in electronic systems, forming hybrid organic and inorganic mini-drones. There are even more complex and controversial projects, such as robots that make autonomous decisions and others that propose giving AI empathy. Work is under way on systems that recognize the features of empathy (faces, voices, intonations, acts and gestures, for example). The aim is for them to respond in kind as well, although achieving some degree of emotion will be harder. Once again, science fiction resembles and anticipates reality (2001: *A Space Odyssey*, *The Terminator*).

Two key concepts must be understood in order to emulate the workings of the brain. The first is the study of the brain's complex connections, called the connectome, which investigates the enormously complex set of connections among the billions of neurons in the brain (some eighty-six billion neurons). The second is understanding neurotransmitters with their different receptors, that is, keys with various locks that open many doors. This produces a system offering millions of variables that ultimately bear on gene expression. Gene expression ends up becoming the synthesis of proteins as function and information, which will be configured in the brain as learning.

The nervous system is made up of one of the few kinds of excitable cells in the human body, neurons (muscle cells are another). These cells work with energy, independently, and this can be measured, for example, with an electroencephalogram. This energy is also part of the code in

which neural language, the basis of intelligence, is generated. The number and size of neurons, their connections, their chemistry and their electricity thus make up the structural basis of intelligent functioning. This organic system can be emulated by inorganic systems, such as the computer based on silicon networks. Work is now also being done on organic and hybrid systems, the latter mixing organic and inorganic material.

The assistance and collaboration this intelligence can offer human beings is now being discussed, but artificial intelligence can also be applied to weapons. It could thus produce an imbalance as serious as, or more serious than, the one seen in the First World War, when the industrial revolution was suddenly applied to a war in which that revolution was tested on human beings. The war began on horseback and ended with airplanes, submarines, chemical weapons and heavy artillery, killing ten million people and leaving thirty million seriously wounded or maimed, something never before seen in human history.

Artificial intelligence raises ethical and bioethical dilemmas, and it will be very hard to predict the future once AI is empathic, makes independent ethical decisions and handles weapons and military intelligence. This artificial intelligence will also use the internet, from which it draws information, until it is able to influence society intensely. A recent report by the World Economic Forum says that AI could increase employment and the revenues of companies, which, read superficially, can be misleading, since the report makes clear that this applies only to companies that invest in it.¹⁰⁹ What it does not discuss is what will happen to the companies that do not, or what would happen if all of them did so at the same time, for how could a robot that replaces thousands of people increase employment?

For now, the only way to analyze the connections of a human brain in all their complexity is with a computer program. The human brain has so many connections that it would be equivalent to an extreme quantity of information, some 1,000 exabytes, more than all of Google's servers store,

¹⁰⁹ World Econ. F., *The Future of Jobs Report 2018* (2018), <https://www.weforum.org/publications/the-future-of-jobs-report-2018/>.

as the cell biologist Jeff Lichtman of Harvard University points out.¹¹⁰ It would be materially impossible for researchers to analyze a human brain by counting its connections without the help of computing. To complete the study of human consciousness we would therefore, paradoxically, have to use an artificial computing system. Questioning Descartes's premise "I think, therefore I am," it might become "I use a computer, therefore I am."¹¹¹ The possible future of AI will be something resembling conscious human beings, but with a high level of complexity and far greater potential. AI must be regulated. The question is how this will be done in so anarchic a world.

¹¹⁰ Lichtman et al., *supra* note 97.

¹¹¹ R. DESCARTES, DISCOURSE ON THE METHOD pt. IV (I. Maclean trans., Oxford Univ. Press 2006) (1637).

CAN A MACHINE BE CONSCIOUS?

Some neuroscientists and philosophers of mind ask whether machines could come to possess an artificial intelligence (AI) that reaches levels of consciousness, in other words, whether they could become so complex that, besides learning from every experience, they would come to possess self-awareness, that is, subjectivity. AI involves a process of artificial reasoning, but today the aim is also for it to be able to grasp human empathy and represent it. AI seeks to develop problem solving, but with creativity and decision-making, and with ever more information in less material and less time. The question is whether machines will be able to attain self-awareness and social cognition.

Self-awareness, or metacognition, could be described as the intellectual elaboration of who we are, where or when we are and, in general terms, what we are doing. It also implies the possibility of discovering ourselves, of sitting in judgment on ourselves and of changing our decisions accordingly. The human psyche works as though the brain were innate “*hardware*” that stored learned cognitive and emotional information as “*software*.” That *hardware* starts working very early in the infant through basic activities. Social cognition and metacognition would be two basic activities of subjectivity, and the question is whether AI will be able to achieve them. Social cognition gives us empathy, a function that makes it possible to understand intersubjective relationships. It is the capacity to understand the other, as distinct from metacognition, which is the capacity to understand oneself.

In order to relate to other members of its species in such complex ways, *Homo sapiens* had to develop highly elaborate cognitive processes, which would have contributed actively to interpersonal impact. Understanding what is happening to the other would be an “intersubjective metacognition,” called “social cognition” or “theory of mind.” One of the most prominent researchers on human consciousness, Christof Koch, chief scientist of the Allen Institute for Brain Science in Seattle, believes

that if this were to happen with machines, they would cease to be human instruments and become ends in themselves, something that science fiction has anticipated, from the classic *The Terminator* to *Black Mirror* or *Travelers*.¹¹²

There are two opposing hypotheses on this point. Some consider what might happen on the basis of the theory of the “global workspace,” or “blackboard architecture,” supported by Stanislas Dehaene, a neuroscientist and philosopher at the Collège de France.¹¹³ This theory posits the nervous system as a network or blackboard that can learn its way to subjectivity, which means that the functional connectome, and not the structural substrate (our basic brain *hardware*), would be the basis of consciousness, and this would allow a machine to have consciousness or to copy it. This position is endorsed by the distinguished scholar of consciousness Jean-Pierre Changeux of the Pasteur Institute in Paris.

Other scientists and philosophers of mind support integrated information theory, based on the “identity of structure.” In other words, “it is not only function,” and the physical structure of the neuronal components, and not merely their functional organization, must be taken into account in order to reproduce or generate a consciousness. This concept of integrated consciousness, devised by the neuroscientist Giulio Tononi of the University of Wisconsin-Madison, puts forward the idea of the integration of consciousness not only in the human brain but also in other animals or in any matter that can contain information.¹¹⁴

The last question is whether consciousnesses can be copied or installed in a computer or in another brain. Some argue that reproducing

¹¹² C. KOCH, *THE FEELING OF LIFE ITSELF: WHY CONSCIOUSNESS IS WIDESPREAD BUT CAN'T BE COMPUTED* (MIT Press 2019).

¹¹³ S. DEHAENE, *CONSCIOUSNESS AND THE BRAIN: DECIPHERING HOW THE BRAIN CODES OUR THOUGHTS* (Viking 2014); S. Dehaene et al., *A Neuronal Model of a Global Workspace in Effortful Cognitive Tasks*, 95 PROC. NAT'L ACAD. SCI. U.S. 14529 (1998).

¹¹⁴ G. Tononi et al., *Integrated Information Theory: From Consciousness to Its Physical Substrate*, 17 NATURE REV. NEUROSCIENCE 450 (2016).

the functional structure of the connectome could generate the same consciousness, but specialists in integrated information theory disagree. They hold that what will be required is a brain structure with the same causal properties, built up by genetics and epigenetics over the course of a lifetime, that is, the same *hardware*, or the same neuronal blank slate together with the environmental changes that followed. It would amount to a kind of dubious immortality, lasting as long as the machines or clones endure or until some accident cuts them short. It sounds like science fiction, but it is not so far from reality.

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