Chapter 3
What Is Social About the Human Brain?

The first neuroscientist to focus exclusively on the social nature of the brain was Leslie Brothers. Her observation is worth repeating: "while our individual brains are singular and self-contained, the *processes* on which they depend for functioning are social ones. We have seen that there is no fully working human brain without the presences of other brains. The functioning brain is social in the sense that any given brain is completely dependent on other brains for its development. Without question, the synaptic brain is contained in our individual skulls but the intangible thought processes which these synapses make possible depend on a social environment with other actors who are engaged in everyday public discourse and interaction" (Brothers 1997 and 2001).

In Brother's words, "Just as chromatin proved to hold the key to the mystery of inheritance, human conversation holds the key to the mind" (Brothers 1997:xii). She suggests we take the first step in bridging the gap between minds and brains by acknowledging that cultures arise from the mutual influences which humans have on each other. "This linguistic framework forms the living content of mind, so that the mind is communal by its very nature: it cannot be derived from a single brain in isolation" (Brothers 1997: xii).

Therefore it is important to identify what is meant by the term "social." Certainly it means more than the presence of other similar bodies or gregariousness. Most young mammals are gregarious. We become socialized in the social psychological sense when the other person's anticipated response is incorporated into our own developing lines of action. Traditionally sociologists have referred to this process as role-taking and treated it as a part of a theory of self-awareness, but we now know that much of the social attunement and coordination which comprises social interaction is completely outside of our consciousness. Although this lack of consciousness does not challenge the critical part that self-awareness plays in the flexible self-control of human behavior, it does mean that the social aspect works on two levels, the conscious and the unconscious. In further chapters we shall see that major aspects of the unconscious are riddled with the cognitive and the symbolic and that to ignore this fact is to leave out at the least one-half of what is social about our brains.

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Intersubjectivity

Any discussion of our communal natures, and what we mean by the social must deal with the fact that while we are all different individuals, most of us must live in a world we see as common to all of us. The in-depth answer to this is the concept of intersubjectivity which Brothers uses adroitly.

Intersubjectivity is best understood by asking what a society would look like if we were all individualist empiricists. If pressed on the point, many of us might assume that knowledge is based on direct observation. Some theories of how we go about knowing the world are asocial and some are social. The traditional empirical epistemology is particularly congruent and supportive of individualistic societies with their asocial focus on the private. Originally empiricism relied on fact, seen as in opposition to theory, and fact was gathered by the individual's private senses.

But to one person standing on a hill, the shape of a tree may look very different from that observed by a person up close to it. The problem with this is if we rely purely on observation, there would have to be two trees. That would be what pure observation gives in this case. If the empirical "world of appearance" to the individual alone is all we accept, then the two persons are isolated from each other in their two different perceptual worlds.

Our Social Natures Win Out. Regardless of our empirical predilections, people of all ages and societies opt intuitively for the existence of a common world. The idea that there are two separate, objective trees offends our sensibilities regardless of how consistent this is with our culturally given commonsense epistemologies. Why this pervasive intuitive rejection of logical consistency? It is because the belief in a common world, regardless of our diverse subjective experiences of it, is the *sine non-quo* of human connection and society itself. Nonetheless, it took more than a few decades for the old empiricists to realize that the assumption of the isolated individual, relying on his biologically given senses alone, could never produce objective knowledge. It could never produce knowledge transcending the inherent differences among the subjective and/or *perceptual* worlds of diverse, private individuals.

Northrop (1948) reminds us that Heraclites had hinted at this during the dawn of Greek philosophy: "Those who are awake have a common world; those who are asleep turn in their private worlds." Northrop updates this more concretely:

> (A)s Albert Einstein and most expert scientists who have examined with care the methodological foundations of scientific knowledge clearly recognize, the belief in an objective, public world with scientific objects in it the same for all observers, is a theoretically inferred, not a purely empirically given knowledge (1948, 43).

O'Neil (1970, 94) states that this notion of an objective world is based on the "naïve and massive everyday assumption that there is a world which, despite the variety of view points and circumstances, we nevertheless think we hold in common." It is to this abstracted common world that we appeal even to settle our differences. While such a world gives a sense of consensus, it is also necessary for the existence of arguments. *Without the assumption of one common tree, discussants*

would have nothing to ague over. There would be two trees and no problems. Except that society could not exist. Disagreement is only real if it is over the same subject matter. Otherwise we are talking past each other and not really talking to each other at all. This is what makes the intersubjective essential for human discourse and communication.

The conclusion to the above is that the assumption of the common world arises out of human talk. This in turn is the answer to Simmel's question of what makes society possible. We become part of each other through intersubjectivity and symbolic discourse. As Schultz (1967) suggests, intersubjectivity is the essence of social life, without it, social action is impossible. It is indeed ironic that the objective world as it "really" is – Kant's "thing in itself" – the scientific world is given through human talk. But the fact that it is necessary for human conversation cannot be seen as its cause. This would be teleological. A cause has to come before an event. Intersubjectivity is caused, if not guaranteed, through the human brain's mirror neurons and our tendencies for the imitation of others. Nature and nurture must work together.

Intersubjectivity and Neuroscience. The term intersubjectivity was coined in sociology by the noted phenomenologist Schultz (1967). For Schultz, intersubjectivity is the essence of social life without which social action is impossible. Not only do human beings with different actual experiences of the same things convince themselves that they nevertheless live in a common world, but part and parcel of this process is the awareness of the independent lifeworld of another. This leads us in the direction of role-taking from a sociological viewpoint and mind-reading from a cognitive neuroscientific viewpoint. Both perspectives understand that humans do not only respond to each other's bodies as much as they respond to each other's cognitively created persons or selves.

Cozolino (2006: 300) joins Brothers in warning against "neuroism," which encourages us to consider each individual as a given. But he also emphasizes that individuals cannot be separated from the group. We are always involved in a context of mutual cooperation. Since neurons are as social in regard to other neurons as individuals are to each other, the interconnectedness of neurons must be our unit of analysis just as surely as the interconnectedness of individuals is the focus for social psychology.

Our bodies guarantee a part of this sociality. Gregory (1999), for example, reminds us that neonates 3 weeks after birth adapt their brain waves to those of their mothers. Many of us will remember the study by McClintock (1971) of the synchrony of menstrual cycles of women sharing dorms. Gregory points to "rhythmic entrainment in dance and music and as well as with persons engaged in sawing and hammering in the presence of each other" (Bernstein 1967). Then there is the matter of imitation discussed in a later chapter. Imitation is significantly more complex than it sounds and has much to do with our human connectivity and what holds us together. Dijksterhuis (2005) summarizes these tendencies: "a process of behavioral adjustment ensues in which behavior or behavioral patterns are, often subtly, brought more in line with the behavior of another person." Gregory (1999: 254–256) summarizes studies of a variety of unconscious mutual adaptations and then shares

studies of his own. Both on the conscious level of minded behavior and on the unconscious level on which most of our brain works, we are social to the core.[1]

The Construction of Persons and Their Subjectivities

Another way of revealing the social nature of the brain is to look at ways it contributes to interpersonal connections. On the social level this connection can be seen in the languages, and especially significant symbols, are prerequisites for intercommunications. On the face-to-face level it can be seen in the way we relate to each other as persons with inner lives. Cognitive social psychologists talk about "theory of mind" which overlaps closely with Brothers' "social editor," but the latter is more specifically involved in brain areas per se than is the case in the literature on "theory of mind." Theory of mind does not refer to the scientists' theory, but to the observation that all normal humans beings learn to invest each other with minds that are separate and distinct from their own.

We have seen that both socially minded neuroscientists and sociologists are fighting a battle against the ideologically distorted model of the self-contained person portrayed by so many psychologists, sociologists, and self-help writers. This model has been decried for some time by eminent representatives of all the social sciences. Now we can add to these social psychological reformers many prominent neuroscientists including Leslie Brothers and Michael Gazzaniga who authored *The Social Brain* in 1985. The social nature of the brain for Gazzaniga comes from his discovery that the conscious, linguistic side of the brain acted as a compulsive interpreter of events and as a coordinator of the brain's many mute, modular parts. Brothers' treatment locates many more social aspects of the brain and thus will be our focus here along with more recent contributions by Cozolino (2006). Probably the most influential cognitive psychologist stressing the social nature of the brain and its dependence on broader society is Cacioppo (2002).

Language, the Brain, and the Construction of One's Self and Others

We have already noted Brothers' position that it takes numerous brains to make one brain work and that these numerous brains do not work without language. She goes on to say that an observable external body becomes an intangible *person* when it is perceived by the actor to own a conscious subjective experience. Strange as it may appear to us, this perception is not an inevitable observation but has to be imputed by the active interpretations of special parts of the brain. Brothers goes to some effort

[1] You will remember here that most of this unconscious is in the service of functions in which we have no interest, like the working of the anatomical nervous system or the control of body temperature and breathing.

to present the process of constructing other persons as "problematic" rather than seeing it as so obvious that it needs no explanation. We are so used to perceiving "persons" that it is hard to imagine how it could be any different from the way it is. But we do not literally *see* other peoples' inner lives. Something else must be involved that is "read into the world" by the actor with the help of language, the brain, and the gestures of other persons which we then interpret.

Words as Mere Sounds and Words as Meanings. The difference between hearing the mere *sound* of a word and taking its linguistic meaning is obvious enough, but understanding the processes which combine these two is critical to understanding how we become compelled by our brains to construct other selves. We are so used to believing that we *hear* the meanings of words rather than *thinking* them that it is very hard to disentangle literal sounds from their cultural meanings. Nonetheless, if we think we hear words primarily with our ears we are quite mistaken. It is impossible for me now merely to "hear" the sound of the word "help" without reacting to its meaning. A young man hearing a beautiful woman say how much she adores and loves him is not going to be occupied with the different *sounds* of "love,", "adore," and "you." Even in the most mundane cases we are literally compelled to hear only the semantic or meaningful aspect of words. Some aphasics hear word sounds accurately enough, but fail to take the next step in conceiving meanings (Brothers 1997:4–5). It is hard for me now even to remember specific words whose actual sounds per se once came to my attention, although I can distinctly remember in my youth thinking how strange some words sounded. After a significant amount of effort I have just now remembered liking the sound of "Caledonia" because to me it had such an exotic ring. However, that is a matter of its personal sound as perceived by me and has not one thing to do with how the word is used publicly to refer to a place in Scotland. Our language deceives us once again by using a purely sensory term like "hearing" to describe understanding verbal communication. The term "hearing" leaves out the most important half of the story. The *sounds* of human discourse are of secondary importance. One could ask a partner "did you hear me?" and the other could answer with a literal "Yes," without knowing a thing about the *meanings* of what she actually said. Sounds are just publicly shared vehicles for linguistically formed, and thus socially relative meanings. The term "hearing" which attributes comprehension to the ears alone, leaves out the work that must be done unconsciously in the immensely complex part of the brain called Wernicke's area which enables us to render these sounds (or hand gestures) into meanings.

This area is usually located in the back top of the temporal lobe of the left-brain and is intimately involved in the comprehension of spoken language. It is connected by neural pathways to Broca's area which enables speech production and is more to the front of the brain above the temporal lobe. It is Wernicke's area in back of the temporal lobe that gives us a natural push to hear meanings rather than sounds. Likewise, we do not simply see mere bodies but we are compelled to perceive people who have them. Brothers (1997:4) refers to the philosophers Ayer and Strawson who argued that the connection between the concept of a person and an inner life is not a logical though it is absolutely taken as such to us.

Around the age of 6, bodies come to have this semantic aspect (though it takes several years more to become proficient role-takers). As with verbal meanings it becomes impossible just to sense appearance, bodily movement, voice, and face. Instead, we read the face's meaning as a "persona." Brothers' argument is that just as we are biologically prepared to learn a language (that is to "take meanings" and be unaware of mere sounds), we are also biologically prepared to subscribe to the concept of the person with an inner life. Note that a biological "preparedness" to construct persons does not rule out the equal importance of social interaction and especially an ongoing linguistic order which the person draws on to create semantic selves and intersubjectivity.

Misidentification Syndromes

Since the unconscious by definition works in silence, we often have to wait for its malfunctioning to appreciate its accomplishments. Patients suffering from the various "misidentification syndromes" are cases in point. The causes of these maladies are found in brain lesions, most of which are diffuse. A patient may feel that they are someone else or that someone else was taking over their brain. Brothers gives evidence that in contrast to the specialized and relatively delineated Wernicke's area, one's own mental life and that of others is encoded in widespread regions of the brain.

She makes a telling argument that our ancestors began with a brain system specialized for perceiving and responding to bodies and their gestures and that a slight modification of this system enabled us to generate the precepts of persons and their minds. This type of emergent change is quite common in evolution, and the brain has been aptly labeled one of the world's greatest tinkerers, taking pre-established structures and changing them for new structural adaptations.

The Brain as Social

Brothers (1997:13) starts her argument for the social nature of the brain by pointing to the finding that 40 newborn infants who were all of 9 min old were much more likely to follow a face-like picture with features in normal positions than one with features out of place or a blank shape of a head. The fixation on the mother's face is an obligatory brain stem reflex that ensures "imprinting" of this vital social information." In one study, 7–11-week-old babies looking at adult faces shifted their gaze to the eyes when the person was talking even though one might think that the more pronounced movements of the mouth would have been more interesting. The suggestion is that the expressive movements of the region around the eyes attracted this early attention. Within 36 h after birth, infants imitate adults as they open their mouths and stick out their tongues. According to Brothers (2001) even blind infants exhibit a social smile. Smiles imply the other side of the early connection equation.

A smiling baby with great big eyes is hard for many adults to resist. Studies like these imply an innate predisposition of infants to establish and maintain rapport. In the months following birth these motor reflexes decline because they have done their job and can leave things to the cortex's more flexible mode of operation. These findings strongly suggest a hypothesis that we have a brain which predisposes to the social.

While being cautious not to reify the different capacities of our two brain hemispheres, the left side seems usually given to linguistic functions and the right side tends toward to recognition and interpretation of emotional expression. These observations lead Brothers (1997:15) to suggest that;

> . . .The child does not attach utterances to persons because of logical, abstract necessity. Instead utterances are intrinsically attached to persons because language perception (in Wernicke's area) shares the same neural ensembles that encode expressive faces and voices.

The brain's representations of facial and vocal expressiveness form the developmental core of the representations we call the "person." Brothers builds to a description of what she calls the social editor: a system of brain regions that serves powerful social interests and encourages the brain as a whole to report on features of the faces of others and the broad social environment.

The Brain as Social Editor. As Brothers (1997:61) summarizes;

> "The social editor" is a set of structures in the anterior temporal lobe and areas related to it that evolved to select certain neural ensembles in sensory cortices which encode social features and link them to action dispositions.[2] Brain areas which comprise the social editor are discussed as follows.

The Amygdala. The brain's social editor revolves around the amygdala and related structures such as the orbital frontal cortex, anterior cingulate cortex, fusiform facial area, and temporal lobe. The insular and somatosensory cortex[3] are somewhat involved also. The fusiform face area integrates information relating to the identification of faces and their expressions. As faces change so do the regions drawn on for their identification and analysis (Cozolino 2006: 58). When emotion is identified in faces, the amygdala starts the process of sending this and other facial information to the fusiform face area and integration region in the occipital lobe (Fig. 3.1).

The amygdala is best known for its function as a warning system but this characteristic is intertwined deeply with its function as the key actor in the social brain.

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[2]An action's potential or "impulse" is an explosion of an electrical charge that sends information down from its origin in the cell body to another neuronal cell. This is created when a stimulus moves a resting neuron to increase its charge enough to fire its message. All action potential are the same. There are no differences in the quality or speed of any neuronal cell. The resting potential of a neuron is about –70 mV. This is +70 mV more than on the outside. At rest there are more potassium ions inside the neuron than outside and more sodium ions outside the neurons than inside. This depolarizing current causes a neuron to fire when it reaches –55 mV.

[3]Perhaps Brothers does not talk about the insular because it is so deep inside the temporal lobe that exploring it has only recently been made possible.

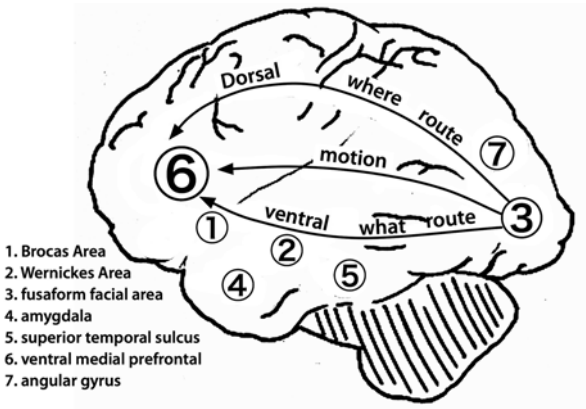

Fig. 3.1 Dominant parts of the social brain

As Brothers informs us, "One's brain must detect and report on social events – the more quickly and accurately, the better." It is a complex system of 12 interconnected nuclei with various sensitivities for attention, learning, and emotional memory. It's almond-sized structure sits on the end of the hippocampus of the limbic system on a plane with the front of the temporal lobe. It is activated in different parts by different aspects of faces. For example, the right hemisphere of the amygdala becomes activated when emotion is seen in another person's face. Unfamiliar faces activate the left hemisphere of the amygdala but it is important to see facial recognition as produced by a whole system involving the areas discussed below. The amygdala does nothing by itself. LeDoux warns us that, on its own, it is just a piece of meat.

Because of the amygdala's connection with other regions, it becomes a part of the neurosystem that can actually process information and control behavior. The amygdala begins working as early as 8 months into gestation and allows for startle and/or fear responses even prior to birth. It makes split-second assessments at speeds of less than 100 ms as to whether something is good, bad, or dangerous. Frequently it will be dead wrong, but because of its speed it can sometimes be life saving. At speeds like this the amygdala is too fast for consciousness. The direct connection of the amygdala to the autonomic nervous system serves to translate its appraisals into immediate survival reactions (Cozolino 2006: 164). It can evaluate something before our prefrontal lobes have determined what it is. Speed and vigilance characterizes the amygdala. But these are not its only functions.

The amygdala and the hippocampus are both heavily involved with enabling memory. This means both parts of the brain are involved in learning because a lesson forgotten is not a useful lesson. Learning implies memory (Fig. 3.2).

Cozolino points out that the amygdala is quick to learn and slow to forget. Traumatic experiences in warfare exemplify the lasting power of amygdala-driven memories. Many soldiers with post-traumatic stress disorder have found that once at home these memories never leave them and the war goes on in their memories, waking them with a start from their sleep. More than that, the amygdala has a strong

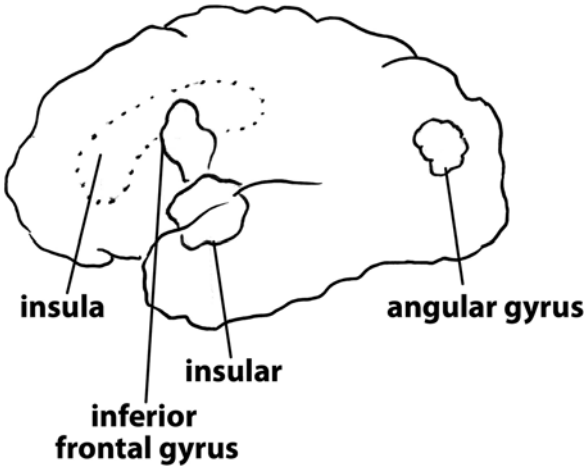

Fig. 3.2 Brain areas involved in autism

tendency to generalize to similar situations. As fearful situations subside, the more thought-based orbital prefrontal lobes take over.

Some patients who had amygdalas which were traumatized while other neighboring brain areas were left undisturbed had difficulties in recognizing fear in others' faces. One such patient had similar difficulties in understanding facial expressions and also in ascertaining the direction of gaze. Brothers (1997:49) describes a patient who was electrically stimulated in his left amygdala making him feel that he did not belong there – like being at a party where you are not welcomed.

Since the amygdala is the hub of the social brain, its evolutionary development is worth attention. It has evolved from an organ processing smell in those animals that depended on odor for purposes of communication. As primates became more dependent on social interaction, the amygdala became more and more specialized to vision. At the same time, the primate face increased its capacity for expression as dependency on group coordination increased. The lateral part of the amygdala in humans increased greatly in size during the same period in which the human cortex increased. As a result of these evolutionary developments, the amygdala became involved in transmitting and receiving messages from the face, which itself was developing into a complex area of 7,000 possible expressions. Since the amygdala is also involved in assessing sounds and touch, it remains a vital part of the social brain built to facilitate speedy and subtle social interactions (Brothers 1997 and Cozolinio 2006). The amygdala is a key component in neural networks associated with fear, attachment, unconscious learning, early emotional memory, and emotion across the life span. Damage to this area causes difficulties in visual memory, as well as in auditory recognition of fear and anger in others. Not surprisingly, this results in a loss of social judgment, loss of ability to communicate and the capacity to read faces. According to (Cozolinio 2006: 167) the primary role of the amygdala in the social brain is to modulate vigilance and attention in order to gather information, remember emotionally salient events and individuals, and prepare for action. While

the amygdala is perhaps best known for its fear responses one must remember that this overlaps with its broad social functions.

The Prefrontal Cortex. When compared to total body size, our cortex occupies three times as much of the area in the brain compared to total body size as is true in other primates. The increase in cortex size is in the association areas of the brain and the prefrontal cortex, which integrates cognition and socially relevant emotions. The left hippocampus, specializing in memory, is involved in connecting a name to a face. Other functions like location and motion of the same person (which are not so intimately involved in social interaction) involve different brain areas (Cozolino 2006: 58). The amygdala triggers a neurotransmitter enhancing and amplifying patterns of neuron firing related to social events. The OMPFC (orbital medial prefrontal cortex) sits at the apex of the neural networks of the social brain and is as much an extension of the limbic system as it is a full citizen of the cerebral cortex. This is why any reified notion of the limbic system as a self-contained primitive brain is a misleading reification.

The OMPFC is associated with cognition and conscious deliberation as well as rational decision-making, but only in interaction with its surrounding structures. The OMPFC is thus a conversion zone or an association area integrating internal bodily sensation with external information. This makes it essential for conscious feeling and especially the regulation of signals from the often-overactive amygdala. However, this emotional control is hampered by the fact that the amygdala works much faster than the conscious awareness of the OMPFC. In addition, we have seen that the amygdala's supply of neuronal circuits working up on the cortex is much more robust than the neuronal circuits of the cortex working down and exerting control on the amygdala. In addition, high levels of amygdala activation and the hormones this produces inhibit the OMPFC and we lose our ability for detached reasoning.

In Brothers' view, the different areas involved in perceiving facial expressions are specialized enough to be seen as a subsystem for social processing and is biased to seek social information.

The Fusiform Facial Area

This is the association area of the occipital lobe dedicated to the identification of faces. According to Brothers (1997:xiii) "the primate brain evolved to send and receive facial gestures and now deploys these (gestures) as an essential part of discourse."

The loss of the ability to recognize faces is known as prosopagnosia and is the cause of intense grieving by its victims even though they may know through other senses that the person in front of them is someone close to them such as a parent. Information from this area is sent to the amygdala. As we have seen, if a face contains emotion, the fusiform face area (FFA) sends its representations to the amygdala's right hemisphere. Data from unknown faces that need to be evaluated

are sent to the amygdala's left hemisphere and if we need to name a face, the FFA sends the message to the left hippocampus.

There are three tracks of visual processing involved in getting messages from the FFA to the conscious prefrontal cortex. The dorsal track deals with *where* the face is (i.e., its location in space). This track projects up and forward through the parietal lobe. The ventral (bottom) track deals with *who* the face is (recognition and identification). It goes to the temporal lobes and then to the prefrontal cortex. Finally, there is a middle track that goes to the frontal lobes and has to do with visual attention and *direction* of eye gaze.

The Temporal Lobe. In addition to the FFA, the superior temporal sulcus and the amygdala are the areas primarily responsible for face recognition although many other brain areas are involved as well. More generally, the temporal lobe houses areas specialized for the sound of the human voice but this is much less understood than is the way we process facial expression. The upper bank of the central superior temporal sulcus (STS) on the outside of the brain responds to voices but not to other auditory stimuli. This suggests an exclusive dedication to the sounds of human communication – thus language. The back of the upper temporal lobe is considered the site where perceptions of gestures normally accompanying speech are integrated with information from the eyes and mouth.

The temporal lobes have a distinctive place in the history of neuroscience and in the argument for the social brain. According to Brothers (1997), as early as 1930 neuroscientists found that lesions in the front temporal lobes of aggressive macaque monkeys made them very docile. At that time no one saw this as particularly relevant since there was no significant interest in neurological social processes. In 1976 Arthur Kling imposed similar lesions, but kept the monkeys in social groups rather than in isolated cages. In this more natural context it became obvious that the monkeys were normal in general behavior with the exception of having significant trouble dealing with social cues. By that time the significance of this difficulty was appreciated and the first steps toward the social brain hypothesis were initiated. Similar observations were still lost on some researchers who in one situation reported by Brothers (1997) were only interested in visualization. They found that some neurons in the temporal cortex fired selectively and exclusively in response to hands and faces. These findings by scientists with interests other than the social brain were instructive because researchers from very different perspectives were finding the same results.

By 1999 social brain researchers were finding more evidence for their hypotheses that in humans the amygdala, the cingulated gyrus, the temporal lobes, and the prefrontal lobes (all of which are highly interconnected into a modular system) contained socially dedicated circuits. They discovered that gaze directions and facial expressions were processed in dedicated neural units and ultimately were combined to yield a perception of the person. Later the superior temporal sulcus (STS) was found to be the home for mirror neurons which allow us to literally feel what others are feeling. This establishes the critical part that the prefrontal cortex and especially the STS play in the social brain. If one is impressed with the complexity of brain areas involved in the social brain, there is even more to come.

The Insular. The insular is a new kid on the block in three senses. It is a relatively recent evolutionary development. It does not exist in non-social animals. It is another part of the human brain that has undergone a huge expansion as apes and humans developed to their present form (Fig. 3.3).

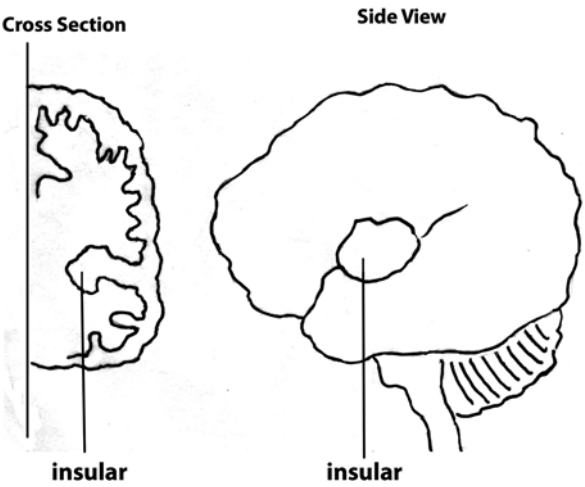

Fig. 3.3 Placement of insular

It is also new to neuroscience because until the fMRIs came on the scene there was no way to get at it. Until recently it was mistakenly thought to be restricted to eating and sex, primitive parts of the brain that few self-respecting neuroscientists, biased as they were toward the cognitive, wanted to study. Thus, interest of researchers in the area is a new development.

In infants, the insular is on the surface of the temporal lobe, but soon the frontal and temporal lobes grow over the insular so that electrodes are ineffective in reaching it. This meant that until Damasio's work in 1994, a large part of the brain puzzle was missing. The insular brought the entire body underneath the brain into the picture. The insular puts the body into emotion. If you were looking downward close to the edge of the Grand Canyon you might have a very uncomfortable feeling run through your body – some may feel it in their stomach and others in their thighs. No doubt after the tragic shootings by a student at Virginia Tech, the compelling speech by Professor Nikki Giovanni to fellow mourners sent chills through the bodies of many in her audience. We can distinguish these responses from the activities of mirror neurons because here we have individuals responding separately to an external event and their perceptions of it, rather than reacting to another person and his experiences.

According to Blakeslee (2007), the insular is a receiving zone that reads the physiological state of the entire body in social and non-social situations and then generates subjective feelings. It is the insular that changes raw body states into social emotions and according to Cozolino (2006), this is what makes it a part of the social

brain. A bad taste or smell is recast in the frontal insular as disgust. A sensual touch from a loved one is transformed into delight (Blakeslee 2007). The bottom line is that mind and body are integrated in the insular.

The second modification that the insular represents is not in circuitry, but in the type of cell it uses which is found only in humans, whales, apes, and possibly elephants. These are called VEN neurons named after Von Economo who first described them in 1925. They are large cigar-shaped cells tapered at the ends and found exclusively in the frontal insular and the ACC. This system has to do with self-monitoring. It warns us when our behavior may lead to a negative outcome. It is a part of the anterior cingulate cortex and works subconsciously.

The insular and VEN neurons are also important in putting the body into expectations. When you get ready to go outside on a cold day the insular lets you feel cold before it happens. When I was doing my physical therapy after a broken leg I would say, "ouch" before the bending which I was doing actually hurt. My therapist and I laughed about what we called my "anticipatory ouch," but if you are going down a hill way too fast on your bike, that anticipatory shudder is no laughing matter; it may activate your amygdala and save your life. The same thing may make you very careful around your kitchen disposal. This is also relevant for drugs, dependencies on alcohol, and tobacco because it is the anticipatory sensual satisfaction that drives their use.

The Cingulate Cortex. The cingulated cortex is another brain area absent in nonsocial amphibians and reptiles. It is a central part of the social brain because it is responsible for care-taking and resonance behaviors. It is also critical in attention, which helps caretakers focus on the babies instead of themselves. It provides the neural infrastructure for social cooperation and empathy. Without the cingulate cortex (CC) there simply is no maternal response. Like the insular and the somatosensory cortices, it is organized like a map of the body. Along with the insular, it is involved in the whole gamut of emotions from gratitude to lust. Damage to the CC decreases empathy, emotional expressiveness, and motivation to communicate. One of Damasio's patients who had been severely injured in this area became mute. After her recovery, she again was able to talk and said that during her incapacity, nothing seemed to matter and she had nothing worthwhile to discuss (Brothers 1997: 53).[4]

The Importance of Eye Gaze in Social Life

In popular culture the presumed "location" of the self gives it an elusive character. We have seen that we infer other peoples' selves from their facial expressions and what they say, but we never literally "see" them directly and we can always be wrong about our inferences.

[4]Cozolino (2006: 57) includes the hypothalamus in his description of the social brain, but it is not clear to me from his description that it is a critical part of this system.

On the other hand we quickly come to believe that human beings are not things but *persons*, and persons are not to be treated as mere things. Most of us just assume that people are their bodies but you can lose a lot of your body and still be a person, and if "eyes are the windows to the soul" it is not much of a window – not if all you see its the reflection of yourself!

As we have seen it is an observation of great importance to understanding the social nature of the brain that we consider eye contact a very intimate act and thus it can be a pleasant "turn on" between two consenting people. Usually when we stare at someone straight in the eyes we are either flirting with them or doing just the opposite – "staring them down," which is seen as an invasion. We are so sensitive to others gazes that the phenomenon of looking at people is riddled with norms to protect the social comfort of all of us. People can get into a lot of trouble in bars and such places by looking the wrong "macho" in the eyes. A man in a bar with a chip on his shoulder might show real or pretended outrage at someone looking at him, at which point he may say, "You see something you like over here buddy?" We are very guarded about who we "let in" like this and those that come in "uninvited" may have to pay a price for it. Undesirable men that keep staring at women make them rightfully uncomfortable because it is a disregard for their persons and too much regard for their bodies. On the other hand, adults scolding children will often react with a stern "Look at me when I talk to you!" In different cultures and subcultures the norms are different. Here the expectation is that a person being reprimanded keeps the gaze downward as a sign of respect.

The timing and length of looking at others therefore is an important skill. We learn to look at people with a noncommittal glance off to the side as if we are looking at some one else. To make matters more complex, if this fails and they look back, it can produce embarrassment unless we can quickly think of something to say. Suffice it to say that we have elaborate procedures arming us from the sensitivity we have to others.

When a person looks at us for even a short length of time, it is not surprising that all five brain areas described above come into play as well as the three paths evaluating the "where," "what," and direction of eye gaze.

Two important features of the human eye are the colored iris and the white sclera surrounding the iris. The sclera only exists in humans and its contrast to the iris allows us to ascertain precisely the direction of another's gaze. In short, we can definitely say that the brain takes note and that it considers the gaze of vital importance.

Pupil size is also important. Greater pupil size conveys greater positive emotions and interest in what we are seeing. If we look at pictures of the same woman with smaller and larger pupils, the larger pupils will generally make her be seen as more attractive.[5]

[5]This section was aided by Cozolino (2006, 159–163).

Autism as a Partial Loss of Social Connection

An important opportunity for medical research occurs when specifiable areas of the brain are destroyed or rendered nonfunctional. We can then see if the functions which are lost can be related to the damaged structure thereby providing a lead to refine our knowledge of areas of brain functions. (Of course, we also have to make sure that the lost function is not really the result of a correlate of the damaged structure.)

Interestingly, the incapacities which suggest autism reflect just those capacities needed for embodied simulation and the human connectedness which it makes possible. This is the function of mirror neurons. Surely autistic deficits are due to more than mirror neurons, but it is equally certain that they include them. Autism is not a unitary condition with one definable symptom. There are many kinds and gradations of autism. Nonetheless, the most general deficit seems to be the inability on the part of autistic of autistic people to construct a "theory of other minds." Because the syndrome takes many different forms, workers with such individuals prefer the phrase "autistic spectrum disorder."

Characteristics which suggest autism include detachment, lack of social skills, and absence of eye contact with others, lack of interest in or understanding of people's subjective worlds including their moods, emotions, and intentions, and the lack of role-taking abilities. Among other things, this results in difficulty in using pronouns correctly. Autistic individuals tend to refer to themselves in the third person. (It is important to recognize that children cannot learn the proper use of the word "I" by rote imitation because everyone refers to the child as "you.") While human beings are the most capable of all primates in mimicking others of their kind, autistic people lack this ability. Ironically, the most gifted primates in "aping" others are not apes but humans.

Other symptoms include an absence of empathy and difficulty with language comprehension even though autistic people can be highly intelligent in other areas. They tend to interpret others very literally, but in normal discourse meanings are often not literally expressed. Language is largely metaphorical. Thus, a subset of autistic children told to "get a hold of themselves" or to "get a grip" might start grasping at their own bodies. Much of language learning consists of "taking a person's meaning" rather than taking them literally. Autistic children are often just not interested. Voices on the phone which ask, "Are your parents in?" may be answered with a simple "yes" or "no" by an autistic child who would then hang up.

All of these deficits are just what one would expect to see if mirror neurons were disabled or non-existent. The initial evidence that such is the case came from the lab at USC-San Diego run by Ramachandran and Oberman (2006). EEGs were used to measure brain waves in normal people. One component of such waves is the mu wave. This wave is blocked or suppressed anytime a person makes a voluntary muscle movement. It is also blocked when a person watches someone else make the same voluntary action. Thus, mu wave suppression became the non-intrusive equivalent of the electronic probes of mirror neuron activity in monkeys. It is not really the equivalent because all human measures so far only reflect the areas of activity

rather than specific, discrete neurons. The San Diego researchers found that with a sample of 10 autistic children who had only lower impairments, their own voluntary movements blocked the mu waves just as it did in normal children. However, the suppression did not occur when the autistic children watched others perform the same action. In a normal comparison group, mu wave suppression existed for watching as well as for acting, indicating intact mirror neuron activity. This meant that the autistic child's motor system was intact but that his mirror neuron system was not. Such findings have been replicated using other techniques as well, especially those used in the study of mirror neurons.

While these findings showed reductions of neuronal activity in the prefrontal cortices, the problem autistics have with metaphors occurs in the angular gyrus, which sits at the crossroads between the vision, hearing, and touch centers.

Metaphors add greatly to our quests for intersubjectivity because all of us have common experiences with our bodies and its motor actions on the world. We use this common experience to make sense to each other. All of us know what the verb "hit" means because we all hit and get hit. We automatically know what is meant when somebody says, "I hit them hard with the message that they had to work harder." But nonetheless, seeing the commonality between the motor action of "hitting" with the highly abstract notion of impacting the minds of others to work harder has very little to do with literalness. Few actions could be more different. It has a lot to do, however, with the concrete experience of our bodies which gives sense to metaphors and contributes to intersubjectivity.

Ramachandran and Oberman describe an old technique to illustrate this point. Two shapes are drawn, one jaggy and one curvy and the audience is asked which shape is "bouba" and which is "kiki." Regardless of their native tongue, audiences will pick bouba for the curvy picture and tiki for the jagged one. Thus, they are automatically able to recognize the commonality between a jagged visualization and a harsh sound as well as the smooth quality of both the curved visualization and a softened sound. Since this response transcends language, and is quite reliable, we can safely attribute it to automatic tendencies of the human brain. The use of metaphor in sense-making seems to be a universal characteristic of language.

The capacity for metaphor is most probably housed in the angular gyrus, sitting at the junction between the centers for hearing, touch, and vision. This is hypothesized because of its strategic location and because indirect evidence of mirror neurons has been located there. The functional capacity of this structure is referred to as cross-domain mapping, a feature which exists in other areas of the brain also. It comes as no surprise then that a large subset of autistics do not perform well on the test for understanding metaphors. Many otherwise normal children with brain damage in the angular gyrus fail the bouba/kiki test and have trouble with metaphors just as autistics do, so there is good reason to focus on this structure and its suspected mirror neurons as at least one source of the ability to cross domains and fully understand language.

Throughout her volume, Brothers (1997) compiles evidence strongly suggesting that dysfunction occurring during infancy in the amygdala and/or the social editor that can produce autistic behavior. Autistic children pay scant attention to faces. This

was dramatized in a study which gave autistic and non-autistic children the task of sorting pictures of different facial expressions with some of the depicted faces wearing hats. The basis for sorting the pictures was left up to the children. The autistic children sorted the pictures according to whether or not hats were worn. Normal children sorted according to the different facial expression of emotions. It was not because the autistic children were not capable of recognizing facial expressions, but they were not interested in the same way normal children were.

While most people analyze faces automatically, doing this takes significant effort for many autistics. Even with this effort, their images of faces can be mechanical and raw. Despite their deficiencies, autistic individuals are systematic, objective, and logical in their thought processes. They can pick up minute details but cannot put them together as a whole. As noted earlier, the facial region around the eyes is a particularly expressive part of the face and in comparison to normal children, autistic children give this scant attention. They apparently lack a brain editor drawing attention to the eye region which allows us to attribute mental states to others and to participate fully in conversations.

The four most common characteristics of autism are (1) impaired social relationships, (2) impaired communication, (3) trouble with make-believe play, and (4) repetition of rituals (Frith 1989:173–174). Others add resistance to change, purposeless movement, and self-injury.

When the Social Environment Fails Our Social Brains: an Ugly Story

We have seen from the beginning that our brains are organized for sociality. Our brain's socially dedicated systems are relational and responsive; they are not self-sufficient structures even though they are genetically hardwired. Hardwired does not mean guaranteed. For the social nature of the brain to materialize, it needs a responsive social environment. A social environment which supplies food and shelter is necessary, but it is not sufficient. What is needed is an interactional environment of mutual responsiveness which involves the active participation of both the baby and the caregiver. Without the environmental supports for this sociality (most of which is emotional), we do not develop the foundations for anything else. Contrary to the prejudices of our "hyper-cognized" and distanced culture, human intellectual capacities are based on a firm emotional foundation. It is emotion that must first be secured in cognitive development and it is emotion which organizes the brain.

Given the above, we should expect to find that infants who are born into society but denied mutual responsiveness would have a very difficult time. As it turns out this is an understatement. Such infants do not develop an interest in, or even the capacity for, social connectedness. In its place are fear, anxiety, depression, and in many cases physical deficits leading to death. The story of infants coming into the world ready for social interaction but nonetheless being deprived of it provides

telling evidence for the social nature of our functioning brains. The destructive consequences which occur when infants are deprived of the environmental supports of this nature document the interactive nature of human development.

The sources of such evidence are numerous. Probably most revealing are the early studies conducted by René Spitz and the more recent neuroscientific re-evaluation of his work by Tredway et al. (1999). For a 2-year period during the 1940s, Spitz observed 90–100 children in each of two very different types of social environments. In addition, 34 children were observed in private homes as a comparison group. The caregivers in the first two facilities could not have been more different, although there were some superficial similarities.

The "foundling home" babies were treated according to the medically approved child-rearing practices of the time. Conditions were sanitized and babies were fed with bottles on strict regimes at the same time every day. Infants were kept in cribs with sheets draped over the sides, isolating them from other babies and adults. The spread of germs was effectively minimized along with an absence of human interaction. The ratio of nurses to babies was the same as in a typical modern hospital – between 1:8 and 1:10. Anyone who has spent time in a hospital either as a nurse or as a patient knows that this is not very intensive. The babies were left alone in their cribs most of the time for 15–18 months.

The nursery was very different. Although mothers in both groups were similar demographically, the nursery caregivers were mothers caring for their own or other mothers' babies. Some mothers had been labeled as feebleminded, psychopathic, and/or criminal. But the mother to caretaker ratio was 1:2. Mothers competed among themselves to see who had the most capable and attractive baby, and although conditions were not quite as sanitary as in the foundling home, the infants received ample attention. After 6 months the babies were transferred to rooms shared with five others.

All babies were tested on three dimensions: physical health, psychological activity, and emotional responsiveness. Even though only "rudimentary" efforts were made in the nursery to ensure physical health, the infants developed normally with a summary score of the three dimensions of 101.5 and 105 during the last 4 months.

The fate of the infants in the more sanitized and regimented foundling home was very different. Basically, the children showed behaviors similar to Harlow's monkeys "reared" by wire mother "surrogates" with bottles of formula stuck in them: after 1 year the foundling home babies stopped responding to others completely while vehemently resisting new people, toys, or other items. Their time was spent in swaying, head knocking, or pinching themselves until ulcers developed. Most were psychiatrically disabled to an impairable degree in spite of the sanitary conditions. Physical health was a similar disaster. By 3 months every baby had some health condition and there was an epidemic of measles. Spitz divided the children into younger and older groups. The younger group had a death rate of 23% and the older group, which should have been more robust, had a 40% mortality rate. Apparently their immune system, which should have grown stronger over time, became weaker as they aged in that environment. With increasing age (1.5–3.5 years) the children also became worse on the other dimensions. Only two could speak two words, hardly any

could feed alone, all were incontinent and all but one were seriously underweight in spite of their rigid eating routine. The average combined scores (which were over 100 in the nursery home babies) progressively dropped to 45 for the foundling home babies, which Spitz associated with that of a low-grade moron (Tredway et al. 1999).

Generally the infants started out with normal reflexes such as smiling at the approach of strangers. By 6.5 months the smile was no longer there. In one typical case, by the 7th and 8th month when the observers appeared the infant lay still and looked at them with profound suffering. Talking to the infants made them weep and more talking only intensified the weeping. Those children who did survive demonstrated low intellectual functioning, attentional deficiencies, rampant shyness, psychosis, and outlandish social behaviors.

For these children biology had done its job and the babies started life with normal social reflexes. But the social environment did not do its job with catastrophic consequences. Clearly, genetics and environment must work hand in hand in the critical context of early human socialization. Other examples of children born in society but socially isolated in the interpersonal sense that really matters also are readily available. None, however, have been described and compared with other similar groups as completely as those provided by Spitz. More recently we have the sad story of Romanian babies who were raised in similar circumstances in understaffed state institutions who suffered similar outcomes (Cozolino 2006).

A Neurosociological Interpretation of Isolation

Tredway et al. analyzed the Spitz results in terms of the consequences of social isolation for the developing infant brains; here we find the real contribution to neurosociology. We have seen that emotion organizes the brain and that the brain's early development sets the building blocks for later cognitive development. The beckoning smile of the baby is obviously emotional just as are the responses from the adults which the smile evokes. In short, early socialization is largely an emotional enterprise. If Brothers' position on the brain as a dedicated social system is correct, then in those instances where the system is not fostered environmentally, the whole brain and its development would be disrupted. "Human nature" should not materialize. We have seen that this is only too true. The next step then is to show more specifically how the brain is affected in neuroscientific terms.

The consequence of social isolation is referred to as "separation distress syndrome" – an appropriately emotionally toned label. The normally strong attachment to the mother begins in the womb and produces the chemicals that nourish the healthy limbic system – opioids, oxytocin, vasopressins, norepinephrine, and other neuroactive agents. Prolonged isolation produces a deregulation of these chemical substrates. This deregulation is thought to be a primary factor in producing depression over time. It comes from the lack of environmental support for a number of interacting brain areas which puts them on high alert and makes

them produce an excessive amount of cortisol. These interconnected areas are referred to as the HPAH axis, comprising the hypothalamus, the pituitary, and the adrenal-hippocampal axis. These are particularly important brain areas for human beings.[6]

With the separation of an attached infant from its mother, the pituitary is induced by the hypothalamus to release a hormone into the blood that ends up in the adrenal cortex and produces cortisol. As part of this process, the amygdala is also activated, increasing its arousal state. Thus, an increase in stress produces an increase in sensitivity to fear. Moreover, the amygdala can activate itself which only increases sensitivity to stress making it difficult for the infant to calm down on his own. Usually external caretakers can sooth the infant with physical contact and calming noises associated with positive comforting episodes of the past. These activate the infant's opioids with a calming effect. There is a high density of receptors in the amygdala which receive other calming chemicals (benzodiazepines). An important part of socialization takes place when infants or children learn to downregulate these negative processes for themselves and produce their own opioids. Thumb sucking may be an illustration of this because it can be associated with feeding and the warmth of the caretaker. But with little or no experience of such warmth, learning these techniques is not possible for the infant.

We can already see how prolonged exposure to isolation produces an accumulation of corticoid levels that can alter both brain and body physiology (Tredway et al. 1999: 126). But there is more. According to LeDoux (1996: 248–249) the medial prefrontal cortex, an essential part of the social brain and attachment, can also be damaged by consistently high levels of glucocorticoids (GCs). If the prefrontal cortex is damaged, it can no longer control the amygdala and the cycle described above is made even worse. Normal levels of GC in the hippocampus strengthens the memories which are formed in new learning. Pathological levels of GCs can reactivate previously forgotten fears and make them worse than they originally were. Memories of fears can be repeatedly reactivated regardless of external fear-inducing stimuli in cases of isolation. LeDoux (1996:250) has shown that this "preservation" of anxiety-producing memories also results from lesions to the lateral and medial areas of the prefrontal cortex.

Damage to the brain areas described above would normally produce eventual disorders relating to impulse control and antisocial behaviors such as sociopathic and character disorders. This type of damage, especially to the ventromedial prefrontal lobes, prevents the development of just those life skills that allow for social effectiveness, as Damasio's patients who have damage to this area have shown.

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[6]The hypothalamus is the head of HPAH system with extensive connections to what Cozolino (2006:57) calls the social brain. It controls the autonomic nervous system and the hormonal secretions from the pituitary gland including those involved in emotion. The hippocampus stores long-term explicit memories and is underdeveloped in infants. The adrenal gland is the source of cortisol, our primary stress hormone which, in over-abundance, destroys hippocampal neurons in adults. Suffice it to say this is a very powerful system with broad effects on the brain as a whole.

Harlow's monkeys reared with a surrogate "mother" made of a metal net showed extreme fear of anything new that was put in front of them. Monkeys reared with a cloth surrogate mother would inch toward the new object, run back to the cloth mother and eventually feel safe enough to explore the object. Not so with Spitz's foundling home children. They reacted with extreme fear when strangers approached and responded fearfully to Spitz himself. This behavior is known as "approach-withdrawal." In infants the front and back regions of the temporal lobes on each hemisphere mediate the response. The left anterior region is believed to be involved in approach and the right anterior region is involved in withdrawal (Davidson et al. 1990). Since the foundling home infants could not withdraw, they were forced to experience stranger fear over and over again. Repeated panic lowers the fear response threshold, intensifies negative emotional memory, and reactivates memory usually inhibited by the frontal lobes. It is well known that the right hemisphere houses negative emotions which are regulated and controlled by the left hemisphere; when people suffer stokes in the right hemisphere they often have to deal with depressed moods and emotions. Tredway et al. suggest that withdrawal and depression may share similar brain circuits and may have produced the depression in the foundling home infants. Also linked to depression is the fact that norepinephrine levels as well as serotonin levels decreases as prolonged stress continues.

Conclusion

During the last two decades, increasing evidence from neuroscience has mounted regarding our social natures. The core of this finding is that the brain plays an essential part in assuring we will recognize that others have selves like our own as well as generating the linguistically created intersubjectivities which make societies possible.

Brothers (1997:64) notes that the consequences of having a social brain are not all positive ones. The electrical stimulation of the amygdala produces mostly emotions of discomfort in social settings. She mentions that the few anecdotal cases where the amygdala is missing altogether tend to be happier and less anxious. The amygdala may save us in moments of danger but it leaves us generally anxious and defensive. Ervin Goffman (1967: 235) described it passionately:

> Whether the character that is being presented is sober or carefree, of high station or low, the individual who performs the character will be seen for what he is a man behind many masks and many characters, each performer tends to ware a single look, a naked unsocialized look, a look of concentration, a look of one who is privately engaged in a difficult treacherous task.

In terms of causation, our brain-given tendency to construct persons as opposed to mindless bodies can be reconciled with the social aspect by attending to the equally important fact that societies must provide the brain with specific beliefs about the nature of these persons and their minds. For example, many would argue

that Goffman spoke for those in alienated and competitive societies. On the other hand, the fact that autism develops in spite of supportive environments means that a social field is not sufficient either. As is so often the case in such issues, the truth is in the dance.

Certainly, the fact that our brains are social to the core does not fit easily with the central assumptions of western individualism and the intellectual history of capitalism. As we shall see, a consequence of our "mirror neurons" is that altruism (not exactly center stage in profit-driven theories of self-interest) is as central to our natures as other sentiments. We have learned from the biochemistry of belonging and the effect of isolation on developing infants that there are serious challenges to the tabula rasa assumptions of the enlightenment and the "normalcy" of the growing isolation experienced by individuals in our society (see Smith-Lovin et al. 2006).

For most of my academic career, it was considered an irresponsible value judgment to argue that a whole society could be abnormal and could operate against our natural tendencies.[7] Humans, being blank tablets whose behavior were completely dictated by their societies, "had no natures."

The social arrangements which comprise society may have been developed by human beings, all of whom come as individual forms. But their interaction with each other produces emergent institutional arrangements which have no individual authorship and whose forms can be opposed to things human, or, more accurately, humane. Because humans generate social structures does not mean that these structures will be humane any more than intelligence should be confused with wisdom. Hopefully, the above may prepare reasonable grounds for reflecting not just on ourselves, but also on our society.

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[7] A recent argument for a theory of emotions that allows for such a political evaluation of society can be found in the introduction to Redding's (2001) *Navigation of Feeling*.

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