THE HUMAN BEINGS DISCOVER LOVE

Nondum amabam, et amare amabam, quaerebam quid amarem, amans amare.
I was not yet in love, and I loved to be in love, I sought what I might love, in love with loving.[1]

Attachment is an evolutionary strategy that ensures the existence of social species. Love, you have to admit, is something more than that. The origins of love reside in the attachment behavior of social animals and in the mating behavior of all the animals, but human beings seem to have taken it to a level beyond.

For one thing, we have a word for it, and it is a word of singular power. Think of another word that might be used six times in a short sentence yet infuse it with such depth and meaning. Think of another word that has more power. There isn't. Truth? Beauty? Those words speak only to an individual's perspective and are as often as not the occasion of rancor and dispute. Love speaks to something transcendent.

It is an interesting word, at least in the European languages. Our word, *love*, is the same as *lief, lieb, liufs, lof, lov, lob, lop*, all deriving from the Indo-European base, *leubh*, meaning, nothing more than "to love." The word of the Southern Europeans, *amare*, comes from another Indo-European base word, *ama*, an infantile sound akin to *mama*.[2] So, love appears to be a pristine word. It derives from nothing but itself. It was with us, in all likelihood, when we humans first began to speak.

Words have power, but why does this word have so much power? Words refer to ideas, but wherever did this idea come from? The idea that at we all, almost as a matter of course, partake in a transcendent force that gives meaning and direction to our lives and, indeed, to life itself. It is the idea of a pervasive element that governs our lives and that elevates the natural world.

Shall I compare thee to a summer's day?
Thou art more lovely and more temperate.
Rough winds do shake the darling buds of May,
And summer's lease hath all too short a date.
Sometime too hot the eye of heaven shines,
And often is his gold complexion dimmed;
And every fair from fair sometime declines,
By chance, or nature's changing course, untrimmed;
But thy eternal summer shall not fade,
Nor lose possession of that fair thou ow'st,
Nor shall death brag thou wand'rest in his shade,
When in eternal lines to Time thou grow'st.
So long as men can breathe, or eyes can see,
So long lives this, and this gives life to thee.[3]

Love elevates the natural world but it is not detached from it. The natural world, as it happens, is the way we participate in it. So, the natural question to ask is where did the word and the rather fantastic idea behind it come from?

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[1] St. Augustine, Confessions III i
[2] Ernest Klein, A comprehensive Etymological Dictionary of the English Language, 1971.
[3] Shakespeare, Sonnett 18

Intelligence among the Human Beings

Love among the human beings is as different from attachment behavior among the animals, as are language and intelligence. Animals are intelligent, some more than others of course. They do all manner of smart things, as the naturalists never tire of letting us know, or the fellow down the street who told my daughters that his dog had a vocabulary of 256 words. A *receptive* vocabulary of 256 words, he neglected to say; my smallest daughter was disappointed that the dog couldn't *say* anything at all. But animals have language, too, as we all know from the TV. *There he is folks, on your TV, this highly intelligent* (animal, fill in blank*). He has a vocabulary of 256 words!* Then the announcer says, *perhaps we humans are not so unique after all*. To which I say, speak for yourself. It is certainly true that animals have the rudiments of language and intelligence, and it also true that those rudiments are the evolutionary foundation of our own capacity for language and intelligence. But just as attachment behavior is only a small thing, relative to the human experience of love, so is our language and intelligence far advanced beyond that of our animal cousins. It is more than a difference in degree, it is a difference in kind. Yet the psychology of some animals – parrots, for example, dogs, horses and, in their perverse way, our nearest primate cousins -- is so close to ours it is almost uncanny.

There is no doubt that our intelligence evolved from that of lower species, although how exactly that occurred is still a puzzle being worked out. Our ancestors, if nothing else, were quite assiduous at wiping out their immediate forebears. *Arrivistes* they were, probably, and having less evolved parents hanging about must have made them uncomfortable. Be that as it may, there is no less than 5,000,000 years of evolutionary separation between us and our nearest surviving ape relations. The only way we know what must have happened during that time are a few odd bones and rocks. The paucity of the fossil record, however, has never seemed to discourage our scientist friends from making all manner of speculations. Indeed, a scant record is a distinct advantage for anyone who wishes to advance a pet theory; so I shall do no less. I promise to restrain myself from outlandish speculations, though. In fact, everything I have to say is based on just two small, indubitable facts: we have big brains and our ape cousins have small ones. Over the course of a circumscribed period, the last 2 million years to be precise, the brain size of our genus, *Homo*, doubled and then doubled again. That was a *good thing*. Two million years ago, our ancestors pretty much just sat around and scratched. Now, we write books, surf the internet, build automobiles that can go 10,000 miles before an oil change is necessary and compose sonnets to love. Reflecting on these two facts – we have big brains, they have small ones -- takes us into interesting territory.

One of the signal problems in paleoanthropology has been to explain how big-brained *Homo* evolved from the arboreal and ape-brained australopithecines, who were a particularly successful species living in Africa 3-5 million years ago. Lucy, whom you've probably heard about, was an australopithecine. She – her fossilized skeleton that is -- was discovered in Ethiopia in 1974. She walked upright, but she had the cranial capacity of a chimpanzee, about 400 cubic centimeters. We think that it was Lucy and her kind who gave rise to genus *Homo* about 2 million years ago. Over that comparatively short span, hominid brain size increased from 400 cc to about 750 (*Homo habilis),* then about 900 (*Homo erectus*), and then about 1600 (*Home sapiens sapiens*, i.e., you and I). As their brains grew, the first representatives of our genus grew larger in size, became fully bipedal, and developed complex social structures, the capacity to fabricate tools, language, clothes to wear and monogamous pair-bonding strategies.

The growth of brain size by a factor of four over two million years or so was an impressive achievement. It was impressive, indeed, because there are biological constraints against it happening. Big brains reside in big heads, and therein lies a problem. Big brains are associated with higher intelligence, and although we ordinarily consider that to be a good thing, intelligence is expensive, and that creates another problem. That all this happened at all was because of a remarkable technological achievement: the way our hominid ancestors decided to organize their little societies. It was our first and arguably our most important technological achievement. The evolution of intelligence was nothing less than a triumph of social organization over limitations imposed by biology.

Here is the first problem: A smart baby is something to be proud of but a baby with a big head is something to endure. The pelvis of a bipedal primate is only so big and it will not permit the passage of a fetal head that is appreciably bigger. This is what is called the “obstetrical dilemma.” The dilemma is that the evolution of large-brained infants was a challenge to the capacity of the hominid birthing process. The size of the pelvic girdle of someone who wants to walk on two legs is necessarily limited by biomechanical factors that we don’t need to go into here. The point is that the only way for a woman to birth a large-brained infant is to do it while his head is still small.

The solution to the obstetrical dilemma was for *Homo* to give birth to an immature infant. Thus, compared to other primates, the human newborn is *twelve weeks* premature and almost impossibly helpless. And even as the child’s brain grows at an extraordinary rate during the first twelve months of life, his body remains helpless during that whole time. He can’t walk or hold onto mama until he is year or two old. The infants born to early *Homo*, therefore, required an extraordinary level of parental care.

The mothers who took care of these tiny, helpless babies were correspondingly disadvantaged. It was a signal, almost miraculous transformation that induced our African Eve to take the risk, and an equally improbable event that the males of her band would abide the experiment, or indeed to encourage her. Consider it the evolutionary equivalent of a trapeze artist hurtling herself into the sky and without a net, trusting that her partner will be there to catch her. And this is how she did it: first, she had to get bigger. That gave her pelvic girdle a little more leeway. So, compared to other primate females, females of genus *Homo* are bigger, relative to their male counterparts. Bigger females were better prepared to endure the risk of carrying a helpless infant. One may also presume that bigger females were better equipped to assert maternal protectiveness as a social value for the band. Over a relatively short period of time in evolutionary terms, but over many generations nevertheless, the hominid female grew progressively in size. Her offspring were born with bigger brains but bodies that were even more woefully undeveloped. And the men in her tribe developed the capacity to cooperate to provide for the women and infants.

The evolution of *Homo*, therefore, was associated with fundamental changes in the social organization that had characterized earlier primate societies. Scientists argue about the precise order of things, but we know that these events transpired: hominids adopted a terrestrial rather than an arboreal habitat; living in the *veldt* made bipedalism advantageous; tall, bipedal hominids surveyed a wider horizon and their arms were free to carry tools and weapons and infants. Something about this environment was a catalyst for brain growth, which entailed a prolonged period of infantile helplessness, which required in turn a degree of parental investment that is unique among animals. Hominid societies had to be organized, therefore, in a way that promoted cooperation between males and females, and also among males. The increase in the size of females relative to males during this period was an advantage to the strength and competence of the band, but it also increased the relative weight of “maternal” psychology.

It was during this time, by the way, that our genus became committed to monogamous pair bonding.

The obstetrical dilemma is only one of the disadvantages of a big brain. The second problem is that brains are exceptionally expensive in terms of the energy they require. The human brain accounts for 2% of the body’s mass but no less than 20% of its energy expenditure.[4] An australopithecine like Lucy had a brain that wasn’t

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4 Aiello LC, Wheeler P. The expensive tissue hypothesis. the brain and the digestive system in human evolution. Curr Anthrop. 1995;36:199–221.

nearly so expensive to maintain and it worked well enough, at least for what she wanted to do with it, on a diet of fruits, roots and insects. *Homo*, on the other hand, had to deal with mewling babies and assertive females and at the same time find new, high-energy-rich sources of food. Mainly meat, the flesh of large animals to be precise, which contains a lot more energy that fruits, roots and insects do. Those complex social structures that we have come to like so much need a lot of food to eat.

Evolution by natural selection enjoys periods of stasis when nothing much happens, and then something happens to get the process moving again. Mutations in the genes that govern brain growth doubtless occurred many times over during the careers of the primates and early hominids. Most of the time, they must have been unsuccessful. Mothers would die in childbirth or immature infants would perish for want of care. But then, in one magical moment, the experiment succeeded. There was a band of primates who were able to experience the benefit, proportionate to the expense, of having a large brain.[5]

Higher intelligence is, of course, the advantage of a large brain. Across the phylogenetic scale, animals with higher brain volumes are more successful in social learning, innovation, and tool use.**Error! Bookmark not defined.** The earliest theories of the expansion of intelligence, therefore, emphasized the role of superior intelligence in mastering environmental challenges like how to find food, how to avoid predators, how to hunt and make war. But there are liabilities associated with having a big brain and higher intelligence. The only way to overcome these liabilities was to improve the quality of social interaction within the group. Cooperation, altruism and kindness had to rise to new and special levels. This, I believe, was the signal event in the birth of Man and it was the foundation of love itself.

What happened to us over the past two million years is an example of runaway evolution.[6] Genetic mutations that promoted brain growth finally caught on, and the result was runaway selection for brain volume, higher intelligence and social structures characterized by interdependence. The reason it was a runaway process is the emergence of a positive feedback loop. Brain size required more complex social structures, and complex social structures stimulated the need for higher intelligence.

A number of researchers have argued that the increase in brain size was far in excess of what was required to flake rocks into tools, to hunt large animals and to find one's way around the savannah without getting eaten. They point out that size of our brains is well in excess of what is required just for environmental mastery. They maintain that it is the "computational demands" of living in a complex society" that selected for large brains.[7] We take those cognitive demands for granted; we hardly think about them and they reside these days mostly in our heuristics. But to the early hominids, they were entirely new. In a complex society, comprising about 150 individuals, there are partnerships to negotiate. Competition has to be balanced with cooperation. One has to discern whom to trust and who is a faker. Individual decisions have to be responsive to decisions made by other group members. One's choices must serve not only one's own bioenergetic needs, but must also permit other group members to meet theirs.[8]

According to this theory, there is only one conceivable reason why brain and intelligence could have increased so robustly in so short a time: the intense sociality of the hominids.[9] [10] Data to support the theory are to be found in brain itself. The parts of brain that increased the most during the evolution of *Homo* were in the

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5 Dunbar RIM. The social brain hypothesis. Evol Anthrop. 1998;6:178–190.

[6] Other examples are the formation of self-replicating molecules, the emergence of prokaryotic cells and the adoption of a terrestrial habit.

7 Science. 2007 Sep 7;317(5843):1344-7. Evolution in the social brain. Dunbar RI, Shultz S.

8 Susanne Shultz and R.I.M Dunbar. The evolution of the social brain: anthropoid primates contrast with other vertebrate. Proc Biol Sci. 2007 October 7; 274

9 Chance M.R.A, Mead A.P. Social behaviour and primate evolution. Symp. Soc. Exp. Biol. 1953;7:395–439

10 Proc Biol Sci. 2005 272(1575): 1865–1875. The social nature of primate cognition Louise Barrett1,3* and Peter Henzi2,3

neocortex, especially the frontal cortex, a region that subsumes most of the functions of social behavior. The frontal neocortex grew much more robustly than the areas of brain that control autonomic and sensory-motor functions that are necessary for hunting and fighting and remembering how to get back to a good water-hole.[11] In fact, it is a distinct characteristic of primates that the size of the groups in which they live is correlated with the volume of their frontal neocortex, but their relative capacity for environmental mastery is not. This theory has been formalized in the literature as the "social brain hypothesis." The essence of the SBH is that the need to solve problems in a social context imposes significant cognitive demands, and these demands are what selected for higher intelligence. [5]

Therefore, once there were bands of hominids who committed to cooperation in the care of immature infants and the provision of high-energy foods to nursing mothers, evolutionary success was driven by the quality of the interdependent relationships within the bands. A virtuous cycle, therefore, with higher intelligence requiring greater degrees of support and more supportive social structures stimulating the growth of intelligence.

Different aspects of hominid socialization, however, have been emphasized by different researchers, and, inevitably, controversies have arisen.[12] For example, the idea of 'Machiavellian intelligence,' named for the infamous Italian political philosopher, who said, notably, *It is better to be feared than to be loved*. The Machiavellian theory is based on the premise that animals living in social groups compete for scarce resources. According to this view, successful competition involves the ability to 'out-wit' other group members.[13] Deception, for example, is frequently used by primates as well as other animals. It is advantageous, therefore, for an individual to anticipate how another will behave in certain circumstances, and thus to manipulate or control the outcome. Many animals have evolved the capacity for deceive: the angler fish, who dangles what looks like a juicy morsel right in front of his gaping mouth, or the teal who leads a predator away from her nest by pretending to have a crippled wing. Primates, though, engage in deceptions in a knowing way; chimps, in particular, exhibit strategies that are clever but particularly nasty. The proponents of Machiavellian intelligence were deeply influenced by naturalists who observed such behavior in chimpanzees, like Jane Goodall and Frans de Waal.

It is easy to imagine how 'Machiavellian intelligence' would trigger a cascade of increasingly elaborate cognitive counter-strategies.**Error! Bookmark not defined.** It reflects the cognitive demands involved in tracking a complex web of relationships through time and forming coalitions and alliances. The presumption is that primates are biologically prepared for forms of social engagement that require the mental representation of abstract concepts, like social bonds and alliances, in order to negotiate the social landscape.**Error! Bookmark not defined.** In other words, natural psychology.

The Machiavellian theory may be relevant to the lives of chimpanzees and has impressed a goodly number of academics, who are themselves rather accustomed to competing for scarce resources and using deception in a knowing away. I, for one, am not inclined to agree with them. There probably is a short-term advantage to being a male who can supplant another male in the favor of a likely female, kill the children she had by that unhappy fellow and eat them, but I don't think it is a strategy that will lead to long-term evolutionary success, let alone a positive feedback loop in the direction of cooperative and interdependent societies. Chimps do that, sometimes, but remember, they were our relatives who didn't evolve. How much smarter than a chimpanzee do you have to be, how much more evolved does your social group have to be, before that kind of behavior is regarded with disapproval and the cad who thus behaves is soundly thumped? Another advantage of having comparatively larger females around.

11 BMC Biol. 2007 May 10;5:20. Primate brain architecture and selection in relation to sex. Lindenfors P, Nunn CL, Barton RA.
12 Brothers L. The social brain: a project for integrating primate behaviour and neurophysiology in a new domain. Concepts Neurosci. 1990;1:27–51.
13 Byrne R.W, Whiten A. Tactical deception in primates: the 1990 database. Primates Rep. 1990;27:1–101.

It is neither necessary nor do I think it is compelling to consider the social brain hypothesis simply in terms of dominance and deception.[20] Individuals in social groups compete for resources, it is true, and males compete for access to receptive females. Size and strength do not always win the day, even among the chimpanzees; sometimes, smaller males will band together to win out, and one presumes they are the clever ones. But social acuity is not favored just because it enables more efficient exploitation of one's conspecifics. Individuals in primate societies are also interdependent, and cooperation provides positive benefits for both donor and recipient. In fact, reciprocity and altruism are consistently met with in primate societies, even ours, although some academics are understandably slow to recognize it.

Only a *naïf* would suggest that competition, selfishness, deception, exploitation, cruelty and violence were not also part of the lives of genus *Homo*. They occur among all our primate relatives. They are also some of the behavioral traits I have enumerated in the foregoing chapters. One has to concede that there is a dark side to our evolutionary lineage if but because there is a dark side to us still. And as the stories of my patients have made clear, that unhappy side of our nature reveals itself right next to love. Nevertheless, if I were forced to choose love or hatred as the dominant force in the genesis of human intelligence, I would choose love.

It is more likely that our evolution as highly intelligent social beings has been driven by the tension between forces that are demonic and angelic. Attachment, cooperation and altruism protected infants and vulnerable young mothers and whole bands of proto-humans as they wandered out of Africa more than a million years ago and colonized all of Eurasia. It was a signal achievement and it was driven by nothing more than the desires to eat, to stay warm and to raise a new generation of children. But it was Machiavelli himself who remarked that *Never was anything great achieved without danger. Homo* survived in a dangerous world because he himself could be a dangerous character. During the War, George Orwell said, *We sleep safe in our beds because rough men stand ready in the night to visit violence on those who would do us harm*. As I shall explain in the next section, the chemistry of attachment is the same chemistry that provokes aggressive behavior towards outsiders. Protection is sometimes a violent event, but violence is tolerable over the long-term only in the service of love.

Several years ago, I wrote about the "obstetrical dilemma" when I was researching the biology of intelligence for my last book. It was a textbook having to do with the treatment of patients with brain injuries and mental handicap. During my readings, I learned that

> *There are clear examples from the prehistoric remains of early man and even Neanderthals that disabled individuals were cared for, participated in and were valued by their small bands of fellows. Skeletal remains indicate that people with severe brain injuries were able to survive and recover and to live for years even in the most hostile environments – for example, in Ice-age Europe, where the Neanderthals lived, and in the high Andes. Even disabilities that were clearly congenital in nature could be tolerated, remarkable when one considers the low margin of surplus resources possessed by prehistoric bands. One must suppose that the division of labor left at least some duties available even for disabled people. Alternatively, they may have been held in esteem as divine intermediaries of some sort.* [14]

The care of infants and children in a new and hostile environment was the function of a new psychology characterized by trust and cooperation, kindness and charity. It would appear that in the origins of our kind, trust, kindness and cooperation were necessary for the growth of brain size, the birth of intelligence and the formation of complex and extraordinarily successful societies.

So faith, hope, love remain, these three; but the greatest of these is love.[15]

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14 Gualtieri
15 1Cor13:13.

Learning to Talk

While *H habilis*, *H erectus* and *H sapiens* were doing all these fabulous things, what do you think they were talking about? They were talking about their children and their husbands. What do you think they were talking about?

They might have been saying, *Gee, it feels like we've been riding an evolutionary line that is accelerating at an exponential rate, driven by three interlocked elements: brain growth, intelligence and socialization. And, have you noticed, we girls are talking a lot more these days?* Chances are, of course, that they weren't. For the greater part of those 2,000,000 years, our ancestors were probably talking a lot, but without the syntactic intricacies of modern languages, or the vocabulary. They were speaking "proto-language":

> *…a concatenation of vocabulary items according to pragmatic pressures (e.g. put the `word' for the most salient idea first), with no level of grammatical organization involving phrases, or inflections, or grammatical words such as determiners, auxiliaries, or case-markers*.[16]

A protolanguage is Tarzan-talk. Bickerton described some examples of what he called "living fossils" of proto-language.[17] For example, Pidgin was a communication system typically formed in slave plantations, where adults from diverse linguistic backgrounds were brought together and had to negotiate a *lingua franca.* From Pidgin Hawaiian in the late 18th and early 19th century:

- Nuinui pool. Make kanaka. (Much-much gun. Kill men.)
- Maitai, nana Amerita. (Good, see America.)
- Apopo tabu. Aole hanahana. (Tomorrow forbidden. Not work.)
- Maitai, nuinui maitai. (Good, much-much good.)

Then there is child language, these from a 23 month-old boy.

- Fix it.
- Tear up.
- More doggie.
- Door shut.

Some apes have been trained to sign. Koko was a language-trained Gorilla:

- That cat.
- More pour.
- Me good.
- Koko purse.

The girls probably did better than that, especially as the millennia slipped by in hundreds. There were more people (i.e., homininds) around and there were more things to talk about. Husbands, for example. There were, you see, a couple of interesting things that happened as complex social structures became complex. Two things, in fact, that substantially reduced the complexity of living in those complex social structures. First, the rudimentary grunts and screams that characterize primate communication gave way to proto-language and, then, "formal language." That made it easier to get a point across when there were a lot of hominids around. And to make things really simple, *Homo* took up monogamy. The two events were not directly related, but they were both related to what I referred to as the weight of "maternal psychology."

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16 James R Hurford The evolution of language and languages In The Evolution of Culture edited by Robin Dunbar, Chris Knight and Camilla Power, 1999, Edinburgh University Press. p.173-193

17 Bickerton, D. (1995). *Language and Human Behavior*. University College London Press.

Language first. Language is not a discrete evolutionary line. It co-evolved with three other lines which were all related, all essential one to the other, and all happened together. Language evolution is entwined with the growth of the brain, the cultural development of primate societies and the expansion of intelligence.

Think of the brain as if it were an information storage and processing unit. In fact it is, and it can store and process a great deal of data. Its capacity however is not infinite. So, if you think about all the things a band of 150 or so hominids have to keep up with as they tramp around in the bush, all the petty little details and things to watch out for, not even a modern human brain could keep up. The hominids, however, came up with a neat trick: they found a way to utilize the storage and processing powers of all 150 brains together. In modern parlance, they discovered how to network their computers. By so doing, different individuals in the group could cultivate different knowledge and different skills and could take on different responsibilities according to their knowledge and skills. They were able to use what we call "distributed intelligence." Their little bands thus became information storage and processing units in their own right, but with a much higher capacity and a greater degree of flexibility than the brain of a single individual.

They trick they used to take advantage of distributed intelligence was to develop an efficient information-sharing system. That is what language is. It is a device for information transmission, a way to share the knowledge and skills of the whole group.

There are three kinds of information that language transmits. One is exclamatory: *Great Scott, there's a venomous snake over there!* The second is declarative: *There is a tree beyond that little hill that has a lot of juicy ripe fruit on it.* The third is social: *There, there, it's OK. Here, sit down, let me pick some bugs out of your hair.* You would think that #1 and #2 were the really important ones, and they certainly aren't unimportant. But, as it happened, #3, affective communication, was the really important one. Remember the social brain hypothesis: brain growth is only explicable as a response to selection pressures in highly social groups. Ecological challenges, like where the venomous snake or the fruit-tree are, simply don't carry the same weight towards generating highly intelligent brains. The snake is either there or he isn't; even a mouse can perceive that and communicate his distress to other little mice. Dealing with other hominids, you have to agree, is a lot more complicated. If you're like me, you've been doing it all your life and you still don't get it right all the time.

The social brain hypothesis necessarily assigns to hominid females a central role in the development of language. That is why I said, a little while ago, that they were talking about their husbands and their children. I didn't say that they were talking about girls or hunting large animals to supply the bioenergetic requirements of the band. That is because language development was a signal achievement of female psychology.

You don't need ponder all the theories I am about to lay on you to know that is the case. We don't have to go further than natural psychology: women like to talk. Men, in response, grunt, as they continue to read the newspaper or watch TV. The grunt means, *Yes, I'm listening*, or *Yes, you're right* or *Is that so*? What it really means, of course, is: *Why the hell des she talk so much*? The answer is that she is a woman. Women are better at talking than men, they like to do it and they do it more. On just about every verbal test they score higher. Little girls learn to talk before boys do. Women remember words better than men do, while men have better memories for abstract figures and for spatial relationships.

More to the point, women use language differently from men. Women are more prone to use language as a tool for social bonding and their conversations are more likely to be concerned with social information. That is why they are better at "small talk" than men, who tend to use language in a more competitive way, as a form of advertising or social dominance. Women's conversations are structured in a more collaborative way, with frequent expressions of interest or sympathy (not grunts) while another woman is talking, sometimes finishing a sentence for her, all the while affirming that they are on the same wave length. Men's conversations tend to be more direct – factual information is exchanged or argued over – and if a man interrupts another man, it is usually to disagree.[18] Think of a group of female chimps, one grooming another, and quietly chattering as they do. And a couple of male chimps in the background screaming at one another.

For a long time, it was hard to relate human language to the communication of chimps, because all we were aware of were their screams, emotional outbursts like *There's a leopard over there!* Or *I'm going to bite you on the ass!* When chimps exchanged information in a less frantic way, it was by gestures. The problem, in terms of the comparative neurology of language, is that highly emotional vocalizations of apes are not lateralized to the left hemisphere, as language is in the human beings, while gestural communication is. In fact, when apes gesture, it is more likely to be with their right hands, which are controlled, as you know, by the left side of the brain.

In 1984, however, an interesting discovery was made by Heffner & Heffner, who reported that Japanese macaques (snow monkeys) were in fact left brain lateralized for the perception of their "coo" calls, which are not emotional vocalizations by any means, but social exchanges.[19] Since then, more attention has been given to the social communication that occurs among grooming groups of different apes and simians. Female chimps sit quietly, picking off lice from their sisters and eating them, pulling off bits of dirt and burrs and smoothing their hair, all the while gently clucking or cooing; and all the while blissfully unaware that they are laying the foundations of formal language.

The areas on the left side of brain where language functions are located are in the neocortex, and this is the brain region that accounts for most of the growth of brain from snow monkeys to primates to hominids to human beings. The evolution of societies is associated with expansion of the cortical regions of the brain. Even in the existing primate species, it is the relative volume of neocortex (relative to the rest of the brain) that correlates with the size of their social groups. Larger group sizes correspond to larger neocortical volume.[20]

And as it happened, females were the vehicles of neocortical development. A stunning insight on the evolution of large brains, by Lindefohrs et al, is the calculation that males and females exercise differential effects on cortical development. Lindefohrs began by considering the relative numbers of males and females in different primate species; the proportion of males to females is different in different primates. He found that primate groups that contained more females had higher neocortical volumes than primates who lived in groups with more males. Species who lived in groups with relatively more males tended to have greater subcortical volume, the brain regions that include the limbic system and the hypothalamus, parts of the brain that mediate emotional and physiological responses.[21] This discovery dovetailed nicely with evidence from genomic imprinting that shows that neocortical size is inherited maternally, but the limbic system is paternally inherited.[22] Lindenfohrs concluded that male and female brains have responded to different kinds of social pressures: females

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[18] Dunbar

[19] Heffner, H. E. & Heffner, R. S. (1984) Temporal lobe lesions and perception of species-specific vocalizations by Japanese macaques. Science 226: 75-6.

[20] Cummins, DD. Social norms and other minds: the evolutionary roots of higher cognition. In, DD Cummins & C Allen, The Evolution of Mind, pp 30-50. NY, Oxford, 1998.,

[21] Lindenfors P, Nunn CL, Barton RA. Primate brain architecture and selection in relation to sex. BMC Biol. 2007;5:20. doi: 10.1186/1741-7007-5-20.

[22] Keverne EB, Martel FL, Nevison CM. Primate brain evolution: genetic and functional considerations. Proc R Soc Lond. 1996;262B:689–696.

to social integration, males to male-male competition and fighting.[23] It is, however, the neocortex that has expanded dramatically during the course of hominid evolution, not the limbic system.

Hominid females were larger, relative to males, than subhuman primate females, and human females are the largest of all. So, our African Eve was able to assert cooperation and protectiveness as social values for the band by insinuating a larger neocortex into her male and female progeny, with its particular capacity for prosocial behaviors: communication and understanding, reciprocity, long-term planning and temporal processing. Primate sisters have always been socialized; cooperative care of the young, for example, is the rule among them. Among the hominids, the brothers were gradually socialized as well. Their mothers have gradually been insinuating a female brain into their heads. In the origins of our kind, social cooperation and inter-dependence co-evolved with a large brain, and language is the software that runs the system.**Error! Bookmark not defined.**

Grooming

This larger hominid neocortex is where language formed, especially on the left side of the brain. It is also the part of the brain that enables social organization. The first glimmerings of language occurred in the frontal neocortex as an agent of social bonding, and it began during the long parts of the day when primates sit around and groom one another.

In primates, grooming is the primary agent for social bonding. There is no question that a gentle, caring touch carries more emotional weight than mere words. Words can also have a soothing quality, as we know from the cooing mothers do to their babies and lovers do to each other, but no words are as powerful as a good hug or a great big juicy kiss.

This is no time for a chat! Haven't your lips
Longed for my touch? Don't say how much,
Show me! Show me! Don't talk of love lasting through time.
Make me no undying vow. Show me now!
Sing me no song! Read me no rhyme!
Don't waste my time, Show me!
Don't talk of June, Don't talk of fall!
Don't talk at all! Show me![24]

Mere words may not have the same emotional weight, but they have the advantage of serving many functions in addition to social bonding. Gestures, expressions, touch may be more central to our experience of attachment, but language has superimposed itself on all of that because it do so many other things as well. Nevertheless, it holds on to its roots as an agent for social bonding. So much of our conversation, even now, is devoted to the exchange of social information: our children, our spouses, our friends, what they did and how they felt about it. No news travels faster than the news that A and B are getting married, except perhaps that A and B are getting a divorce. When Time magazine was a respectable publication, it had a small section called "People." The section was so popular, People morphed into a publication in its own right, and now it has 400,000 more subscribers than Time. When you meet someone who only talks about his work or his golf game, you consider him an infernal bore. If this book were just about theories of attachment and evolution, and if I hadn't given you stories about real

[23] Sexual selection on males and social selection on females have exerted different effects on primate brain architecture. Species with a higher degree of male intra-sexual selection carry a neural signature of an evolutionary history centered on physical conflicts, but no traces of increased demands on sociocognitive tasks. Conversely, female sociality is indicated to have driven the evolution of socio-cognitive skills. Primate brain architecture is therefore likely to be a product of ecological and species-specific social factors as well as different sex-specific selection pressures. (Lindenfohrs et al, op.cit.)

[24] Eliza Doolittle in Oscar Hammerstein, My Fair Lady

people and their travails, I don't think you would have got this far. That is the reason this chapter is at the end of the book.

It is possible to fight without using language, it's possible to compete, to deceive, to exploit without language. Animals, even fish and reptiles, do all of those things perfectly well. But it's not possible to cooperate very well without language. It's not possible to distribute intelligence. You might could teach a kid to use a stick to catch termites – one of the high points of chimpanzee "tool-making" – but endeavors of greater complexity require more complex communication, and language is a very efficient form of communication.

We are participants, therefore, in an evolutionary line that is accelerating at an exponential rate, and it has been for some time. And remarkably, the most recent developments have been the most important. The rudimentary language of early hominids developed structure and breadth, and that generated another virtuous cycle. Smarter hominids had more to communicate while they were grooming one another and so they invented words to do that. Words increased the collective intelligence of the social band, increased the level of cooperation and environmental mastery and supported the survival of even smarter children. Genetic changes that increased the size and efficiency of the neocortex were easier to accommodate. Since our own species was created, perhaps 200,000 years ago, there have been at least three such changes. Mutations in genes that are associated with speech, language and brain growth are known to have occurred about 100,000 years ago.[25] [26] About 50,000 years ago, humans carrying those new genes spread out of Africa and summarily replaced all previous hominid migrants, including the colonies of *H. sapiens* who had migrated earlier.[27] [28] [29] Then, fully modern languages were formed, around 40,000 years ago, associated with a sudden and marked improvement in stone tool technology.[30] At the same time, we see the first representational art in the caves at Lascaux. Around that time, the dead were buried with ritual and surrounded with objects that symbolized their lives or perhaps that they might need in the afterlife. Human beings, *H. sapiens sapiens* by now, were developing the capacity for abstract thought. Then, another genetic mutation arose, only about 5800 years ago and has since swept to high frequency.[31] This is simultaneous with what is called the Paleolithic revolution, the development of agriculture, cities and literacy. Two of the most recent mutations, in Microcephalin and ASPM, both have a very young genetic signature; they may still be evolving in *H. sapiens*.[32]

It is a fair guess that love as an abstract concept developed sometime within the last 40,000 years, or perhaps in the past 5800 years. Does that mean that everyone before that time was just attached, and then love happened? I don't think so. I think that love evolved over the past 2,000,000 years, and the seed of it has been around much longer even than that. Love is something like a germ cell in all of the social animals, and the growth of intelligence and language have just allowed us to appreciate it for the force that it is. There is no question that the strongest words that we have are "friend" and "trust" and "love." They speak to something that is very deep, not only within us, but deep in our evolutionary history.

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29 Biochem Biophys Res Commun. 2006 Jul 7;345(3):911-6. Molecular genetic determinants of human brain size.Tang BL.
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32 Biochem Biophys Res Commun. 2006 Jul 7;345(3):911-6. Molecular genetic determinants of human brain size.Tang BL.

MIRROR NEURONS

In the next section, equally devoid of stories about people but with some cheerful little animals, we shall talk about how love happens to your brain. We still haven't defined it properly, as you may have noticed, but before we do, there are still a couple of steps to take. Before we leave the topic of language, I should tell you how we think that happened to your brain. It probably has to do with "mirror neurons."

I mentioned before, when we were talking about snow monkeys, how primates communicate largely through gestures, and the control of gestural communication in primates is somewhat lateralized in the left hemisphere. Gestural communication includes facial expressions, hand gestures and body language, and is usually thought to be a precursor to language. It is still an essential component of communication. Gesture and speech are entirely different modes of expression, with different formats: speech conveys information in a "segmented, combinatorial format," while gestures convey information in a "global, mimetic format." When gesture and speech arise together out of a single idea, they communicate a coherent message: saying *I don't know* and shrugging one's shoulders at the same time. Sometimes, though, they convey contradictory information: *I don't know* accompanied by a nudge and a wink.[33] When someone's gestural communication is at variance with his words, we are well advised to attend to the former. That is because gestural communication is phylogenetically older, more securely automatized, and less amenable to conscious control. If some fellow happens to say *I love you* your grandmother would advise you to *Look into his eyes*.[34]

Gestural communication is older than vocal language and it lays down a logical foundation upon which language can develop. How this happens was explained by Jean Piaget, a French child psychologist, who studied the cognitive development of children. The earliest period of logical development, according to Piaget, was a "sensorimotor period" in the first two or three years, before the child developed any language at all. Sensorimotor logic was *the logic of actions (relations of order, interlocking of schemes, intersections, establishment of relationships) rich in discoveries and even in inventions (recognition of permanent objects, organization of space, of causality).*"[35] An infant's first behaviors are random and reflex-driven. These are gradually supplanted by rule-governed behavior (touching, grasping, pointing, directing gaze, looking away, locomotion). The neural mechanisms that mediate these behaviors develop into logical devices for thought and as devices for the transmission of conceptual information.**Error! Bookmark not defined.** Kimura referred to this as the "internalization of moving body parts"[36] This is the same developmental process that we discussed in the previous chapter when we talked about "behavioral systems," "affectionate systems," and "internal working models."

The neural basis of sensorimotor logic resides in an interesting family of neurons that are involved in gestural communication, the so-called "mirror neurons." Mirror neurons are a thoroughly unique type of nerve-cell that have a dual function. They function as motor neurons, controlling movements, but they also function as sensory neurons, perceiving the same movements if they are performed by another individual.[37] Mirror neurons fire when a subject performs a specific motor action (e.g., the monkey picking up a mug) and they also fire when

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[33] New Dir Child Dev. 1998 Spring;(79):29-42. The development of gesture and speech as an integrated system. Goldin-Meadow S.

[34] Duchenne proved that a smile is generated by two muscles: the zygomatic major, which controls the mouth, and the orbicularis oculi, which surrounds the eye. The latter is cannot be controlled voluntarily, but the former can be. That is why a mouth smile, sans eye smiling, seems insincere. Smiling with one's eyes is physiological proof of a sincere emotion. Psychopaths, I think, are mutants who can exercise willful control over their their orbicularis muscles.

[35] Piaget J. Language and learning: the debate between Jean Piaget and Noam Chomsky. Ed, M Piatelli-Palmarini. Cambridge, Harvard Univ Press, 1980.

[36] Kimura, D. Neuromotor mechanisms in the evolution of human communication. In Neurobiology of social communication in primates, eds, HD Stecklis & MJ Raleigh. NY, Academic Press, 1979.

37 Behav Brain Sci. 2003 Apr;26(2):199-208; From mouth to hand: gesture, speech, and the evolution of right-handedness.Corballis MC.

the motor action is simply observed (observing a second monkey picking up a mug).[38] The first monkey isn't doing anything, just looking at monkey number 2. But the mirror neurons in his brain are firing, as if he were performing the action, when the second monkey is doing it.

The mirror neurons are probably related to contagious behavior, like yawning, and to unconscious imitation, as when you find yourself leaning forward with your head on your hand, just as the person you are talking to is doing. But why in the world would nature choose to insert a number of neurons in our brains that were responsible both for observation and execution? There are certainly enough neurons in the brain to support a separation of these functions, and, in fact, in the main, they are. One of the basic rules of neurology is that there are motor neurons here, in the front, and sensory neurons there, in the back. This is the way God made our brains, and the brains of all the other animals that have a cerebral cortex at all. Why, then, do we have mirror neurons?

The answer lies in the importance of imitation. Contagious yawning and echopraxia are simply peculiarities that the mirror neurons are prone to. The reason why we have neurons that are equipped both to observe and execute is that they are ideally equipped for the purpose of imitation, and three things that seem to have arisen out of imitation, learning and language and emotional responsiveness. Observing the actions of monkey number 2 doing something gives monkey number 1 a template for doing the same thing and with minimal cost in brain energy because the template is formed in the same nerve cells. Imitation, therefore, is an elaboration of sensori-motor logic as an extremely efficient basis for learning.

There are only a few neurons in the brain that are equipped with this extraordinary dual function, and they are dedicated, it appears, to only a few behavioral functions that are so important they require a very efficient system. One of those functions is sensorimotor logic, learning the basis for the relations between our movements and the things around us, not only by doing but also by observing. Another function is communication. Mirror neurons are concentrated in the language areas of the frontal cortex, and scientists have made a strong argument they are the agents for the development of language.[39] [40] Imitation is a simple system in chimpanzees but it is a complex system in hominids. It was likely the basis for pantomime, the earliest form of story-telling.[41]

The mirror neurons are also involved in the experience of empathy. When you find the person you are with leaning forward as you do, with his cheek resting on his hand, as yours is, and the low, gentle tone of his voice the same as yours, you get the idea that the two of you have a connection going. You may be right, because your mirror neurons are probably firing in synch. As it happens, the two of you don't just have mirror neuron networks in the brain regions that serve gesture and language, but also in the insula and the mesial frontal cortex, regions that subserve emotional response. Neurologists have come to identify the function of mirror neurons as a way to understand the actions of other people and their intentions behind them. They are a sort of "virtual reality simulator" of the actions of another person, allowing one to empathize and view the world from his or her point of view.(Ramachandran & Brang, 2009). People who are autistic, in contrast, who have deficits in language and the ability to empathize with other people, are found to have lower levels of activity in the brain regions where the mirror neurons dwell. (Cattaneo & Rizzolatti, 2009) Neural mirroring solves the "problem of other minds," how we can access and understand the minds of others. It makes intersubjectivity possible, and facilitates social behavior.(Iacoboni, 2009) Finally, the anatomy of the human mirror neuron system exhibits gender differences.

38 Gallese et al. 1996; Rizzolatti et al. 1996; Kohler et al. 2002

39 Brain Lang. 2007 Jun;101(3):260-77. Speech-associated gestures, Broca's area, and the human mirror system.Skipper JI, Goldin-Meadow S, Nusbaum HC, Small SL.

40 Rizzolatti G, Arbib MA. Language within our grasp. Trends in Neurosciences. 1998;21:188–194. [PubMed]

41 Behav Brain Sci. 2005 Apr;28(2):105-24; From monkey-like action recognition to human language: an evolutionary framework for neurolinguistics.Arbib MA.

As you might expect, women have significantly larger gray matter volume in mirroring regions than males do.(Cheng et al., 2009)

I have taken this little discursion into the world of mirror neurons in hopes it will lend a neurological veneer to an otherwise speculative exposition about the evolution of intelligence and language. It is also to underscore the point of my argument. The development of language was accomplished by the same neural system that is also central for the development of empathy and affection. Intelligence and language, our most elaborated attributes, appear to have evolved in the same types of brain cells that govern our capacity to connect with, to attach to other human beings. When they got to a certain point, to the point where they could really start understanding things, they discovered that it was love, all along.

Excuse me, though, for throwing “intersubjectivity” at you. It is an ugly, Latinate word. Even “empathy” is a bit technical, a Greek word, as you might imagine. The guy with his hand on his cheek is exuding intersubjectivity and empathy, but when he takes his hand away from his cheek and puts it on your knee, your mirror neurons will just be firing away. The words they generate, though, will be neither Latin nor Greek, but one of two good Anglo-Saxon words, “friend” or “creep.” The mirror neurons in your mesial temporal cortex may be firing away but your brain is doing a lot of other things, too, before the arrow falls on one or the other Anglo-Saxon word. How the arrow falls is the subject of the next chapter.