Tools of Perception - The Construction of Reality

By Howard Bloom.

History of the Global Brain - VII

Between 65 million years ago and the present, collective intelligence tentatively stretched toward globality once again. The bird species salaciously called tits showed up on the scene roughly ten million years ago. Airborne, they were high-speed spreaders of behavioral memes. It is difficult to tell what kinds of tricks these creatures passed to one another in prehistoric times.

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The diversity generator of competition between feathered flocks launched new variations on antique ploys. To get a notion of how this must have worked, it's useful to eyeball another modern example. The oystercatcher, whose ancestors evolved roughly 50 million years ago, lived on seacoasts and used a flat, knifelike bill to dig worms and shellfish out of sand. Evidence suggests that during the last five hundred years some Scottish and British oystercatcher flocks were crowded out of easy pickings on the beach and forced to look for feeding grounds in savagely unfamiliar terrain. They moved upriver - an unheard of step for birds adapted to the edges of the sea. Eventually, the homeless wan-

Some idea about the tricks comes from an incident famous among animal behaviorists . During the late 1940s, London's milk vendors replaced cardboard bottle caps with aluminum foil. A few blue titmice figured out how to pierce the flimsy metal so they could sip the liquid's crown of unhomogenized cream. So rapidly did this innovation spread that seemingly overnight dairy robbery was fattening the bellies of titmice the length and breadth of the British Isles. Conformity enforcers had spread a potent meme.

derers discovered a paradise not presaged by instinctual memory: irrigated farm lands and riverine wetlands perfect for the excavation techniques built into their genes. Like bacterial "random walkers," they'd opened a vast new resource to the species. In this way non-conformists had made their contribution to a planetary software pool.

The contagious ways of doing things called "behavioral memes" knitted separate species together. Pleistocene mammals still live side by side in the Serengeti plains of East Africa: the zebra, the wildebeest and the Thompson's gazelle. When the dry season sucks life from their flat pastures in the southeast, these animals make a hundred mile procession north to hilly Kenyan woodlands rich in watered meadow. Zebras lead, each year improvising a new track, but always with the same destination in mind. The herd of wildebeests - a potential chaos of a million animals - is conformity enforced to follow the striped equines. Then the delicate gazelles, taking their memetic cues from the zebras and the wildebeests, are swept by imitative drives to bring up the rear. When the immense migration reaches its goal, the diversity generator of speciation fits these varied animals into a megapartnership. The first arrivals, zebras, crop the roughest and tallest grass - food too tough for wildebeests to eat. This browsing exposes tender mid-height shoots upon which wildebeests can make their feast. By the time the gazelles appear, the turf is sufficiently low to offer their favorite dish, ground-hugging vegetation. Though memeless, the grasses join the multi-species circle dance, repaying the pruning they've received by sending up fresh shoots and stalks. Chimpanzees

, which became a separate species roughly six million years ago, developed flourishing cultures - inventing memes and passing them down the generational chain. The chimps of Gombe and of today's Tai forests created sets of tools for opening palm-oil nuts. The implements of the Tai, Mahale and Gombe chimps are subtly different and used in different ways. All three groups have learned the handiness of sticks. But only the Tai have figured out that twigs and branches can be used to pull the marrow from the hollow of a bone. Mahale and Tai chimps use their fingers to nab the protein snacks we call termites and ants - stoically enduring their victims' bites. The Gombe residents have mastered the knack of dipping sticks into the fortress entrance of a mound and harvesting bugs in painless quantity. Gombe chimps also use sticks to scratch and clean themselves. Their Tai and Mahale counterparts haven't yet attempted this hygienic art. Even the use of stone hammer and anvil to crack nuts - dependent on techniques so intricate that they can take seven years for a young chimp to fully master - are radically different in each group. There is, however, one stark uniformity - each troop has seized the "concept" of tool use.

The strangest networkers of all first climbed to their feet roughly four million years ago. Their hands were more dexterous than those of chimps. Chimpanzees tossed stones and sticks at tigers and others who invaded with potentially evil intent. But their aim was pathetic and the distance they could clear was barely 20 feet. Proto-humans had a hurling arm and an aim sufficiently sure to bring a bird down in mid-flight. Their fingers were nimbler too. Chimps primarily use stone tools ready-made by nature. Humans took a far more active role in this technology. Chimps had already invented weaving (though birds had beaten them to it). Every night the mini-apes interlaced leafy boughs to make a sleeping nest. Humans were equipped to knit far more than this one artifact.

Roughly 2.7 million years ago, Homo habilis began to crank out tools from stones and bones. In the beginning, this was largely a matter of finding a rock which was already sharp or a cracked rib with an accidental point, techniques on a par with those of chimpanzees. Our shallow-skulled ancestors (their thinking apparatus was half the size of what we carry in our skulls today) had figured out how to use crude implements to dig and grind. The technology spread from group to group, but only reached from Ethiopia to adjoining Kenya, a distance animals like birds would have found disdainfully small. It took a million years or so before the communal intelligence of proto-humans stretched its scope. Then Homo erectus, with a 56% larger brain, came up with two new breakthroughs - tapping one stone with another so skillfully that the target rock's lines of stress fractured, dislodging flattened slivers small and large. Later the new hominids devised a second step: creating hand axe blades by tapering each side of the rocky sheet. Now the spread began to leap. Early flaking travelled from Northern Africa to the continent's far south. From 1.8 million years ago to roughly 500,000 years ago, it somersaulted the thousands of miles to Europe far in the northwest and China in the almost unimaginably distant east. The hominid collective mind was going global, carried by what archaeologist Clive Walker calls "timewalkers" - those of our ancestors seized by travel lust. African tool making forms (termed Oldowan) were used from England, Hungary, Germany and Israel to Peking. Separation did not create major change, nor did time. The Acheulean-style stone axe was in use from 1.5 million b.p. until a mere 4,000 years ago.

As humans spread, so did other signs of their unfolding global mind. Fire was popular in both Africa and China over 400,000 years ago. The axon of travel had spread Promethean flame across a walking distance of over 10,000 miles. The stone tool kits of that period, whether in Africa, Europe, or Asia, were very much the same. Again, the glial tissue of learning had

shuttled a common pattern across a far flung neural weave. Wherever men and women went, they carried their emulative memes. So fiercely did the conformity enforcer work that it guaranteed a common shape for tools during 1.5 million years.

The environments over which men swept spurred diversity generators too. In Southeast Asia many anthropologists are convinced men learned how to fashion their hunting tools not from stone and wood, but from a plant able to take a sharp, hard point - bamboo. 100,000 years ago more regional variations cropped up. This took another 20% boost in brain size - brought by our immediate predecessor and near lookalike, Homo sapiens sapiens . In the north, men contrived ways to cope with vicious cold . Weather shifted cataclysmically, lakes of immense size appeared and disappeared, new lands opened as oceans shrank then closed again beneath returning waves, and even the Mediterranean Sea changed and rechanged utterly. All this provoked new forms of flexibility. Proto-humans echoed the ancient patterns of bacteria, which triumph over catastrophe by forging whole new ways of life.

Chimpanzees and baboons long ago learned to hunt in groups. The meat of colobus monkeys is a favorite among chimps, who cleverly deploy in squadrons to corner their elusive prey. Baboons occasionally invent team tactics to bring down a small gazelle or wild pig. But after several years, the males who bring home bacon move on and forget this social skill, only to eventually create it once again.

By 35,000 years ago, brains like our own were allowing humanity to realize exploits far beyond the animal ken. Chimps do not forget the tricks of group hunting. Nor did we. With our delicately flaked stone tools, now far more sophisticated than they'd been two million years earlier, we were able to strip the fur from our prey (woolly mammoths were popular, in those days of ice), carve out their ribs, use the calcium struts as framework for large homes, and cover the crescent-shaped bones with fur. One pelt would not suffice to tent a house of substantial size. Our ability to use one tool to fashion another, something no bird or chimp seems to have known, allowed us to extend weaving far beyond the limits to which chimps and birds had taken it, making threads from sinews and needles from bone. With these our ice age ancestors could stitch enough hides together to roof and side their skeletal supports. They could also fashion pelts into elaborate clothes, then encrust their haute couture with beadwork made from carved, drilled and polished bits of bone. Our new skills had brought us back to the elaborate decoration of early bower birds.

Why the constant echo of the same forces, even many of the same modus operandi, among men, microorganisms, birds and other beasts? It's often said that humans differ a mere 1.6% to 3.6% in our chromosomes from chimps. But we forget that most of our genes we share with life forms from the most to the least primitive. We are all programmed by a common heritage. In later episodes I'll suggest a theory to explain why old motifs reappear in the strangest ways. Why men, for example, are compelled to act so much like quarks and leptons hungering for companionship. This theory penetrates the cosmic tapestry to a level molecules, genes and emperors must obey. But we will have to save the unveiling of this scalpel for a later time, and first see how the pentagram of complex adaptivity works its deepest mysteries.

1 Language Networks

Knitting nodes of humans like synapses was long distance trade, which first reared its head two million years ago, specializing in the swap of rare and workable stone . A crucial aid in the give and take of craft and raw material was a transmitter capable of threading whole new kinds of intricacy from one mind to another. More than the wrrs and chutters of monkeys, this was a brocade of sound that gathered tufts of meaning into tapestries. Specialists call it syntactic language: noises linked in structured chains of nouns, verbs and adjectives. Some theorists propose that the germ of sentences may have appeared two million years ago. One hypothesis suggests that speech's rise coincided with the beginning of tool making. Another says it came about as a substitute for the grooming which holds a troop of monkeys or apes together. Even the most cautious expert seems to agree that full-fledged language was in place by 30,000 years ago. Amidst the wealth of speculation, one bit of evidence stands out. Analysis of a two million year old skull from Koobi Fora in Africa indicates that Homo habilis possessed a patch of brain unknown in our previous ancestors. This new cerebral curio was Broca's area - an apparatus vital to fluid, nuanced self expression .

For many episodes, I've traced a form of socially transmissible knowledge not recognized in previous memetic schemes: the behavioral meme. Human and animal bodies pick up information from pressure gauges in the bottoms of the feet, from nerves which wrap the base of fur and body hairs, from others sensing the vibrations of bristles in the ear, from the tips of neural fibers groping molecules in the nasal cavity's air, and from light detectors in the eye. The nervous system zaps these gleanings to a jerry rig of gadgetry whose strange ways we'll soon see. And all is funneled through the emotional center of the brain - the limbic system - a leftover from reptilian and early mammalian times. There, instinct and personal memory set off signal flares such as excitement or disgust. Should a batch of input spark a meaningful ignition, the limbic

system routes the arrival to the storage lockers of the mind. But not all storage lockers are the same. In fact, there are two radically different kinds.

If the entering experience is fear, elation or a body movement - leaping from the top branch of one tree to another, riding a bicycle, hammering a recalcitrant nut into giving up its meat - it is shuffled down to the amygdala and planted deep under the eaves of the cortex in a curved mesh of axons called the striatum, with excess packed away in the motor and sensory pathways, the cerebellum, and a widespread nervous system so out of our control that its very name is "autonomic." We've seen the bewildering variety of animals who can manage this imitative learning feat, catching the passed football of emotional and muscle memories. In humans implicit memes remain outside of our awareness. Yes, we know how to ride a bike. But the finest rally racer can't explain the symphony of neural cues he uses to sustain a simple thing like balance. If we focus consciously on the angle to which we must adjust each vertebra while slaloming through traffic at top speed, we are likely to lose the hang and scrape our head on asphalt.

Broca's area, the brain enhancement possessed two million years ago by the Homo habilis known as KNM-ER 1470, helped create entirely new forms of data cabinets, those which house explicit memes. Explicit memories, the kind we can recite and convey by speech, the kind that our story-telling consciousness can spin into detailed instructions or share with a high-paid shrink, take a very different route to permanent storage. They pass upward to the hippocampus, where they are distributed to the cortexes of the temporal lobes, accessible to manipulators like Broca's area and to two others which emerged in early Homo habilis - the supramarginal and angular gyri . These are some of the processors which prep data for our blathering consciousness and tongue .

Language laces spectacular new properties into the group brain. Among other things, it stitches individual minds into a quilt of mass hallucination - an intricate shared vision able to carry a tribe beyond all visible horizons or to throw the clan dramatically off course. This consensual delusion - known to us as "human culture" - has become the most intriguing network-splicer of them all. But within it lies a paradox - for language and culture spawn simultaneous opposites: conformity and diversity. The wrestling of these intimate antitheses gives the group brain of humans an agility not seen since the creative global web which first arose among cyanobacteria some 3.5 billion years ago.

However, to unravel the weave and clash of culture's phantasms, we must first expose one of the strangest ways in which conformity enforcers needle-and-thread generations and widely dispersed humans into a common drapery...the illusion of "reality."

2 What is "Reality"?

> This way, that way, I do not know
> What to do

I am of two minds.

Back to basics for a moment. Just what is "reality?" Is it an oh-so-solid thing you can pound with your hands and rivet with your eyes? Or is it, as postmodernists proclaim, a projection of the social brain? Postmodernism is often a fashionable bungle of obfuscation, but in this case the eyes and hands don't have it - the "radical constructionists" do. Reality is more a fabrication than even the trendiest postmodernists suspect.

In the late 1930s and early 1940s, logical positivists said that knowledge broke down into two parts: "sense-data, and the conceptual structures we use to clip the sense data together." One formalizer of the emerging philosophy, J.S.L. Gilmour , proclaimed that sense data are "objective and unalterable." Good guess, but no cigar! Canadian neurologist Wilder Penfield's studies are often cited by those who believe reality is a concrete thing we perceive without distortion. When Penfield touched the naked brains of neurosurgery patients with electrodes in 1933, they reported vivid, detailed memories. The conclusion many drew and continue believing to this day is that the brain warehouses fine-grained tapes of past experience. Later analysis showed this conclusion was mistaken. Many of the "memories" were confabulations. One patient , for example, recalled the time that he'd been robbed down to the minutest detail. There was only one problem - he'd never been robbed in his life. The reality of the external world registers poorly on the human mind. One eyewitness to Abraham Lincoln's assassination swore the killer had crawled away on his hands and knees, another said he'd leaped fifteen feet, a third declared that he'd stopped to deliver a line of Latin, and a fourth said emphatically that he'd shimmied down a flagpole. There was no flagpole at the scene. Even the most highly trained observers end up mixing fiction with their "facts" . Before chromosomes were discovered, scientists looked carefully at cells then drew what they had "seen" without a chromosome in sight. After chromosomes had become accepted truths, researchers suddenly peppered their "unvarnished" cellular portraits with the things. Lacking the concept of the chromosome, observers would have sworn these objects were not there. Other oddities

spindle, fold and mutilate the seeming firmness of "the real world." Turn the level of lighting up and down and the sound of a nearby buzz saw seems to rise and fall

as well. If you shine a light and play a faint tone over and over again, then turn on the light in utter silence, the mind will hear a tone that isn't there.
The image that we see is the end product of chopping, coding, long-distance transmission, neural guesswork and editable cut and paste. The slice and dice begins in the eye itself, which separates and reshapes input rather than merely taking snapshots. Some photo cells are specialized to register a fine edge. When they spot what they are looking for, they take enormous liberties. They "request" that the cells around them cease reporting what those cells "see" so the edge-experts can spotlight the contour which they're working to pick out. Yes, data-juggling begins at very the frontier where our senses meet the outer world.
Next come radical forms of transmutation. Photo cells transmogrify incoming light to a pulse of chemicals and electrons. Twisting things even further, the 125 million neurons of the eye must compress their hoard of interpretations to a code able to squeeze through a cable a mere million neurons in size. On arrival in the brain, the compacted stream stops briefly in the thalamus, where it is mixed, matched and modified with flows of input from ears, muscles, fingertips, and even sensors indicating body position.
The thrice rearranged jumble of jigsaw pieces is sent off to the visual cortex, where it is divided up again. Each portion is tucked into a separate storage belt responsible for gleaning a different type of meaning. If you're twirling in a swivel chair , one belt will reshape the blur whipped past your eyes to a picture crisp with artificial clarity. Meanwhile neurons from all over the brain sift scattered fragments, trying to contribute their own sense of them. For instance, cells which signal if an animal or human is friend or foe add their best guess to the moving batch of "sensory" ingredients.
Finally a council of representatives from the superior colliculus, the thalamus, the locus coeruleus, the hypothalamus and the occipital cortex pool their squabble of conclusions and cast a vote on what the twinges of light impinging on the retina might be. Not until they've agreed on an image do they send it to the left cerebral hemisphere, presenting it as a panorama accompli to the conscious mind. What we see is not the product of direct perception, but of a reconstruction which borders on fragile artistry.
The assembly process we call "sight" is so powerful that if you are given a set of goggles whose custom lenses turn everything you see upside down, eventually your sensory construction crew will take the topsy turvy rays of light and rebuild their image upside up.
The eyes are not the only "senses" which use a Rube Goldberg process to simplify the world. The entire human body is composed of separate systems bouncing signals back and forth, sometimes conflicting, sometimes reaching a disturbingly synthetic compromise. Dr. Michael Gazzaniga feels a center in the left cerebral hemisphere pulls together messages from the competing factions and fashions them into a policy statement of the moment. It also uses them, in Gazzaniga's opinion, to construct a theory which it calls the self and another which it calls the world. But that ever-changing theory can be terribly off base.
Often we don't have the foggiest idea of what's going on in our most immediate reality - our selves. Researchers rigged subjects to a finger-pulse stress detector, then ran their human guinea pigs through a modestly hair-raising situation. When the ordeal ended each victim was quizzed on how he or she felt. "Fine" said many, whom the stress detector indicated were very rattled indeed. "Upset," said others who, according to their physiological signals were actually quite calm. Further studies have shown that adolescents who report they are aggressive often aren't, and those who say they're not aggressive are. In one research trial, women were hooked up to a device measuring vaginal blood volume and given an erotic story to read. Many who said they were aroused weren't, and many who said they weren't were. In yet another experimental probe, subjects were wired to an electroencephalograph rigged to register sleep and were allowed to doze off. Though many fell into a solid slumber, they usually were certain they'd stayed wide awake.
As we shall see in our next episode, the internal assembly steps patching together our reality are filled with open loops demanding input from a crowd of other human beings. At a level far, far deeper than we know, even the most granite of our solidities is a chimera frozen in position by the conformity enforcers of the communal brain.

Published on 1997-10-30 00:00:00 in Telepolis
http://www.heise.de/tp/artikel/2/2073/1.html.