Chapter 6
Mind

Abstract This chapter defines mind as a subdomain and internalized posting of the psychological and makes it a specific and defining feature of the mammal. It is argued that mind as a faculty of emotion, memory, and representation, and anchored in the limbic system, has evolved from REM sleep in the early evolution of the mammalian brain. The name-giving feature of the mammal is the breast-feeding of its off-spring, and it is described how this reproductive mode is the end-result of an evolutionary trend from a quantitative reproductive strategy (safety in numbers) to a qualitative (safety in extended care). Finally it is described how the unique mammalian features form a complex and place the mammals in their own distinctive life-world.

From Theatre to Computer

If you found *sentience* and *intentionality* to be stressful subjects, *mind*, the next evolutionary subdomain, should come as a relief. It simply means what it has always meant to English speakers, or at least has since the days of the first British Empiricists. Namely, a receptacle inside the head, fed with sensory input from the outside, in which impressions, emotions, and thoughts reside. David Hume, co-owner of a theatre in Edinburgh, said it perhaps best: "The mind is a kind of theatre, where several perceptions successively make their appearance; pass, repass, glide away and mingle in an infinite variety of postures and situations."[1] A theatre is exactly what the mind is, complete with front stage, stage lightening, curtains, backstage, wardrobes with costumes of the wildest variety, cellars with old sceneries and props, and lofts with trunks full of scripts and old screen plays that can be replayed again and again and reworked over and over, a place of memories, imagination, and dreams.

When Aristotle said that higher animals—a step above simple animals on his psyche-ladder—have imagination and nocturnal dreams,[2] it would be *mind* he was

[1]Hume (1739, Book I, Part 4, Section 6).

[2]"Imagination is that in which an image arises for us…Imagination takes place in the absence of [sensation], as e.g. in dreams … If actual imagination and actual sensation were the same, imagination would be found in all the brutes: this is held not to be the case; e.g. it is not found in ants or bees or grubs." Aristotle, *De Anima*, iii, 3.

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talking about. In his evolutionary AT scheme Leontiev identified this stage with intellectual activity and insight, that is, the ability to combine operations into new solutions in the head before proceeding to execution, and that would be *mind* also.

A station between input and output, mind is basically the *intervening variable* between stimulus and response ($s \longrightarrow o \longrightarrow r$) introduced by Tolman, sometimes called *the black box,* and supplied with an elaborate algorithm[3] by Clark Hull, who said, "It should be a matter of no great difficulty to construct parallel inanimate mechanisms, even from inorganic materials, which will genuinely manifest the qualities of intelligence, insight, and purpose, and which, in so far, will be truly psychic." Hull, the founder of what has been called Mechanistic Behaviorism, continues: "That such mechanisms have not been constructed before is doubtless due to the paralyzing influence of metaphysical idealism." That would include the intentionality described above, which RT considers its anti-scientific archenemy; victory was in sight, however: "The appearance of such 'psychic' mechanisms in a not very remote future may be anticipated with considerable confidence."[4]

With the advent of the computer soon after, the prediction came true with a vengeance, and lowly stimulus-response psychology was elevated to cognitive science. As RT recognizes no principled dividing line between man and machine, cognitive science was born with two programs: To turn the mind into a computer; and to turn the computer into a mind (AI). In other words, with cognitive science, our mind is made into a computer in place behind the eyes and between the ears, a carriable and programmable *head-top* with memory storage, editing facilities, and analytical capabilities.

This is very excellent too; the mind is precisely such a head-top. To have the courage to accept this is vitally important. Because it is basically correct, but first and foremost because it is the key to understand psychology. English speakers use the terms 'mind' and 'mental' for everything psychological, which tends to make a distinction between mind and the psycho-logical impossible, and, by turning everything into mind, makes the psycho-logical invisible.[5] The first step is therefore to separate the two, next to give each their due, and finally to have them meet again in mutual respect.

We give mind its due, when we accept that it is precisely what the RT-people say it is, an informational input-output machine, a head-top computer, albeit built from sentient bio-components. Only this logistical device is *not* itself the psycho-logical; Hull's inverted commas around 'psychic' were rather well-placed. As Leontiev

[3] $sEr = sHr \times D \times K$.

[4] Hull (1930, p. 256).

[5] Continental thinkers do not have the same problem, but when Samuel Coleridge first tried to introduce the term 'psychology' he was met with little success. Glasgow professor William Hamilton explained: "[*w*]*hy use an exotic, a technical name? Why not be contended with the more popular terms, Philosophy of Mind, or Mental Philosophy—Science of Mind or Mental Science—expressions by which this department of knowledge has been usually designated by those who, in this country, have cultivated it with the most distinguished success?*" Hamilton (1866, pp. 91–92).

writes, "The introduction of the concept of intervening variables undoubtedly enriches the analysis of behaviour, but it does not remove the postulate of directness."[6] (That is, the local motion character defining of stimulus-response.) Mind, however elaborated, is still stimulus-response, RT and not AT. If not itself the psycho-logical, mind, however, becomes a receptacle of the psycho-logical.

The *psycho-logical* is first and always *a relation in the world,* the intentionality corollary to the second law of thermodynamics described above. With mind, however, the psycho-logical becomes *internalized.* The psycho-logical is still a relation-in-the-world, but this relation can now be represented as an *internalized relation-in-the-world* also; bits and pieces of real life can be played out in the mind, as our nocturnal dreams vividly show. The content comes from the world, only it is moved unto a different stage, placed in a different medium, and that is what makes both the theatre- and computer-analogies so apt. And like the theatre-goer has no interface problem because the life content is already hers from her real life before she starts watching the play on the scene, the owner of the mind head-top is not cut off from real life and has no interface problem either. The interface problem severing mind and world only appears if you insist that your only access to the world is sensory, not existential, which, of course, the Empiricists did for theoretical reasons. Clever David Hume was well aware of that. Or, at least he was when he played back-gammon.[7]

As a mechanism of internalized representation intervening between input and output, and the brain being the ultimate intervening variable, mind is a brain-feature also; the only field of psychology to which the brain holds a necessary key, in fact. Which, of course, explains and justifies the preoccupation cognitive science has with the brain, even if this has furthered the unhappy reduction of psychology to brain science that is the present trend.

The REMS Model and Mammalian Evolution

In a tentative model I suggested many years ago,[8] and the principles of which I still believe, the intervening variable in the stimulus-response link is an ability momentarily to arrest the efferent response while the nervous impulse loops through the limbic carousel with its memory banks and emotional stations (see Fig. 6.1).

The most primordial form of the withholding is found in rapid eye movement sleep (REMS), which combines vivid imagery and affective arousal with cataplectic

[6]Leontiev (1978, p. 47).

[7]"I dine, I play a game of back-gammon, I converse, and am merry with my friends; and after three or four hours of amusement, I wou'd return to these speculations, they appear so cold and strained, and ridiculous, that I cannot find in my heart to enter into them any farther. Here then I find myself absolutely and necessarily determin'd to live, and talk, and act like other people in the common affairs of life." Hume (1739, Book 1, part 4, Section 7).

[8]Engelsted (1977), see also Engelsted (1989).

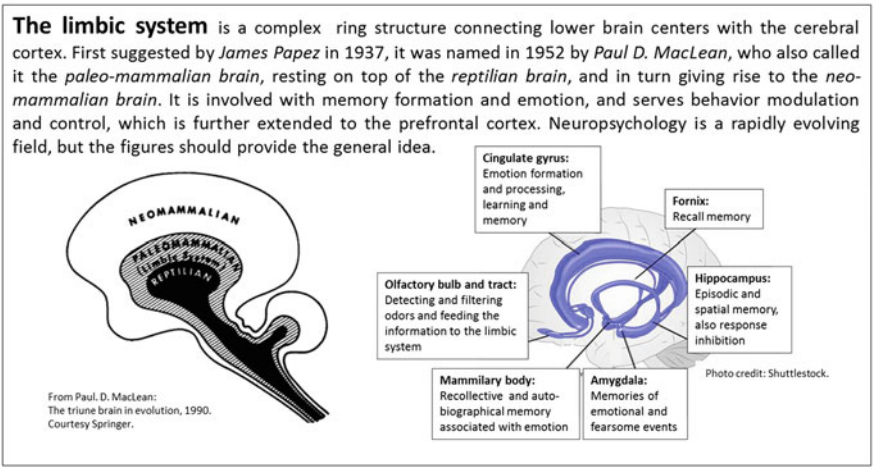

Fig. 6.1 The limbic system

inhibition of the large skeletal muscles, thus making action impossible. With evolution this halting mechanism with potential for deliberation prior to action developed into the more versatile mechanism we here call mind. It is mind that enables the animal to pause instead of immediately jump to conclusion. This allows time for consultation with past experiences stored in limbic and other brain centres, and thereby enables anticipatory future planning.

Notice that this could be called another instance of the negation of the negation. The immediate response (A) is arrested (non-A), leaving time for mindful deliberation, then the inhibition is negated (non-non-A) giving rise to a more deliberate response, which is the new attribute of the mammal.

The included non-A, Tolman's intervening variable, is the mind, and with it a whole new dimension comes into being: *The past.*[9] Thus as *the present moment* came into being with *sentience*, and *the future* with *intentionality*, *the past* comes into being here with *mind*. Present, past, and future are notions of living beings and not of physics, which parses the passing of time with other concepts.

The ability to suspend immediate action extends the time scale of action and transforms the snap *reflex* to the measured *reflection*, the impulsive *affect* to the more persistent *emotion*. It also allows separate actions to be mentally combined and tested before being carried out, as Wolfgang Köhler's Sultan did with sticks and boxes, and Leontiev called insight. Mind simply makes animals smarter.

Birds may have a kind of mind of their own, our family budgerigar did, but the mind we have is a specific mammalian trait. In Aristotelian parlance, mind would

[9]'Mind' is etymologically derived from Old-English 'mynd' and proto-German '*mundiz', which both mean 'remembrance'; 'minde' in my native language means 'remembrance'.

be *the mammalian psyche*. The evolutionary history is a cascade of new and spectacular developments, from prokaryotic to eukaryotic cells, from single cells to multicellular organisms, from invertebrates to vertebrates, from amphibians to reptiles. The mammal is another such invention, and quite radical too.

In contrast with the reptiles from which they first developed in the Permian 265 million years ago, our mammalian ancestors were *endothermic* (warm-blooded) and became for a time the dominant land vertebrates, but only to be later overtaken by another reptile descendant, the dinosaur. Filling all habitats from water to air, dinosaurs ruled supreme for 160 million years until destroyed in the mass extinction following an asteroid strike at the end of the Cretaceous 65 million years ago. The mammals, which had survived the terrors of the Jurassic World hiding away as small night-living insectivores, survived the mass extinction too. With the dinosaurs gone, they came out of the night to fill all the vacated habitats except the air, which birds, the only dinosaurs to survive, held on to.

Their long, long exile during the reign of the dinosaurs explains the major adaptational traits of the mammals, which form an integrated complex. Night-living made *olfaction* the dominant sense—in day living dinosaurs/birds it is vision—and led to a predominance of the olfactory centres, which grew into the *limbic system* as a storage of memories and reminiscences, and, fully to exploit the possibility for deliberation and calculation this offered, next the *neocortex* was added as server support with enormous computational power. Cortex is a neural structure specially designed to analyze sensory patterns, but contrary to vision and hearing, which—James Gibson-wise—produce refractionary images from the perceptual fields of light and sound, there is no such pattern for olfaction to read, its stimulus being only large, drifting molecules. The only way olfaction could 'see' beyond its own nose was if the odour was tagged with the memory of previous relevant situations, and, by recalling these situations—'oh, oh, we have been here before'—make more educated decisions possible. The ability of smells to call forth detailed and emotional memories and images from the past has been famously described by Marcel Proust, but is, of course, known to nearly everybody. This is how olfactory centres developed into limbic structures with memory imagery, and how the neocortical structures were subsequently added as analytical tools to wring out as much information as possible from the relevant images and reminiscences.

The limbic system and neocortex are prominent mammalian features. None of this would be of any use, however, if the immediate response could not be arrested, which made the halting mechanism of REMS a key to the whole mammalian complex. All mammals have REMS and the concomitant imagery; they dream, as Aristotle recognized: "It would appear that not only do men dream, but horses also, and dogs, and oxen; aye, and sheep, and goats, and all viviparous quadrupeds; and dogs show their dreaming by barking in their sleep."[10]

Viviparous means producing live young instead of laying eggs. This is a mammalian feature, though not unique, as hatching inside the female body is found

[10]Aristotle, *The History of Animals,* book IV, 10.

with some reptiles and fishes also. The way it is done in mammals is unique, however. Fetuses must feed too. In the egg, inside its protective shell, they are supplied with non-replenishable yolk and must hatch before the food is used up. In the protection of the female mammal's womb, the fetuses get their nourishment from the body of the mother herself through an umbilical cord.

From the fact that fetuses show extensive REMS in the later stages of pregnancy, it can be argued that the response halting mechanism plays a role here as well. Having a belly full of live and kicking progeny without some means to quiet them down would probably be disruptive. After birth, REMS would be very useful too, to keep the vulnerable young in the nest quietly sleeping for lengths of time during the day when the dinosaur predators roamed, and during the night when the parents went away in search of food. And should a wayward young list away and be chased by a predator, the fright might release the REMS mechanism and trigger a cataplectic collapse, leaving the fleeing and flailing victim prostrate and immobile, and thus—with luck—fall under the radar of the vision dependent predator.[11]

Feeding off the female body does not stop with birth, however. For a long time after, the progeny is provided for with nutritious milk flowing from their mother's teats, which the young suck for life. This is uniquely mammalian, and how the order got its name, *mammae* meaning teats. This makes mammals a radical new leap in a long-lasting trend.

Reproduction, Life's First Priority

Keeping entropy at bay, food and feeding are what living essentially turns on; only the second law of thermodynamics cannot be denied forever. Even before death by aging became programmed into living cells early in evolution, an organism could not count on eternal life; accident, disease, or falling prey to predators would eventually terminate it. Without some other and more permanent way to sustain life than feeding, the food-chain alone would soon finish off life on Earth. Reproduction was the solution, of course. While it still has time, the organism must simply make copies of itself, so that life can continue when it dies. Organisms do; next to feeding, reproduction was always the main preoccupation of living beings, and Aristotle rightly made it the second defining attribute of the living being. From the species' point of view[12]—which the individual does not necessarily share—you may even argue that feeding is subordinate to reproduction, as keeping the individual alive is only a means to make reproduction possible and thus secure the continued existence of the species.

[11]This REMS-response to fright and stress is still around, cataplexy, dream, and all; it is called *narcolepsy* and considered a sickness, which today it is, of course, as the program should have moved up since the Jurassic.

[12]A species does not have a point of view, of course, but species existence has a bio-logic, which in the interpretation of sociobiologists for easy communication often is rendered as a point of view.

Biologists have distinguished two different strategies of reproduction, *r-selection* and *K-selection*, named after factors in a population dynamics equation. In the r-selection, the strategy is safety in numbers. The organism produces a large number of offspring—a female herring as many as 200.000 eggs—and chances that at least a few will survive to reach reproductive age. In K-strategy only a few progeny are produced, sometimes only one, instead the energy is invested in quality rather than quantity, with lengthy parental caretaking greatly enhancing the survival chance of the offspring. As we move up the phylogenetic ladder, K-selection becomes more and more prominent. Magpies build a nest, lay six or seven eggs, sit on them for 17 days until they hatch, and keep watch over and feed the hatchlings for nearly four weeks after. With the mammal, new heights are reached with apes and humans at the summit. The gestation period for chimps is about 240 days (266 for humans); the new-born is helpless and cannot support itself, only after five months is it able to ride on its mother's back, and only at two years of age is it able to move independently; the mother provides the young with food, warmth, and protection, and teaches it certain skills; the young are weaned at the age of four to six, but still need parental backup for several more years; adult males lend a hand—adolescent males are invited to join male social activities like hunting and boundary patrolling—but the bulk of the work is left with the mothers.

The spouting of 200.000 eggs must require some effort, and hatching and feeding a brood of fledglings is no vacation either, but months of cumbersome gestation, draining your body and straining your mind, the labour of birth, with years and years of laborious caretaking following, that seems an almost devastating toil, which raises the question: Why do they do it?

Food is a natural reward; it restores with interest the energy expended and sustains the animal. Reproduction may sustain the species, but certainly not the reproducing organism, and it does not restore the energy expended but is a great drain on the animal's resources. There does not seem to be any natural incentive to engage in the labours of reproduction, including the strenuous act of mating, which became necessary when reproduction early in evolution became sexual; on the contrary, from the point of view of energy economics, there seems to be ample reason not to.

Natural selection—always (and tautologically so) on the side of the species—has come to the rescue, however. Natural rewards lacking, a set of *artificial* rewards was installed, with pleasure centres and hormonally induced instincts, and a chemistry so powerful and addictive that sex and reproduction would always have highest priority and justify any cost. In other words, nature's solution to the un-obviousness of reproduction was to turn us into addicts. It worked, has for more than a billion years.

In this sense, we are servants of the species as much as free self-seeking individuals. Males, with their little squirting appendage, may be excused in believing that they are the sovereign owners of their own bodies, but females with cumbersome bulging breasts, aching menstruations, trying gestation, painful birth-giving, flowing teats, and pushy litters, would certainly know that the species is a very demanding co-owner.

The Mammal's Unique Life World

With the mammal, natural selection took the inherent conflict between the interests of the species and the interests of the individual one step further. By letting the progeny feed off the mother's body directly, in gestation first, then in breast feeding, literally serving up the mother as a meal, a curl was created on the food-chain. The link in the food chain between predator and prey is a relation *between* species—between rabbit and carrot, between fox and rabbit—*inter-specific.* In the mammal, with the cannibalistic feeding of the young, it becomes a relation *within* the species as well, *intra-specific.* This curl on the food-chain means that the two essential attributes of the living being, feeding and reproduction, in the mammal have become intertwined with a host of interesting consequences to follow.

To keep under wraps the contradiction of being at the same time mother and prey would require the mental gymnastics and ability to arrest the immediate response defining of mind. It still does. It is not without cause that modern mothers often must battle to dispel the notion that the little new is a life sucking parasite.[13] And if the family, and sometimes the mother herself, believes that it has been a battle won, her therapist will soon know better. But seen from the young, the situation is not less interesting.

The existential link between organism and food is the origin, prototype, and foundation of the subject-object relation (S ⟶ O), and the structure and content of this relation come to define the world of the organism, its bio-logic and psycho-logic (episteme), its *Lebenswelt,* or *life world*, as the phenomenologists aptly called it. The general structure is the same for all animals, the intentionality and interspace explained above, but for each species, there are particular features beginning with the choice of food and the methods of its attainment. In this sense, each species lives in its own specific—Jakob von Uexküll-like—world. *Econiche* is the term biologists use for these specific worlds, aptly calling the econiches, defining of each species, for *the business* of the species. It is a good analogy; as the specific business demands and conditions of a plumber are different from those of an accountant, so are the demands and conditions of the hawk different from that of the mouse. Extending the definition of a species from the physical characteristics of its members to include their particular way of life, with its wider conditions and demands, is, of course, what we named *ecology* above, the food-source being its first determinant.

Now the very first food-source that a new-born mammal meets is its mother's nipple, and this specific particularity becomes defining of the subject-object relation, as the first instance always does, and therefore constitutive of the mammal's world. As the food is also mother, and mother and young are of the same kind, and interactions between members of the same kind are called social, the defining

[13]The ancient immune system did recognize a parasitic intrusion, and had not the placenta been inserted as an immunological barrier between mother and fetus, the latter would have been killed off as had it been cancer.

relation is social, sociality constitutive of the mammal's world, and mammals inherently social, which means that the co-evolving mind also becomes inherently social.

But the contradiction faced by the mother, is also faced by the young. Is mother friend or foe, prey to be attacked and sucked, or support to be sucked up to? Is the breast good and giving, or evil and denying? To this first perplexing world of the infant, perceptively explored by Melanie Klein, comes next the world of the toddler, where males are introduced as rivals to the mother's goodies and affections, the world imaginatively explored by Sigmund Freud. Whether he was right or wrong in all his pronouncements, Freud was certainly right in this, the mammalian mind, with its archives of past memories, inhibitions and emotions, is psychodynamic through and through, as revealed in its wild nocturnal dreams, but also in its daytime productions where the favourite drama on the theatre's repertoire is playing house.

So while *mind* is just an intervening variable between stimulus and response, a dumb head-top computer built into the wetware of the brain, it is also the messenger and medium of our most complex and dynamic real-life adventures, and the most marvellous piece of work with which psychologists have had to deal. But we would not have known that, had it not been for our human consciousness.

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