How the Brain Works: Coherently!

A multidisciplinary systems analysis of mind/brain/behavior

Eugene B. Shea

Abstract:

All neuroscience is based on a modular brain, each component responsible for certain functions, without explanation of how they cooperate in coordinated responses.

This article offers a new theory of neuropsychology—how the brain works, coherently. It provides authoritative evidence that the Reticular Activating System (RAS), including its 'sentinel,' the Reticular Formation (RF), with two-way communications with all of the brain and body, is the perfect candidate for the 'Command and Control System' in all sentient beings, the de facto manager and coordinator of all brain and body activities.

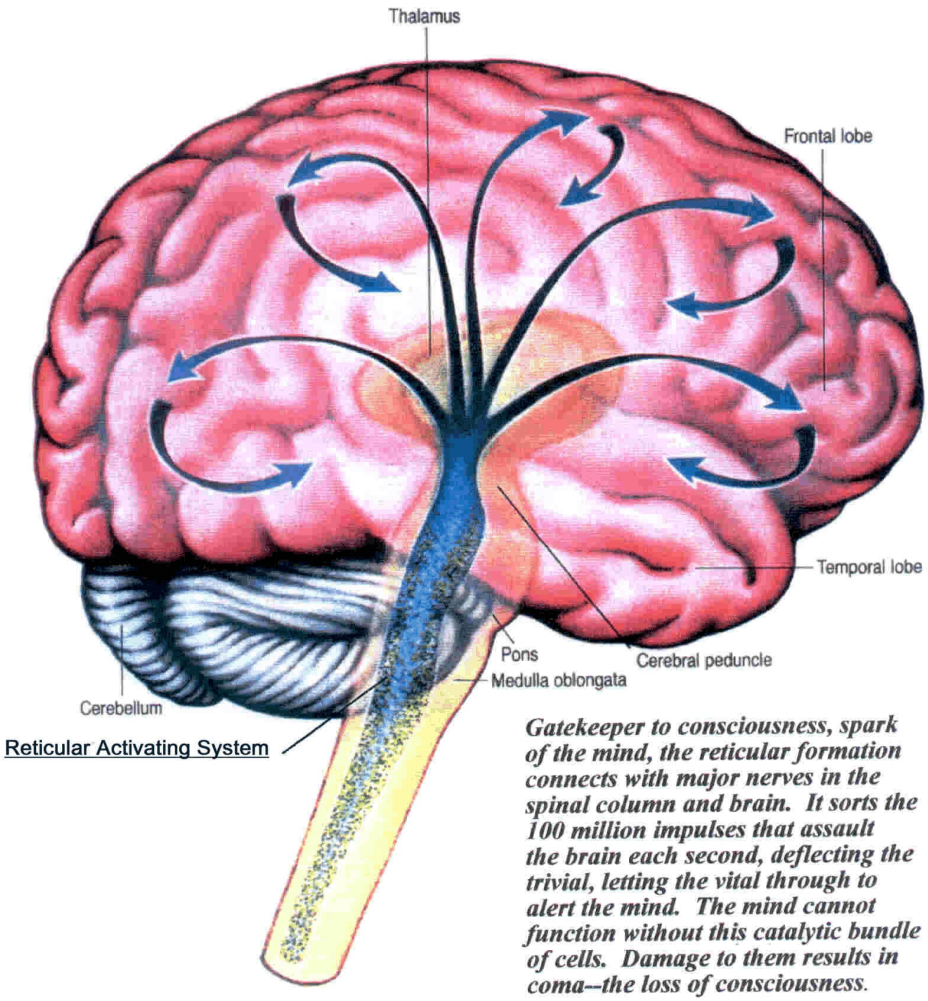
The RF, processing 100 million internal and environmental sensory impulses/second, selects 'significant' stimuli, resolving many biiological imbalances 'silently.' Others are forwarded to thalamus and midbrain—the locus of RAS and consciousness—and to the cortex, the 'hard-drive' memory of data, and sensory and motor sequences. RAS extracts nine times more information from cortex to thalamus, providing cognition; and registers relevant cortex memory response sequences in the prefrontal lobes for resolution and implementation via the premotor cortex. The prefrontal cortex is 'RAM' workspace, balancing responses until one predominates.

RF/RAS monitors and responds to disequilibria in the innate Social-Animal Needs we share with our cousin, the chimpanzee, and/or in the myriad significant self-adopted beliefs and affections—conscious and subconscious—which constitute the unique *'Love/Belief System'* wired in each of our brains. These two sets of programs mingle (one can love SA-Needs for food, sex, socializing, etc), continually generating desires and fears which represent the great majority of RF 'significant' stimuli which engross consciousness.

RAS coordinates all brain and body activities to maintain homeostasis in all our physiological, biological, bio-sociological, psychological, emotional, and volitional states. RAS generates all autonomic responses, emotions, response-impulses, and in healthy brains, all psychopathologies.

RAS *interprets the world to us,* and triggers our responses. Those with unexamined, anarchic Love/Belief Systems are on autopilot—not living, but being lived by the Reticular Activating System.

[The reticular formation] is well placed to monitor all the nerves connecting brain and body. It 'knows' what is going on better than any other part of the brain.
—THE MIND OF MAN
Nigel Calder, Penguin 1973



Gatekeeper to consciousness, spark of the mind, the reticular formation connects with major nerves in the spinal column and brain. It sorts the 100 million impulses that assault the brain each second, deflecting the trivial, letting the vital through to alert the mind. The mind cannot function without this catalytic bundle of cells. Damage to them results in coma--the loss of consciousness.

—THE BRAIN - MYSTERY OF MATTER AND MIND[19]
U. S. News Books - 1981

We are living in a post-hypnotic trance induced in early infancy.
R. D. LAING

However, uniquely capable of creating a Love/Belief System, we are also capable of revising it.
EBS

How the Brain Works: Coherently!

A multidisciplinary systems analysis of mind/brain/behavior

Eugene B. Shea

While neurobiologists have been making great strides in identifying brain diseases and anomalies, enabling them to develop wonderful biochemical products and gene therapy to treat them, cognitive neuroscientists and neuropsychologists are having a much tougher time of it. They are trying to understand the brain processes in stimulus/response, in hopes of eventually arriving at an understanding of the unresolved relationships of mind/brain/behavior.

Many neurologists, biologists, physiologists—even some physicists and mathematicians—are exercising their truly prodigious powers of imagination to justify their conviction that consciousness, reasoning, decision-making, etc.—all our "higher" faculties—must be purely neuronal functions of the cortex.[1]

But since this article will take strong exception to the direction of the research of cognitive neuroscience and neuropsychology, I must devote the following portion to explaining why I believe the great majority of their efforts are on the wrong track. Then we'll take a look at how the brain most probably does work—coherently.

First however, I want to clearly and largely exempt Bernard J. Baars, Ph.D., and Nicole M. Gage, Ph.D. from my criticism, based on their marvelously lucid and carefully researched new textbook, *Cognition, Brain, and Consciousness: Introduction to Cognitive Neuroscience* - Academic Press, 2007.

Dedicated neuroscientists, they struggle bravely with such things as metacognition, intentionality, volition, and *"making choices in the absence of inherently correct solutions,"* which they admit *"remains, at least for now, a uniquely human territory,"* with the implication that it's only a matter of time til scientists get around to explaining it in neuronal terms. They also find it necessary to ascribe homunculous-like faculties to the frontal lobes, e.g., having a *"coarse map of the entire cortex,"* so it can retrieve memories relevant to its decision-making processes. [page 354]

But I am deeply indebted to them for the wealth of current neuroscience research which corroborates my theory, and the glaring gaps in their studies (e.g,, the many neural processes between stimulus and cognition) which this article will address. I think every serious student of cognitive neuroscience should have a copy of this excellent book.

The major problem facing neurocientists and neuropsychologists is that the chimpanzee's DNA is now known to be 99+% identical to our own, so most 'scientismosts' thought this proved we were only a branch of the chimp family, and that the <1% difference could account for our vastly superior capabilities.

But now they have found that the remaining <1% difference is primarily related to hair, skin, bones, blood, muscle, etc.—hardly differences which could begin to account for our superiority.

Our DNA is not similar to that of the chimpanzee,
it is, to all intents and purposes, *identical*.

Then how come we're so different? Never at loss for figments, most scientists have concluded that our differences, or higher faculties, must be found in the cortex, particularly in the prefrontal cortex, both of which are much larger than those of the chimp, assuming that a larger *but biologically identical* brain, must account for our superiority.

So hundreds of researchers are expending millions of people-hours, centering all their efforts to locate human faculties of consciousness, reasoning, decision-making, imagination, volition, intentionality, etc., in some as yet undiscovered neuronal capabilities of the human cortex.

Professor Sebastian Grossman, Ph.D., Emeritus Chair of Bio-Psychology, University of Chicago, points out "... *neuropsychologists' proclivity to 'localize' higher faculties such as consciousness in that part of the brain that has undergone the most obvious evolutionary change. . .*" (in a letter to the author)

Note the good Professor's precise use of the word 'proclivity,' and quote marks around the word *localize*. In other words, they arbitrarily posit our higher faculties in the cortex, not on the basis of any scientific evidence, but because that's where they *want* them to be.

And, with all due respect to Dr. Grossman, we now know that the larger brain is not at all 'evolutionary,' having appeared on the planet in an instant of geological time.

Nor is there any validity to the triune nature of the brain, as composed of evolutionary development from lizard to mammalian to primate brains. The so-called lizard brain in humans is not a brain at all, since it only represents

a portion of the lizard brain, which is comprised, like ours, of brainstem, midbrain, and cortex. Nor, for the same reason, is the 'mammalian brain' a brain. And as we shall see, their derogation of the importance of the lower and mid-brain in favor of the cortex has led researchers to only a perfunctory analysis of their marvelous functions, without which we would be vegetables a few minutes before our demise.

And cognitive neuroscientists are admittedly struggling with a 'binding problem.' The various visual characteristics of an object—color, shape, size, motion, etc.—are registered and interpreted in different parts of the brain. So, they wonder, if I see something red, round, baseball-size, and in motion, where in the cortex—where they think consciousness must reside —do all those percepts come together to instantly tell me that I'm going to get hit in the face with a tomato? The famous binding problem.

The answer as we shall see, is that they don't come together in the cortex, but in the thalamus and midbrain, the more likely home to consciousness.[2]

My first computer 25 years ago, was a Model III Radio Shack running on a Z-80 processor, with 64K of internal RAM and two 64K floppy disks. My current Pentium 4 HT 3GHz, 2.99GHz, with 2G of RAM, and a 150G hard drive, operates on exactly the same principles as my old Model III. The only substantial difference is a faster processor and, more importantly, vastly more RAM and memory.

Now consider the lowly rat, whose peanut-size brain, consisting of a brainstem, a minuscule mid-brain, and cortex, can generate perhaps only twenty or thirty different responses. But those few responses have insured the perpetuation of the species for thousands of years. Now looking at the successive anatomical forms of the mammalian brain of the rat, cat, owl monkey, rhesus monkey, and chimpanzee, isn't it obvious that these are simply sequentially *larger versions* of the rat's marvelously efficient and effective brain? Enlargements which, coupled with a more versatile body and larger brain—more RAM work space and memory—enable the chimpanzee to generate scores of responses and, by operant conditioning and social learning, acquire scores more?

And, since our DNA is identical, isn't it also obvious that our brain is simply a larger chimp's brain, and must also operate on the same principles and components?

I read 10 or 12 years ago that those working on artificial intelligence realized that for a computer to emulate the brain it must be equipped with many facts: children can't be as old or older than their parents, shirts are bought at a department store, etc. They first estimated maybe as many as a million facts. The last time I heard they were up to 10 million and still counting. Where does the brain store all these facts?

Further, can you imagine the number of *neural motor sequence memories*—subroutines—necessary for a typist to hit 9 keys a second for minutes at a time, without realizing what he has typed? For sighted words to appear on a page while he thinks of something else? Can you imagine the number of motor neuron subroutines necessary to drive my car through traffic while I'm daydreaming, and alert me instantly to anything requiring my attention? For our thoughtless morning ablutions? For a concert pianist to have thousands of musical phrases wired to his fingers', hands', arms', feet, and legs' motor neurons? Some of which can be executed continuously for half an hour?

The number of *sensory sequence memories* to read and absorb information at 400 words a minute? To know thousands of words which I can rattle off correctly in an infinite number of phrases? To know the appearance and something about 1,000 people on hearing their names? To recognize 1,000 people on sight from many angles? To recognize the voices of scores of people? To recognize hundreds of songs on hearing one or two phrases? And on what instrument they are played? For an idiot-savant to memorize an encyclopedia?

Where could we possibly store 10 million facts and all these sensory and motor sequences—program routines, subroutines, and sub-subroutines—all this memory? Why, only in a much larger cortex of course! We don't need another operating system; but we humans do obviously need more working space (prefrontal cortex RAM) and more memory, a larger hard drive; both provided by the vast association areas of the human cortex.[3]

Note that none of these memories have any use or meaning to the chimp, which does very nicely with a much smaller but identical cortex.

Also, neuroscientists, using their fMRI and PET scans, have limited themselves to a modular model of the brain, examining each segment (normal, lesioned, or diseased) during different mental activities, as though each is independently responsible for (or independently participates in) one or more of the multiplicity of activities of which the brain is capable.

For example, handicapped by this modular approach, they consider central nervous system activities such as thought, voluntary movement, reasoning, perception, emotions, etc., as *functions* of the parts of the brain which 'light up' when those activities are operant, but mental or physiiological activities which are impaired when part of the brain is damaged or diseased.

But doesn't my computer hard drive operate exactly the same way—activate relevant sectors when certain programs are run, and fail to run those programs when those sectors are damaged? Does that mean my computer operations are *functions* of the hard drive? Isn't the hard drive just a passive memory of operational sequences called forth from

somewhere else? As Baars & Gage warn, we should not confuse correlative with causal. Calling mental and physiological activities *functions* of active brain segments is like saying that running water is a function of the faucet.

Further, believing all our higher powers are in the cortex, researchers have concentrated on the one-way 'upward' course of information from the senses to the reticular formation and thalamus up to the cortex, where they think processing, analysis, and decision-making must take place. But according to Erich Harth in *The Creative Loop - How the Brain Makes a Mind,* they have "*studiously ignored"* the simultaneous downward passage of ten times as much information from the cortex to the thalamus! Baars & Gage say these *"neurons are running the wrong way."*! (pg. 66) [4]

I will try to prove that a much more efficient brain processing, and a binding problem solution, lie in considering consciousness, in both animals and humans, to be centered in the thalamus,[5] the brain's Central Command and Control Center, which uses the cortex to retrieve relevant memories and identify and feed relevant motor response routines and subroutines to the prefrontal cortex RAM for processing (as explained below), until the intensity of a given response reaches an 'enact level,' and is forwarded to the premotor cortex for implementation, or the stimulus abates and the PFC reverts to inactive RAM.

For example, when I am attending to the voice of someone who says, "Marilyn Monroe," I suggest that those words pass in neural networks through the reticular formation to *uncomprehending* consciousness in the thalamus and up to auditory regions in the cortex.

But ten times as much information is returned from the cortex to my thalamic consciousness—enough information to give me a picture of a beautiful blonde in a white dress and high heels standing over a subway exhaust grille trying to hold her skirt down—a picture which would require scores of thousands of computer bytes. Isn't it obvious this picture was simply retrieved to thalamic consciousness from the cortex?

On the other hand, presented with that picture, it is sent in neural networks through unknowing consciousness to visual cortex V1 through V3, and returns the name "Marilyn Monroe" to consciousness in the thalamus, together with highlights of her life.[6]

Researchers who concentrate their efforts to understand cognitive neurology while confining their search for our higher powers to some yet-to-be-discovered faculties of the cortex, while ignoring both our unique metafaculties (explained below), and the remarkable functions of the Reticular Activating System, or ERTAS, the *extended reticular-thalamic system* (Baars & Gage, page 145), and the vast range of their influence on

human cognition and behavior are, I believe, heading down a one-way dead-end road.

Some neuroscientists agree, at least in part: *"From modern neuroanatomy, it is apparent that the entire neocortex of humans continues to be regulated by the paralimbic regions from which it evolved."* [A General Theory of Love, Lewis, et al., pg; 33]

As Professor Grossman puts it, *" . . the reticular formation has been sadly neglected by contemporary neuroscientists, . . "* (in a letter to the author)

In view of the above, it is a major thesis of this article that although we use the brain differently, e.g., for everything from language to putting men on the moon, and therefore develop different capacities of its components, the human brain, in and of itself, has no inherent functional capabilities which differentiate it from the brain of the chimpanzee.

The rest of this article will develop a new paradigm of the human brain, one which can resolve the binding problem, explain from a systems standpoint how the brain does work, and shed a beacon of light on the neurology of human behavior—a unified theory of psychology, cybernetics, and neuroscience.

How the Brain Does Work: Coherently!

To understand human behavior, and identify the locus of consciousness, a multidisciplinary systems analysis of the brain may prove to be a more fruitful approach.

Look at it this way: if beings from another planet got to earth, and simply observed an automobile for a day or two without raising the hood, but listening, examining the gas, the exhaust, etc., they would undoubtedly be able to tell, without a design of each part, exactly what components were at work inside the car. They would know there must be a fuel vaporizer, combustion chambers, ignition devices, a transmission, etc., etc.,

Now, with ever-increasing analytical skills, and ever increasing data, we have been observing each other and ourselves for several thousand years, and no one seems to be trying to analyze the brain from a systems standpoint—to postulate the components and their functions which must be at work "under the hood," in order to explain all the rational and irrational physical, mental, and emotional responses which biologists, physiologists, neuroscientists, and psychologists know the brain can generate and/or implement.

A multidisciplinary systems analysis. . .

Drawing on the disciplines of psychology, cybernetics, and neurology, and painting with a broader brush in a systems analysis, we can perhaps begin to develop a schematic of both the human and chimpanzee brain components and their functions in mind/brain/behavior.[7]

From a systems standpoint, we know that every complex mechanism—and so too, every complex organism—made up of multiple subsystems, a mechanism whose subsystems can operate in unison in a coordinated way, enabling the mechanism to simultaneously accomplish a number of different tasks—like a battleship for example—must have a *command and control system* which manages and coordinates the functions of the subsystems.

To operate effectively, a command and control center must have:

1. Immediate access to all available internal and circumstantial environmental information,
2. A means of rapidly assimilating, evaluating, and prioritizing that information,
3. A means of selecting and implementing appropriate responses to the information, and
4. Immediate two-way communications, for control and feedback, with all of the subsystems.

Now of course the body is a complex mechanism with many subsystems, capable of operating in a coordinated way. So it must have a command and control center, which all agree is the brain. But the brain itself is a very complex mechanism/organism with many subsystems capable of operating in a coordinated way.

It is inconceivable that the human and animal brain, with all of its components and subsystems—much more complicated than a battleship—could possibly coordinate each of their functions in effective management of the thousands of complex physical, mental, emotional, and biological activities of the body, providing as it does, instantaneous, coordinated reactions to circumstances of vital interest, without a priority evaluator and responder to our internal and environmental stimuli— i.e., a command and control system.

But then where is it? What is it?

The only viable candidate for the brain's command and control system is the Reticular Activating System, centered, with consciousness, in the thalamus, which sends and receives signals to and from all parts of the brain and body.

The only segment of the brain which has access to all internal and external stimuli, is known to scan and prioritize that information, then select and implement relevant responses, and has two-way communications with all of the subsystems, is the *Reticular Activating System* including its "sentinel," the *Reticular Formation*.

Although scientists have known about some of the properties of the Reticular Activating System/ Reticular Formation for over 50 years, none of them, to my knowledge, has suggested they form a command and control system for operations of the entire brain.

The key to a cogent systems analysis of the brain was provided many years ago by the renowned Jerome S. Bruner, when he observed,

> *"The human mind has an 'inhibitory system' which routinely and automatically removes from perception, reason, and judgement over 99% of available fact."* [8]

I will show that the *Reticular Formation* (RF), in both humans and animals, is the perfect neurological candidate for Bruner's *inhibitory system*. The RF is an uncharted—unchartable?—amorphous mass of millions of neurons, whose responses are uniquely *unspecific,*[9] located inside the brain stem, about the size of one's little finger. In 1958, physiologist H. W. Magoun described some of its functions in *The Waking Brain*. Together with its millions of neuronal pathways to and from the brain and the body, it was named the *Reticular Activating System* (RAS), because stimulation of the RF awakened sleeping subjects, while damage to the RF resulted in coma.

But now, even after fifty-plus years, neurologists have identified only a few of the RAS purposes. It is so complex that research on it has practically come to a halt.[10] Although its centralized location and countless connections would seem to enable it to perform myriad functions, it is impossible, using current research methods, to identify more than a few of them.

What is known about the RF/RAS raises questions which no one seems prepared to address. For example,

"Nature appears to have gone to great pains to cause essentially all the incoming and outgoing communication channels of the brain to pass through the reticular system."[11]

"[The reticular formation] is well placed to monitor all the nerves connecting brain and body. It 'knows' what is going on better than any other part of the brain."[12]

"[The reticular formation] alerts the brain to incoming information from the senses, and from the centers of thought, memory and feeling. More than that, it adjudicates the relative importance of that information. . . In a way the RAS is like a vigilant secretary, sorting out the trivia from the incoming messages." [13]

"The reticular formation is, in essence, the physical basis of consciousness, the brain's chief watchguard. . .The reticular formation continuously sifts and selects, forwarding only the essential, the unusual, the dangerous to the conscious mind. . . The reticular formation can both send and receive messages. If it suddenly spots one that merits attention, it shoots up an alert through ascending RAS pathways to receiving areas in the cortex. ***Timed to arrive simultaneously with the impulses sent directly from sensory receptors,*** **[! ! !]** *the RAS alerts the cortex to these impulses."*[14]

"The RAS determines which . . . bits of information are important enough - or novel enough - to report to the higher portions of the brain. . . Normally, the information relating to automatic actions, such as the heartbeat and digestion, is dealt with directly by the RAS, which sends out regulating impulses when they are needed without allowing any awareness of them to filter through to the conscious brain."[15]

"Researchers have a relatively clear picture of the physical underpinnings of consciousness. Information streaming in from nerve receptors in the skin, muscles, tendons, joints, eyes, ears and mouth passes first through the thalamus and/or the reticular formation - a group of nuclei in the brainstem. Thus, before even reaching the cortex, impulses have passed through a series of processing regions that behave somewhat like secretaries in an office who screen phone calls, mail and visitors before passing them on to the boss.

"The reticular formation, sometimes called the ruler of consciousness, stands at the critical junction— both in terms of anatomy and function —of the senses and the higher brain. Vigilant day and night, the neurons of the reticular formation sort all incoming impulses. ***By some unknown means****, they determine which deserve further attention, and having done so, flag important impulses so that the cortex will take note of them. At night, while the cortex is deep in sleep, the reticular*

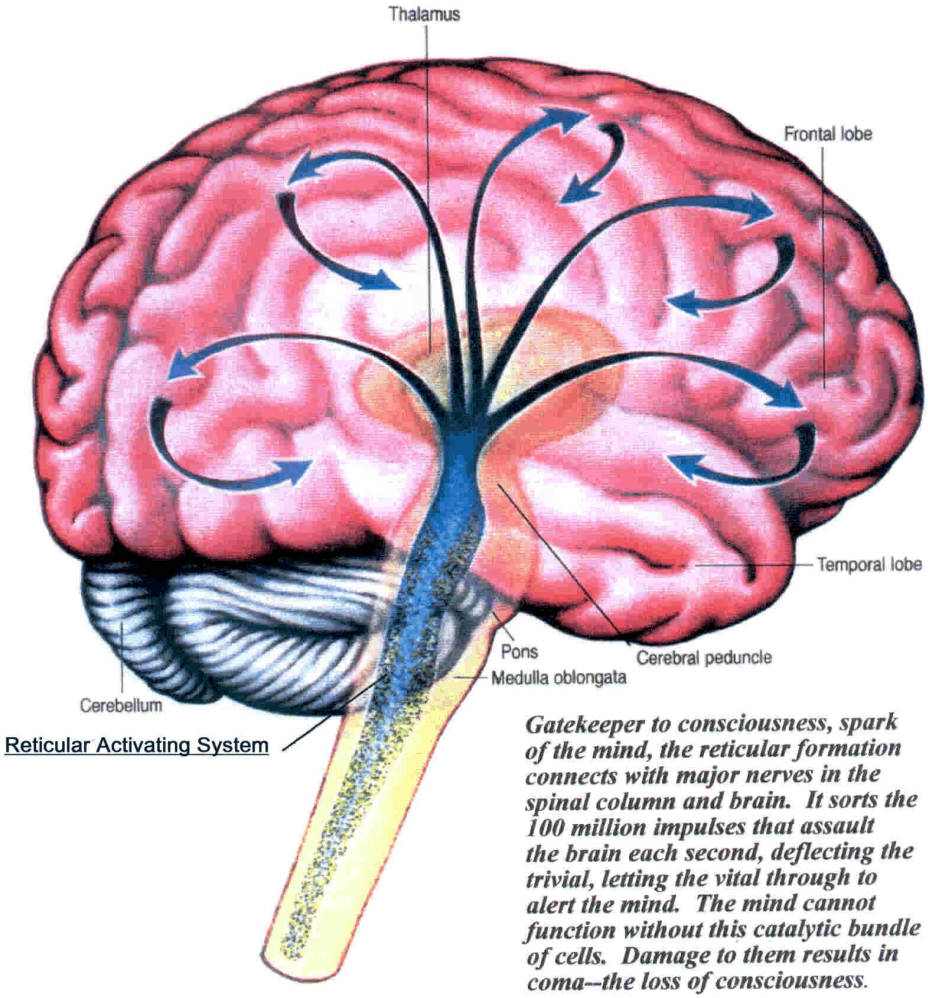
formation keeps tabs on the senses and in times of possible danger is first to sound the alarm."[16]

"There is also direct evidence that the RAS is able to produce the kinds of effects on the operation of the muscles and glands that would accompany the role of a response-selecting mechanism. It seems to be able to sensitize or 'awaken' selected nervous circuits and desensitize others. This is sometimes accomplished by selective muscular activation: electric signals sent over reticular nerve fibers down the spinal cord to terminate on the relay nerve cells whose axons pass out to the muscles achieve a sort of 'volume-control' action that increases or decreases the magnitude of the muscular response."[17]

"The reticular formation monitors incoming stimuli and chooses those that should be passed on to the brain and those that are irrelevant and may be ignored. . . In addition to being a filter, the reticular formation controls respiration, cardiovascular function, digestion, awareness levels, and patterns of sleep.

"In recent years, the reticular formation has been discovered to be more significant than previously thought. Scientists now believe it to be involved in higher mental processes, in particular the focusing of attention, introspection, and reasoning." [18]

Finally, since a picture is worth a thousand words:



—THE BRAIN - MYSTERY OF MATTER AND MIND[19]
U. S. News Books - 1981

I quote all these sources (with emphasis added) to show the consensus of evidence that the RF/RAS is Bruner's *inhibitory system*; that the RF, "like a vigilant secretary," with the power to inhibit, automatically makes it our very stimuli *selector*; but that much more than a secretary, it also selects and implements responses to those stimuli; that together they form the silent sovereign manager of all our vital functions; are capable of "selective muscular activation;" are now thought by some scientists "to be involved in higher mental processes;" and lastly, to remark that, remarkably, *this is all they have to say about this remarkable element in the brain.* All of these authors then go on to discuss other parts of the brain, with apparently no curiosity about how the RF is able to decide what and what not to inhibit—how it decides which of the great multiplicity of available sensory stimuli ***it*** will select for our attention and/or further processing.

From all the evidence, the human and animal RF/RAS can only be characterized as a computer/servo-organism which receives all incoming data, scans and prioritizes that data for further processing in accordance with its *programs*, and, through the Reticular Activating System, selects, generates and controls Responses or Response-Impulses "appropriate" to its iterations of the data.

It is a second thesis of this article, representing a new paradigm of the brain, that in all sentient beings, the Reticular Activating System, given an RF-selected stimulus, uses the whole brain to generate and implement a response in an effort to maintain physiological and biological homeostasis; in social beings to also try to maintain stasis of bio-sociological needs; and in humans, to also try to maintain stasis of our uniquely induced psychological, emotional, and volitional states.

(Hereafter I will use "RAS" to include all the processes of the RF. Also, since the RAS can enact responses, e.g., an increase in our blood pressure, or only a response-impulse, e.g., hunger pangs, the word *response* will be used to indicate response or response-impulse, or both, as the context requires Third, references to the thalamus should be understood to include the activities of its "partner," the hypothalamus.)

What then, are the *programs* on which the RF/RAS is operating? Well, as we have seen above, the RAS is known to control all our vital functions, respiration, pulse, sleep/wake cycles, etc. But the chimpanzee, without higher powers, also gets an immediate response to a disequilibrium in any of its Social Animal Needs. Responses to these Needs must also be generated by the RAS.

And since we are social animals whose DNA is 99+% identical to that of the chimpanzee, we must assume that our *basic* RF programs are the Social-Animal Needs (SA-Needs) we so obviously share with the chimpanzee—Needs which are continually moving into operant and quiescent states. Functioning as *priority interrupts*, any Need can be primary at any given time.

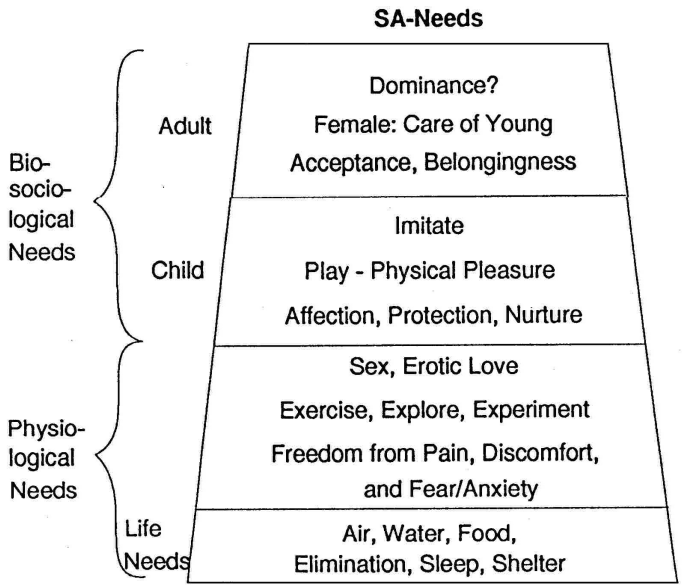


Figure 2 - The Social Animal Needs [20]

So it is the Reticular Activating System which motivates children and chimps to imitate others, to seek belongingness, which makes us sleepy when we are tired, and generates an instant mind/body fight-or-flight reaction to a threat, etc., etc. Of course, both animals and humans learn from experience and improve their performance, so the RAS must have access to all of the organism's Memories, in order to generate the best, or most common precedent response for need gratification or fear assuagement.

But we have some metaneeds and metafaculties absent in our 'cousin' the chimpanzee. One of these is an insatiable metaneed, our need to ***Know***, and its corresponding metafaculty, ***Conviction***, i.e, knowing or believing. Unlike simple animal curiosity, we want to know who, what, where, when, how, and why about everything. Aristotle said, *"We must know."*

Herein lies one of our major human problems: in our need to know, we readily adopt—become convicted of—literally thousands of beliefs (some estimates run in the hundreds of thousands!) based on our interpretation of our experiences, or on inference, supposition, probabilities, deduction, induction, syllogisms, the reports of others, etc.

This led Joseph Jastrow to conclude that *"the mind is a belief-seeking rather than a fact-seeking apparatus."* One needs only follow a four-year old around for a few hours to confirm this idea. We humans have an inordinate need to know, causing us to avidly adopt beliefs by the thousands as we mature. Even things we know as facts act as beliefs, as do all our doubts, disbeliefs, memories, values, and our self-adopted 'needs' additional to the SA-Needs.

But the major things we need to know are "Who am I? What am I? Why am I here? What is the meaning of my life?" In answer to these fundamental questions, we all start building a set of beliefs about who we are, and what we can and 'should' be doing. We start building a self *image*—we identify ourselves with another person, or our family, our body, mind, profession, possessions, religion, reputation, gender, or a cause, etc.—a seemingly infinite number of things.

The beliefs and accompanying activities which make up our self-image thus serve two purposes: they give us a sense of self identity: "I am an American, a wife and mother, a teacher, an environmentalist, etc." And they are accompanied by activities in which we can 'lose ourselves,' and, as long as we are so engaged, repress the nagging questions of "Who am I? What am I? Why am I here?".

As noted, we can simultaneously identify ourselves with a number of things. Aldous Huxley describes it best:

> *. . . since the mind- body is capable of an enormous variety of experiences, we are free to identify ourselves with an almost infinite number of possible objects—with the pleasures of gluttony, for example, or intemperance, or sensuality; with money, power, or fame; with our family, regarded as a possession or actually an extension and projection of our own selfness; with our artistic or scientific talents; with some favourite branch of knowledge, some fascinating 'special subject'; with our professions, our political parties, our churches; with our pains and illnesses; with our memories of success or misfortune, our hopes, fears and schemes for the future; and finally with the eternal Reality within which and by which all the rest has its being. And we are free, of course, to identify ourselves with more than one of these things simultaneously. Thus a man can be at once the craftiest of politicians and the dupe of his own verbiage, can have a passion for brandy and money, and an equal passion for the poetry of George Meredith and under-age girls and his mother, for horse-racing and detective stories and the good of his country—the whole accompanied by a sneaking fear of hell-fire, a hatred of Spinoza and an unblemished record for Sunday church-going.*[17] [The Perennial Philosophy, p 40]

So starting at birth (or possibly in the womb) we each haphazardly develop a unique 'Belief System' in the brain. But since most of our self-image beliefs and many others have an emotional or affective component, I think it is better described as Love/Belief System Eventually this System is comprised of thousands of things we believe, and an ever-changing group of purposes or people or ideas to which we have allowed ourselves to become identified; all of them capable, as we shall see, or giving rise to Desires and Fears.

Now most of us think we see and hear things in their pure form, which are then evaluated against relevant elements of our Love/Belief Systems.

But our instantaneous, involuntary reactions to contradictions of our beliefs or derogation of things with which we are identified, and positive reactions to their support, are *autonomic,* and those responses must therefore have emanated from the RF/RAS.

As William James wrote many years ago:

> *"It is clear that between what a man calls 'me,' and what he simply calls 'mine,' the line is difficult to draw. We feel and act about certain things that are ours very much as we feel and act about ourselves. Our fame, our children, the work of our hands, may be as dear to us as our bodies are, and arouse the same acts of reprisal if attacked. . . In its widest possible sense, however, a man's Self is the sum total of all that he can call his, not only his body, and his psychic powers, but his clothes and his house, his wife and children, his ancestors and friends, his reputation and his works, his land and horses and yacht and bank account. All these things give him the same emotions. If they wax or prosper, he feels triumphant, if they dwindle and die away, he feels cast down - not in the same degree for each thing, but in much the same way for all."*

We humans uniquely respond autonomically to hundreds of circumstances other than those related to the Social Animal Needs, but significantly related to our Loves or Beliefs, and must therefore have been selected and flagged by the RF for interpretation by the RAS *prior to entering consciousness*.

So we have for example, the "cocktail party phenomenon," the instantaneous, involuntary shift of our attention when a loved one's name is mentioned, even in a babble of sounds. Or when someone criticizes our church, or our children, a feeling of antipathy is instantly generated and one or more of our *perceptual defenses* are brought into consciousness. We autonomically generate the same reaction we would to a kick in the shins.

All our sights and sounds come to us preselected, preevaluated, and processed *before* they fully enter our consciousness. Favorable stimuli are rushed intact to our consciousness; but stimuli in conflict with elements of our Love/Belief Systems are, failing complete repression, modified, justified, rationalized, to make them conformable to elements in our Love/Belief Systems.

As we all know, if someone says, "I like your looks," that expression is rushed to our consciousness. But, "I don't like your looks," comes to us perhaps as, "He's a moron."

Further evidence of RF/RAS response-impulses: Haven't we all heard snippets of words or glimpses of something which instantly registered as 'important,' without knowing what it was until the stimulus was replayed in our consciousness for identification and cognition?

And doesn't really bad news take seconds, minutes, hours, days, sometimes weeks to fully penetrate our consciousness? The RAS is also the mind's *shock absorber*.

Can these responses also be a function of the RAS, or do they involve some other brain function? Obviously the RAS autonomically selects and implements responses to our vital functions: respiration, heart rate, digestion, arousal, adrenalin level, etc. And if we share the Social-Animal Needs, it's easy to understand how the RAS would generate an instant response to a threat of pain or isolation or the taking of one's food. But although again, the RAS is the only viable candidate, how could it also pick out from the environment and generate instant responses to the sound of a loved one's name, or a diminution or enhancement of James' *"reputation and his works, his land and horses and yacht and bank account?"*

The answer lies in the fact that Dr. Gary Lynch of the University of California at Irvine has proved that *"learning involves a physical change in the circuitry of the brain."* When we learn something, new synapses are formed in our brains, or existing connections are strengthened, sometimes in as little as ten minutes. (Aside: perhaps in geniuses and idiot-savants, much faster?)

The Plausible Hypothesis

Certainly it is not then an "astonishing hypothesis"[21] to infer that if I love someone, that person's name becomes wired in or near my Reticular Formation, and the RAS generates a response whenever that name is mentioned; or if I believe in a given political party, feelings of anything from cognitive dissonance to hatred will be generated when I hear that party denigrated.

The point is that all of our Loves and those Beliefs with an emotional or affective component, are not additional "learnings" to be stored in the brain as data. They are processed differently, with some representation in the amygdala and hippocampus, and, together with the Social Animal Needs, they represent the *principles* or *programs*—literal *instincts*—which determine how all the data is handled.[22]

Therefore, until some other sensor and response generator of each of these brain actions is identified, what better candidate than the Reticular

Formation and Reticular Activating System? Why would such a marvelous system be limited to sensing and issuing responses to physiological/biological and SA-Needs, and not include, as I suggest in this article, our uniquely induced social, psychological, and volitional states of disequilibrium?

I suggest that the RF/RAS is most likely the entire organisms' equilibrium sensor and balance restorer of all biological and physiological functions of all sentient beings, including the Social Animal Needs and central and peripheral nervous systems in animals and in humans; and further, that in the human it is the RF/RAS, programmed with our Loves and Beliefs, which generates responses in an effort to maintain stasis of our uniquely instigated emotional, psychological, and volitional states.

In addition to all its other functions, the RAS works continuously to bring us equanimity, i.e., Peace.

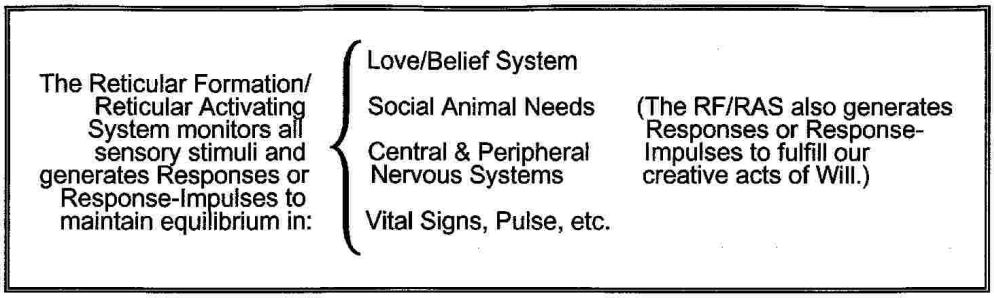


Figure 3 - The RF/RAS Domain

Based on our autonomic responses it is apparent that the human RF/RAS takes on responsibility for the programs of the Love-Belief System, the hundreds of significant conscious *and subconscious* Loves and Beliefs which we all adopt or with which we have been introjected, since infancy. This transformation of the RF, together with our uniquely human metafaculties, makes of each of our brains what we know as the *mind.*

So here is Bruner's inhibitory system, the centralized, indefatigable, quintessential sentinel of the brain, the Reticular Formation and it associated Reticular Activating System, the de facto manager of the brain, as it says in the illustration above, *"deflecting the trivial, letting the vital through to alert the mind."*

But vital and trivial are subjective terms, different for each individual. How does the RF *know* what is vital and what is trivial to each of us, if not in the way this article describes? As noted earlier, I can find no serious literature which addresses this question.

And in addition to vital or trivial, is it not obvious that the RAS also generates responses—from complete repression to a continuum of judgments—between true and false, right and wrong, interesting and uninteresting, dangerous and benign, good and bad, novel and trite, attractive and homely, exciting and boring, sacred and profane, just and unjust, fair and unfair, crude and refined, simple and arcane, etc.? Does it not classify and generate responses/judgments to *everything* we see and hear before we know what they are?

The answer is yes—everyone knows that each of us sees and hears things differently. The classic movie Rashoman tells of three witnesses to a crime, each of which describes it differently. But now we have the neuronal processes responsible for the fact that we all, to one degree or another, live in different worlds, each in our own unique world.

The RF/RAS is programmed by all the conscious and *subconscious* elements of our unique Love/Belief Systems, and all of our operant Social Animal Needs (some of which—sex, power, social involvement, etc.—can be greatly magnified by becoming objects of our Love) and it selects, evaluates and generates responses to all our stimuli accordingly.

Since the RF/RAS is our stimuli and response selector, we are all seeing and hearing the world—experiencing and responding to it—*through* our Reticular Activating Systems.

Think about it. We are each wearing a unique set of diffracting lenses over our eyes and filtering earphones over our ears which select and translate what we see and hear *before* they reach consciousness. We are all exactly like pilots, each flying on our own uniquely programmed autopilot.

Our operant Social Animal Needs, always accompanied by significant elements of our Love/Belief Systems, create for each of us the unique world in which we live, generate all our emotions, shape our behavior, and explain the creation of LeDoux's "synaptic self" - how our **brains** can become **who we are**."[23]

The shocking conclusion we must draw is that the RAS operates exactly like the U.S. government! Like the government, it is a vast and incredibly complex bureaucracy, consisting of scores of open and secret bureaus, departments, and branches, staffed by hundreds of bureaucrats—whose tenors often overlap or conflict, and with very imperfect communications between them—each competing for the "boss's" attention, each with some priority interrupt authority, each mindlessly trying to enact its own limited agenda, and to justify and expand its authority by welcoming data which validates or contributes to its purposes and rejection of that which does not—an appalling, but unfortunately, a compellingly exact analogy. Can cognitive dissonance, and its associated anxiety, be far behind?

We are all living in a post-hypnotic trance,
induced in early infancy.
—R. D. Laing

But in addition to the metafaculty of conviction we also have the uniquely human faculty of ***commitment.***

The animal *is committed* by any response impulse strong enough to pass through the 'action gate' in the frontal lobes to the premotor cortex. But we have the power to commit ourselves to hundreds of things, not only unrelated to the SA-Needs, but opposed to them: celibacy, solitude, fasting, even suicide, etc.

We also have the power of the ill-defined 'metacognition;' but I'm not at all sure it is a 'meta' power. Baars & Gage, (pps. 286-7) recognize metacognition as *"our unique self-consciousness and cognizance of our mental processes. . .the ability to know our own cognitive functions, and to be able to use that knowledge."* They also say the prefrontal cortex (where multiple responses are resolved) is necessary for metacognition. I believe animals too, may be aware of the alternative responses active in the PFC.

Cognitive psychologists, e.g., Merluzzi, et al., have long recognized the faculty of metacognition, which they say *"refers to the ability to monitor a wide variety of cognitive enterprises, . . to monitor one's memory and comprehension, or knowing about knowing or an awareness ot one's own cognitive machinery and the way it operates."*[24]

Both metacognition and commitment are manifest in the well-known Benjamin Libet experiments, which clearly illustrate the pre-conscious (i.e., *sub*-conscious) nature of RAS response-impulses, as well as the subject's metacognizance and and veto- or alter-power over those responses.

> *"Benjamin Libet of the University of California, recorded electrical signals generated by the brains of his experimental subjects* [who had been instructed to move a hand intermittently] *and looked particularly at a signal called the 'readiness potential' that always appears just before a movement. Using special timing techniques, he found that the readiness potential begins about half a second before a subject begins to move a hand. This is expected, since brain activity must begin before the brain issues a command to the muscles. What is surprising, however, is that the subjects do not become aware of deciding to move until only about two tenths of a second before the movement begins, some three tenths of a second after the brain activity began.*
>
> *". . . to Libet [this] says that the intention to act arises from brain activity that is not within our conscious awareness. . . the brain initiates the impulse to act and the conscious self subsequently becomes aware of it. Libet also finds that his subjects are able to veto the impulse to act during*

the few tenths of a second after a subject becomes aware of it. In this sense, consciousness becomes a gatekeeper for intentions generated by the brain, letting through only those that somehow meet an individual's criteria."[25]

This proves that, having committed ourselves to an act or procedure, the RF/RAS then generates the appropriate response-impulses to the PFC, to metacognitive awareness, and subject to our veto power.

But what specifically are the 'cognitive functions' of which metacognition makes us aware? I contend that these are processes of the prefrontal cortex (PFC). Any sensory signal interpreted by the RF as significant, or to what we are paying attention, is brought to uncomprehending consciousness in the thalamus and control of the RAS. The RAS forwards the signal immediately on to the cortex for identification - what is it? where is it? - and a search of the cortex for all relevant memories and responses, which are forwarded to the PFC for execution or resolution.

Now in both human and chimpanzee, these responses, if unambiguous and uninhibited by associated memories (see *feasibility analysis* below), are forwarded through a "pass" channel of the prefrontal cortex (PFC), premotor cortex, and motor cortex, for initiation of the response. (The PFC doesn't "light up" for unambiguous, uninhibited or habituated responses.)

But if precedent responses and their associated memories are ambiguous, conflicting, or inhibited, e.g., a threat generating "fight, flight, or freeze" responses, all responses from cortex memory in the form or their motor sequence memories—each weighted by their associated results—are registered by the RAS in the prefrontal cortex, where, accompanied by continuous additional sensory stimuli directly from thalamic consciousness regarding the significance and imminence of the threat—and additional relevant memories from the cortex—the momentary weight or urgency of each response is adjusted until (in the animal) one response prevails and immediately breaks through to the conveniently contiguous premotor cortex for implementation, or the threat abates.

In other words, the much-vaunted prefrontal cortex (PFC) is simply RAM, which does not store memory, but provides current work-space for inhibited, ambiguous, or conflicting response-impulses, their associated memories, and sensory iterations from the thalamus, until, in the animal, one response prevails, and then penetrates the PFC gate to motor neurons to enact a response. Naturally, if the threat abates, the PFC is restored to inactive RAM.

The PFC does not *decide* which response will be executed, any more than a neuron, receiving excitatory and inhibitory impulses, *decides* when to fire.

But this simple PFC function—also active but not determinate in humans—has led most neuroscientists to ascribe our unique executive powers of reasoning,

analysis, and decision-making to some yet-to-be-discovered genie-like capabilities of the PFC and cortex, simply because they are larger than those of the chimpanzee.[26]

The fact that this weighting function of responses in the PFC is not determinant in humans is seen in the Libet experiment: we have metacognizance of response-impulses, and commitment power through direct thalamic channels to the PFC action gate—a metapower executed by the RAS from a consciously generated *image* contradictory to that of the RAS-generated response-impulse and a *commitment* to its execution.

This brings us to our third metafaculty, the faculty of *imagination,* the ability to create and manipulate words, images, and symbols in our consciousness. Most all philosophers agree this is a uniquely human faculty, though of course many scientists disagree. Baars & Gage take imagination for granted, suggesting several exercises of the reader's imagination. I don't think the matter is debatable.

So except for overpowering responses, e.g., avoiding a flying object, if a RAS- or self-generated response is even slightly ambiguous, conflicted, or inhibited, and does not require immediate implementation, we can either allow it to be executed, or we can *imagine* the effects of that response, *review* alternative responses and their potential effects, select a preferred response, and implement that response by *committing* ourselves to its execution, i.e., opening the PFC gate to action.

Unfortunately, even when we make a considered decision, our analysis of alternative responses is limited to consideration only of our *conscious* memories and SA-Need/Love-Belief System elements, but is subject to strong insidious influences from subconscious elements. Which is why we so often have two reasons for what we do: a good reason, and the real reason.

And we can will to do things we only imagine, to generate actions independently of RF/RAS impetus, even things we've never done before. How is this accomplished? How do we *Will* something to happen?

Let's suppose I decide to go to the grocery store. First, I visualize, *Imagine* myself at the store, and of course I must *Believe/Know* it can be accomplished (the brain automatically runs each of our "*images of intent"*[28] through a *feasibility analysis,* and if it finds a problem, which it often does, refers the conflict to the PFC where it can be resolved per above), then *Commit myself* to going to the store. This process *authorizes* the RAS to execute the motor neuron programs which take me to the store, while I'm free to think of something else if I wish.

Creative Will is the concurrent use of our metafaculties of imagination, belief, and commitment.

How does the brain do this? I submit that when furnished with a clear picture of a result, a feasibility check resulting in belief in its attainability without conflict with more important SA-Needs, Loves, Beliefs, or purposes, and a commitment to achieve it, the RAS is presented with a disequilibrium: *"I'm here - I intend to be there."* In response the RAS, holding that purpose until it is accomplished, takes it to the cortex where it searches out relevant neuronal motor sequence memories—subroutines—and forwards each in turn to the PFC where all are given a subconscious "pass" to the premotor cortex and to the motor neurons which, subject to continual *subconscious* sub-subroutine adjustments—steering, braking, accelerating, based on thalamic sensory input—take me to the store, leaving my mind free for daydreams.

This principle applies to long-range images of intent: "I will be a doctor, lawyer, wife and mother, teacher, millionaire, congressperson, missionary, etc. Any image of intent, firmly held, creates a disequilibrium in the Reticular Activating System, and it constantly brings to our attention from the deepest recesses of the memory and from the environment the jig-saw-like pieces of the elements and opportunities which will enable actualization of the intent.

Although it required a lot of innovation, the parts of Gutenberg's printing press were all in existence when he *decided* to build one, and his RAS led him to the pieces of a solution. The parts necessary to make an automobile were all in place when Henry Ford *decided* to make one. And for Bill Gates to make a personal computer. History is rife with examples of people who accomplished remarkable achievements through a firmly held *image of intent*.

Returning to the functions of the PFC; it is not only ambiguous responses to situational stimuli which must be resolved in the PFC. Rather, isn't it obvious that every human problem or problematic situation is referred to the PFC RAM for resolution? As Baars & Gage point out, "the frontal lobes are critical in a free-choice situation, *where it is up to the subject to decide how to interpret an ambiguous situation."*[27] Don't we all live in a ***sea*** of ambiguous situations?

Aren't most of us always operating on a dozen or two *perpetual* purposes? Like the people described by Huxley and James above, aren't we always concerned with such things as longevity, good health, welfare of loved ones, our love lives, spiritual lives, reputations, career progress, financial security, social acceptance, projection and protection of our idealized self-image, observance of our "shoulds," consistency of our Love/Belief systems, validity of our religious and political persuasions, etc., etc.?

These are purposes to which the environment or our imaginations continually provide relevant stimuli. But because they are purposes which can never be completely resolved and are often in conflict, the RAS can only engender ambiguous, conflicting or inhibited piecemeal solutions. So most of us are flooding our poor PFC'S almost every waking moment. No wonder our PFC's

occupy such a large portion of our cortex! And why so many of us live "lives of quiet desperation," and cognitive dissonance.

(Here's an interesting research project: Subjects have been equipped with a beeper which sounds at various times during the day, with instructions to make note of their thoughts when it goes off. They've learned how often we think about various subjects. Now they should add instructions that subjects also note what they were *doing* when the beeper sounded. I believe this would clearly prove that during the majority of the day, our actions were on RAS management while our minds were occupied elsewhere.[29])

Most unfortunately, as we "mature," many of our RAS-generated responses—which must include all our emotions—tend to become *conditioned responses,* and it's usually much easier to accede to these responses with the attitude, *"That's me; that's the way I am."* Most of us become reconciled or resigned to these specious *synaptic selves*, and **allow** our **brains** to "become **who we are**."

Conclusions

We need a new paradigm of the human brain, as a brain which starts out physiologically and functionally identical to that of the chimpanzee,[30] but is transformed into what we know as a "mind" by virtue of our faculties of metacognition, imagination, and intellect, as well as by the thousands of our self-adopted Loves and Beliefs and their concomitant Desires and Fears which constitute our unique Love/Belief Systems (or what theologians would recognize as our 'hearts') and become the programs of our Reticular Formations as we 'mature.'

We must also conclude that the thalamus, home to consciousness of humans and all sentient beings, constitutes the *Command and Control Center* of the brain, and the RAS as the de facto Manager of the brain. The RF is its sentinel. The inaptly named Reticular Activating System should now be considered the brain's *Command and Control System;* and, until some limits to its jurisdiction are delineated, the RAS must be seen to exercise its influence throughout the entire brain and body.

All other elements of the brain would then represent the subsystems or "tools" of the RAS. Their functions—constantly contributing new sensory input and feedback to the RAS iterations, recovering memories, fleshing out the details of percepts, generating physical and vocal reactions, etc.—are only enacted when innervated by responses from the RAS/RF iterations, or purposes enacted from thalamic consciousness through the RAS, but originating in the person's Will.

Sadly however, even our best intentions, originating in our consciousness,

must take a reverse path through the RAS to reach the muscles which will carry them out, often a tortuous feasibility check, where they are very often *displaced*. They just don't get done.

All the response-impulse reactions of us 'normal' people, whether or not they are assented to, are a perfect RAS reflection of our Social-Animal Needs and the Loves and Beliefs and their concomitant Desires and Fears arising from our Love/Belief Systems, or 'hearts.'

To live in a different, better world,
the mystics, saints, and sages say:

"Nothing need change but our hearts."

"If the doors of perception were cleansed,
every thing would appear to man as it is, infinite.
For man has closed himself up, till he sees
all things thru' narrow chinks of his cavern."
—WILLIAM BLAKE

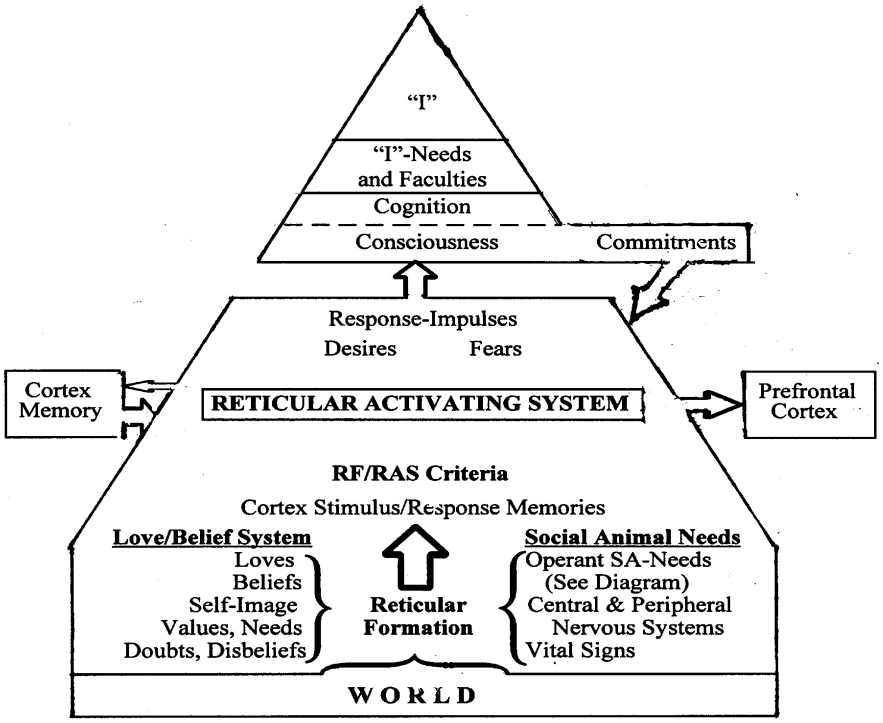
And since our DNA has no significant differences from that of the chimpanzee, and since DNA is known to determine all the anatomical and physiological characteristics - all the capabilities - of the organism, and since we are putting men on the moon and living in homes with all the accouterments of comfort and safety, while chimpanzees are still living in trees, isn't it also obvious that in addition to a larger but physiologically identical brain, must we not be uniquely endowed with a *non-physiological element*, an element whose metaneeds and metafaculties enable us to use, override, and even reprogram the Reticular Formation?—the element which acts as Chief Executive Officer to a RAS Chief Operating Officer as it were?—the element whose faculties enable us to generate an infinite number of responses?

If cognitive scientists are to understand the brain, they must suspend their search for uniquely human faculties of the cortex, expand their studies of the Reticular Activating System (or ERTAS), including its sentinel, the Reticular Formation. They must also hypothesize an AGENT (represented by "I" in the diagram below) of what I have elsewhere proposed are the uniquely human metaneeds to exist, to love and to know, and metafaculties of imagination, conviction, and commitment.

Many serious students of the brain have found it necessary to postulate an Agent of our superior mental capabilities. St. Thomas Aquinas postulated the Soul, with faculties of memory, intellect, and will; Freud's Agent was the "I" (Gernan "ich," which was translated into English as ego, now with negative connotations, e.g., "He has a big ego.") with the faculties of conscious

thought, memory, learning, choice, judgment, and action, Jung referred to a 'self,' or 'God within us;' Karen Horney to our 'real self;' Roberto Assagioli to our 'higher self;' Martin Buber to 'I' and 'Thou;' Arthur Deikman to the 'Observing Self;' Antonio Damasio to a 'proto self;' Ernest Becker (See his Pulitizer Prize winning Denial of Death,) refers to our "proud, rich, lively,infinitely transcendent, free, inner spirit." And myriad mystics, saints, and sages have claimed realization of their True spiritual 'selves.'

Personally, I'm with Aquinas, Freud, and Becker, a spiritual "I", a Soul: proud, rich, lively, infinitely transcendent free inner spirit. But cogniive/ existential psychology indicates the "I" adds Needs to Exist, to Love, and to Know; the "I"-Faculties are Imagination, Conviction (Knowing or Believing), and Commitment (the act of Love).



THE HUMAN MIND

The Neural Processes Between Stimulus and Cognition/ Response and Between Commitment and Execution

The Reticular Formation continuously monitors stimuli from the World, from the Social Animal Needs, and from the Love/Belief System. Significant stimuli are forwarded to RAS which retrieves all relevant stimulus/response memories from the cortex. These responses are evaluated in relation to all Social Animal Needs, Love/Belief System Elements, and other stimuli from the world.

The most 'appropriate' responses are forwarded with the stimulus to Consciousness/Cognition, and the responses to the prefrontal cortex, where, if not too strong, or not requiring immediate implementation, they are subject to

review by the “I” which can select, alter, change, or cancel any response. But if unopposed, the RAS-generated response is enacted. In this way we become habituated to RAS generated responses. The “I”, the Soul, becomes an idle bystander and atrophies; as do our thinking powers.

The diagram also shows how “I” can initiate actions or purposes by visualization, belief, and commitment; but commitments which must go back through the RAS for execution, where they are often ‘displaced.’

These concepts enable us to understand, from a systems standpoint, how the brain works, and explains not only the human behavior commonly considered ‘normal’—as well as our potential for enlightenment—but also most psychoses, neuroses, character disorders, perceptual defense, obsessive-compulsion, cognitive dissonance, displacement, repression, split personality, the powers of the self-image, suggestion, hypnosis, positive and negative thinking, etc., etc. All these effects can now be seen to be the result of a Reticular Activating System operating flawlessly on our SA-Needs—many often magnified by becoming objects of our self-adopted Loves or 'Needs'—and a seething set of Loves and Beliefs and their concomitant Desires and Fears.

And autism, epilepsy, schizophrenia, ADD/ADHD[32] and even some physiological, biological, genetic, and chemically induced pathologies can all be the result of a malfunctioning Reticular Activating System!

For example, all the mood-altering drugs, from crack to marijuana, act primarily on what are called the monoaminergic neurons, all of which are located in a few discrete nuclei in the Reticular Formation.[33] The drugs must have the effect of relaxing the RF, freeing it from its inhibitions and its customary preoccupation with the Desires and Fears arising primarily from our Loves and Beliefs; resulting in enhanced self-confidence and some purification of the senses’ reports—Blake's *“cleansing of the doors of perception”*—and rendering the experience, at least initially, exhilarating.

But of course drugs can and often do yield *bad trips* when the relaxed RF releases to consciousness or into action some inhibitions, passions, or painful or shameful memories which, operating normally, it keeps repressed.

Also one of the obvious derivatives of this concept is that a malfunctioning RAS could yield schizophrenia, and indeed, recent autopsies of a small population of chronic intractable patients who had lived as schizophrenics showed neural anomalies in the Reticular Activating System![34]

The Immortal "I"

A Unified Theory of Psychology, Neurology, and The Perennial Philosophy

by Eugene B. Shea

Originally published by University Press of America
See theimmortali.com

* Revised and updated 2007, 2008, 2011

Questions, comments to: TheSheltonGroup@cs.com
AN ELEEMOSYNARY DIVISION OF INTROMATION, INC.

ENDNOTES

1. Only psychologists, those who know the most about the functional capabilities of the brain, seem to be missing from these speculations. As Allan Bloom writes in *The Closing of the American Mind:*

> *Psychology is mysteriously disappearing from the social sciences. Its unheard-of success in the real world may have tempted it to give up the theoretical life. As the psychotherapist has taken his place alongside the family doctor, perhaps his education now belongs to something more akin to the medical school than to the sciences, and the research relevant for him is more directed to the treatment of specific problems of patients than to the founding of a theory of the psyche.* [!] *The Freudian theories have been incorporated into some aspects of sociology, political science and anthropology, and it appears that the self alone had nothing more to tell the social sciences. This leaves open the question of what the solid ground is on which therapy stands, and where its newer ideas come from. Serious academic psychology is left with the segment that has to all intents and purposes fused with physiology*. [361]

2. See Consciousness in Thalamus and Midbrain
http://www.sciencedaily.com/releases/2002/09/020926071115.htm

For those who believe human consciousness is in the cortex because it's larger than that of the chimpanzee, doesn't that imply that chimps aren't conscious? I think what they are looking for is *metacogntion, self-consciousness*, one of our *metafaculties*, discussed below: en. 24

3. *Such permanent stores may not show up directly in brain imaging studies because they are encoded in the connective strengths between neurons. Methods like functional magnetic resonance imaging (fMRI) activity may therefore under-represent the vast amount of long-term knowledge*. Baars & Gage, p. 295

4. *There is one very important surprise in this tidy picture of maps flowing into higher-level maps of the visual input: after the thalamic nucleus, most axons run downward from the cortex to the thalamus. . . This may seem pretty odd for a simple transmission idea of the visual pathway*. Baars & Gage, Page 71

They assume the upward transmission is a simple transmission idea to the "higher processing centers" in the cortex. But I will suggest that the greater downward flow simply provides further information from cortex memory to the thalamus - the actual center of the "higher processing" of the stimulus.

5 . See ***Consciousness in Thalamus and Midbrain***
http://www.sciencedaily.com/releases/2002/09/020926071115.htm

6. *Dixon (1971) has also argued that the circulating flow of information between the reticular formation and the sensory areas of the cortex is required before sensory input becomes conscious.* Baars & Gage, page 145

7. In *Essentials of Neural Science and Behvavior* edited by Kandel, Schwartz and Jessell - one of the most authoritative and scrupulously honest reports of what scientists know and don't know about the brain - we find the admission:

> *. . . cognitive neural science is only beginning to contribute to the analysis of the richness of internal representations that cognitive psychologists recognize as intervening between stimulus and response. For example, cognitive neural science has so far not directly addressed the subjective sense of individuality, will, and purpose that is common to human experience. Yet these issues are important to us as scientists and as people.*

It is precisely these mysterious phenomena, *"the internal representations that intervene between stimulus and response, . . . the subjective sense of individuality, will, and purpose"* - phenomena which neurologists do not (cannot?) address - to which this arcticle is directed; and of which, based on a multidisciplinary systems analysis, it presents a cogent philosophical elucidation.

The first part of this article is devoted to a bare-bones introduction of new paradigms of the brain and mind which can explain most of the behavior attributable to their (unimpaired) functions. Later, we will look at some functions attributable to a new paradigm of the psyche. Each of these paradigms is elucidated in more detail in the book referenced at the end of this article.

8. Note that Bruner's *inhibitory system* not only automatically removes over 99% of available fact from our consideration, but also from our very *perception*. We don't even see or hear these facts. Since most of us think we select interesting stimuli from the environment, and, except under very special circumstances, we don't—they are selected for us—this is a very important point in our theory.

9. *Electrical measurements made by means of fine probes placed within the reticular activating system reveal an interesting property: the response of its neurons is "unspecific." A single neuron in this region may respond to stimulation of a touch receptor in the foot, a sound receptor in the ear, a light receptor in the eye, or a chemical receptor in the stomach. The reticular neurons appear to perform some kind of summation of the over-all nervous activity of the organism. Such integration would be of limited usefulness if all reticular nerve cells were to perform it in the same way. Fortunately, this does not appear to be the case. Although many neurons in the RAS system may respond to the same set of nervous stimuli, their responses are not quantitatively alike. One neuron may be more sensitive to optical stimuli than to pain; another neuron may show the reverse emphasis. The resulting weighted averages would appear to be just what is needed to monitor the incoming stimuli for patterned relationships that might indicate the necessity for one or another type of response by the muscles and glands of the body.*
   Dean Wooldridge - *The Machinery of the Brain*, McGraw-Hill 1963 pps. 64-65

10. . . . *the reticular formation has been sadly neglected by contemporary neuroscientists*, . . Sebastian P. Grossman, Ph.D. Emeritus Chair, Bio-Psychology, University of Chicago, in a letter to the author.

Also, most current books on "How the Mind/Brain Works," have only a passing reference if any, to the reticular formation, citing only its "posture control and sleep/wake cycle management functions." Neither the *1999 Scientific American Book of The Brain* nor the 2007 *Scientific American Best of the Brain* has ANY references to the reticular formation!

11. Wooldridge, Dean - *The Machinery of the Brain*, McGraw-Hill 1963 p. 64

12. Calder, Nigel - *The Mind of Man* - Penguin 1973 - pg. 30

13. Bailey, Ronald H., et al. - *The Role of the Brain*, Time-Life Books 1975

14. *The Brain - Mystery of Matter and Mind*, U. S. News Books - 1981

Note the phrase, "alerting the cortex" and similar phrases in the following paragraphs. These are based on the almost universally accepted theory among scientists that the cortex is home to consciousness and all our "higher" faculties; that processing of stimuli takes place solely in an upward path to the cortex. But as we shall see, this is an untenable hypothesis, and, rather than *alerting* the cortex, it is more likely that the RAS, centered with consciousness in the thalamus, is using the cortex to flesh out the percept and to identify and implement a response.

15. Silverstein, Alvin & Virginia - *World of the Brain* - William Morrow & Co. NY 1986

16. *How Things Work - the Brain* - Time-Life Books 1990

17. Wooldridge, Dean - *The Machinery of the Brain* - McGraw-Hill 1961

Here we see that although the energy for a physiological response must come from the appropriate area of the motor cortex, it is the Reticular Activating System which administers, monitors, and regulates the *application* of that energy to the operant muscles in order to accomplish the intended purpose.

Thus, the Reticular Activating System does not turn over the processing and resolution of stimuli to higher powers in the cortex, as most neuroscientists suggest, but manages the entire operation from start to finish, guided by the goal-image generated in thalamic consciousness by RF/RAS, or by the Will..

18. *The Complete Idiot's Guide to Understanding the Brain* - Bard & Bard - Alpha Books 2002

19. *Gatekeeper to consciousness, spark of the mind, the reticular formation connects with major nerves in the spinal column and brain. It sorts the 100 million impulses that assault the brain each second, deflecting the trivial, letting the vital through to alert the mind. The mind cannot function without this catalytic bundle of cells. Damage to them results in coma - the loss of consciousness*.

20. This outline of social animal needs is of my own construction. I welcome comments, criticisms, corrections. Not shown on the diagram are some of the autonomic control functions of the RF in regulation of cardiovascular functions, adrenalin levels, etc. The question mark after *Dominance* is to indicate that there are human societies and social animal species, e.g. the langur monkey, which do not exhibit strong urges for dominance, proving that this need is not innate in all social animals, or that it can be readily attenuated through social learning.

21. Francis Crick, *Astonishing Hypothesis: The Scientific Search for the Soul,* Touchstone 1995

22. *Words that have personal significance for participants, 'body bags, Nam, Medevac,' for the Vietnam veterans versus 'revolver, incest, 9/11, or fire' for civilian victims, are repeatedly found to gain access to awareness more readily than neutral words...* Baars & Gage, page 380.

Also see: Science News, *How Brain Gives Special Resonance To Emotional Memories*
http://www.sciencedaily.com/releases/2004/06/040610081107.htm

23. LeDoux, Joseph, *Synaptic Self: How Our Brains Become Who We Are,* Penguin Books 2003

24. Merluzzi, Glass & Genest, Cognitive Assessment, Guilford 1981.
Baars & Gage point out that metacognition is manifest only in prefrontal cortex, and is missing when frontal lobes are damaged. Since the PFC is where our 'cognitive functions' take place, it is little wonder that metacognition is only manifest in connection with activities of the PFC.

I believe animals too, are conscious of the alternative response-impulses resident in the PFC, but their responses are based only on their instincts and memories, and only circumstantial changes can trigger which response will be enacted.

Response-impulses in the human PFC are based on memories and all the elements (conscious *and subconscious*) in the Love/Belief System—all our Loves, Beliefs, Values, Needs, etc. Our metacognizance gives us a much wider variety of responses to any situation, and "I"-power enables us to commit ourselves to the response (right or wrong) which carries the most weight based on all those factors.

25. Klivington, Kenneth A. *The Science of Mind*. MIT Press 1989

From our new perspective, it's important to note that Libet's subjects had agreed—committed themselves—to his instructions to move a hand, giving the RAS *authority* to generate the corresponding response-impulses.

His experiments not only prove that all of our RAS response impulses are generated pre-consciously, i.e., *sub*-consciously; but also exhibit clear cut manifestations of human will to alter or veto response-impulses..

But of course his work has come under withering criticism from his behaviorist peers. Any research which results in the slightest intimation of an exercise of the will is anathema to most scientists and must be discredited. One of his peers had the ignorance to say that the subjects were not exercising free will because they had been told to move their hands!

The answer is that once they had agreed to participate the RAS generated subconscious response impulses at intervals appropriate to the instructions, but which could be vetoed by the subject. Just as if I decide to get a drink of water, I can forget about the details—the RF/RAS will generate all the steps necessary to accomplish the task, but I can change it to a Coke.

26. For example, Baars & Gage ascribe incredible powers to the frontal lobes:

> *Since the selection of the information required to solve the problem at hand is made in the frontal lobes, they must 'know,' at least roughly, where in the brain this information is stored. This suggests that all the cortical regions are somehow represented in the frontal lobes, an assertion first made by Hughlings Jackson (1884). Such representation is probably coarse, rather than specific, enabling the frontal lobes to know what type of information is stored where, but not the specific information itself. The frontal lobes then contact the appropriate parts of the brain and bring the memory trace 'on-line', by activating the circuitry that embodies it.* [p. 354]

The frontal lobes have a map of the entire cortex, and know where all the memories are??? Isn't it much more likely that the RAS finds precedent responses in the cortex and transmits them with the "relevant information required to resolve the problem" to the frontal lobes?

27. Risking criticism from their peers, Baars & Gage admit,

> *The choices we make are not inherent in the situations at hand. They are a complex interplay between the properties of the situations and our* ***own properties, our aspirations, our doubts, and our histories.*** *The prefrontal cortex is central to such decision-making. Finding solutions for deterministic situations is often accomplished algorithmically. . . but making choices in the absence of inherently correct solutions remains, at least for now, a uniquely human territory. In a sense, the freedom of choice is possible only when ambiguity is present*. (page 352 - my emphasis)

"Uniquely human" is an astonishing admission, but their last sentence seems to be a tautology. Doesn't choice *require* an ambiguity, i.e., the existence of alternatives? And isn't ambiguity present in almost everything we do? However, they revert to agnostic scientists, and seem to contradict themselves on the same page:

> *Of all the aspects of the human mind none are more intriguing than intentionality, and volition. But these attributes of human mind are fully at play only in situations affording multiple choices. Numerous assertions have been made by philosophers and scientists that volition and intentionality are uniquely human traits. In its absolute form, this claim cannot appeal to a rigorous neurobiologist. It is more likely that these properties of the mind have developed gradually through evolution, possibly following an exponential course.* pp 352-3

Isn't exponential evolution an oxymoron? And what is *gradual exponential evolution*?

28. See Baars & Gage, *memories of the future*, page 350

29. See: *Could an Inner Zombie be Controlling Your Brain ?* http://discovermagazine.com/2008/oct/15-could-an-inner-zombie-be-controlling-your-brain

30. *Stanford anthropologist Suzanne Chevalier-Skolnikoff, has found that chimpanzees, gorillas, and orangutans develop behavior patterns during the first two years of life (i.e., through the first six stages of the Piaget model) that are identical to the developmental patterns of human infants*. Animal Kingdom, July 1979 Could our brains then be significantly different?

31 St. Thomas Aquinas' Agent was the soul, with faculties of memory, intellect, and will. Karen Horney refes to our 'real self;' Roberto Assagioli to our 'higher self;' Carl Jung to our 'self,' or 'God within us;' Martin Buber to 'I' and 'Thou;' Arthur Deikman to the 'Observing Self;' Antonio Damasio to a 'proto self;' Ernest Becker (See his Pulitizer Prize winning *Denial of Death,*) refers to our 'proud, rich, lively,infinitely transcendent, free, inner spirit.'

And myriad mystics, saints and sages have unequivocally claimed a realization of their 'True Selves.'

Here's what one of the world's most renowned psychologists has to say on this subject:

Now that cognitive psychology has taken the head once lopped off by radical behaviorism and returned it to the body of psychology, we might in the next 10 years consider implanting a heart or a little soul in the same body. When that takes place, it may be easier to know what psychologists can offer to people and how they can do so, because then they will be us.

Philip G. Zimbardo, Ph.D. (1982)
Emeritus Professor of Psychology - Stanford University
Past President, American Psychological Association

I believe this theory fulfills his prediction. We *have* hearts; we *are* Souls.

32. *"It is believed that ADD/ADHD is caused by a problem in the reticular activating system."*

"Neuroscientists have been conducting studies on the reticular activating system and its role in behavior, Alzheimer's disease, and ADD/ADHD. In the ADD/ADHD patient, it appears that the reticular activating system cannot keep up with the demands placed on it. This leads to over-arousal, under-motivation, and the other symptoms of ADD/ADHD."

http://www.attentiondeficit-add-adhd.com/reticular-activating-system.htm

All of the 'demands' on the Reticular Activating System come from the Reticular Formation.

Are television sponsors, paying millions for only seconds of airtime to make an impression, *training* children for ADD?

33 Sebastian P. Grossman, Ph.D., Emeritus Chair, Bio-Psychology, The University of Chicago (verbatim from a conversation with the author)

34. The University of Arkansas Medical School - Unfortunately, the website page announcing this finding has expired.