Chapter One
The General Model of Thought – One Model of Mind

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with minor additions.

This author has proposed that the helping relationship is composed of three relationship types: the healing relationship, the habitual relationship, and the support relationship. Further more it has been proposed that the practitioner using the support relationship does so upon a foundation of three models: the model of mind, the model of change, and the model of relationship. This chapter presents one author's approach to the model of mind. What is important is that one needs to clarify one's model of mind in order to build quality support relationships.

The helping relationship is also the application of advanced empathy theory or **halopathy**. Halopathy contains within it the new human service paradigm of polar unity – that we are relationship patterns through space and time connected to consequences that can be experienced as separate and unified simultaneously. This was described, in part, within the **relationship book series** (www.SacredHealingNow.com). It is also understood that the constructs defining the helping relationship are in themselves patterns. The helping relationship contains a set of constructs, including the human service paradigm described previously, which state that if we can know the relationship process existing at the moment between practitioner and learner, and if we can help the learner to also know this process, then the learner will progress in self development. This relationship process is unique to each practitioner-learner pair and to each moment, but saying this does not add much to counselor training. Some parameters which affect this relationship process can be described and this description can be used to help counselors working with the disabled. The tendency when assisting with training counselors is to define theories using a reductionist approach. This approach is needed because it is a way of communication which is understood. But there is a sense of oneness in the relationship process, a wholeness, which can be lost in the reduction. To minimize this informational degradation the process of reductionist analysis is kept to a minimum. The presentation of "laws" and "principles" continues in this document as a continuation of what was presented in the introduction to the support relationship.

Definitions

The **General Model of Thought** or **GMT** is a model which describes the flow of thought in the human brain. It is the model which serves as the foundation for the tools used in facilitating the process of **mind awakening.** The term mind awakening describes the process of change that takes place in a learner (student, client, son/daughter, employee, etc.) as she/he begins to discover improved ways of knowing.

In nearly all individuals mind awakening can be facilitated by a practitioner (teacher, therapist, parent, trainer, employer, etc.).

One of the six assumptions used herein states that it is possible to define a general course of actions that will help us to increase the efficiency of our problem solving skills and to help us learn how to integrate these skills into all aspects of living. A person's ability to select courses of action depends upon their view of the world. A new course of action will only be chosen when it is seen and only seen when that person has adopted some new view of the world, a new paradigm, that contributes to an expanded awareness thus allowing new choices to be seen. Thomas Kuhn (1970) in his essay on the evolution of scientific thought states that a paradigm is an accepted model, theory, belief, or pattern which helps the person to make sense of their experiences; "...something like a paradigm is a prerequisite to perception itself. What a man (woman) sees depends both upon what he looks at and also upon what his previous visual-conceptual experience has taught him to see" (p. 113). In order for an individual's mind to awaken they must be able to expand their field of vision. In order to acquire this new vision many human service professionals will need to change the paradigm with which they live. ***They will need to make a "paradigm shift" (Kuhn, 1970), so that they will be able to see, explore, know, and assimilate new experiences.***

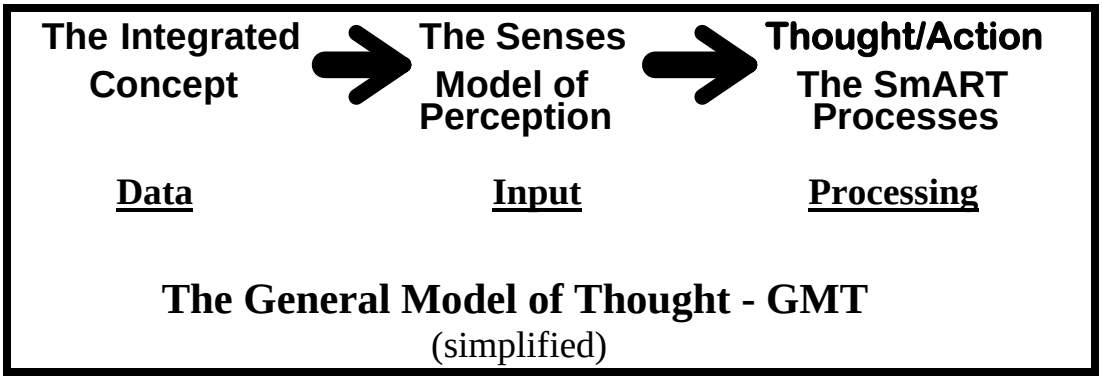

Figure 1: Simplified version of the General Model of Thought (GMT) showing the three principle components which describe the data available for input, the mechanisms of input and processing.

Halopathy uses the new paradigm or **polar unity** and the GMT, General Model of Thought, is one model to help describe the relationship of the paradigm of polar unity to counseling. The GMT is a model of human thought processes designed to show the relationship between thought and behavior so that when practitioners observe behavior they can learn to make better judgments regarding the selection of training tools to help the learner either enhance or eliminate the observed behavior.

The Simplified Version of the GMT

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The large number of apparently divergent approaches to the training of the human mind that have seen their rise to prominence within the last 50 years is perhaps an indication that a new paradigm is needed. Several new constructs are presented and the GMT, General Model of Thought, is the founding construct upon which the others are built. The GMT is a model of human thought processes designed to show the relationship patterns which exist between biology, thought and action. The new paradigm of polar unity is reflected throughout the model.

The model of mind presented is designed to help practitioners translate observed behavior during the practitioner-learner relationship into sound judgments regarding the selection of training tools to help the learner either enhance or eliminate the observed pattern. It is also a model which can be used to better understand the patterns of thoughts and feelings exhibited by the learner during the relationship process. A simplified version of the GMT is represented in the accompanying diagram (the complete version is presented later). The GMT paradigm, which is a model of how the brain works, is based upon functional neuroanatomy. The GMT is composed of the following components:

The **brain efficiency factors** (describing the basic neural structure),
Data- **The Integrated Concept** (describing categories of available brain stimuli),
Input- **The Sensory IPM** (information processing model), and
Processing- **The Thought/Action IPM**, (yielding the SmART Processes).

In addition the GMT contains the **Hierarchical Feedback Principle**, the feedback effect of domain, process, and time.

This data - input - processing (feedback) model corresponds to the systems model developed by artificial intelligence researcher David Marr in the 1970's (cited in Kosslyn and Koenig, 1992) where he states that a neural network system can be characterized in terms of its input, operation and output. This does not mean that the

brain acts like a digital computer. What it does mean is that we can use a systems model to look at brain functioning in order to improve our understanding of human knowing. With this understanding we can move closer to adhering to the Law of Educational Excellence. We can use the model as a foundation for the design of our improvements in mind training (in all the education environments). The GMT uses this systems approach in an attempt to impart to the audience a new level of understanding regarding the brain's functioning. This model is a simplified overview designed to improve the counseling and educational efforts of the practitioner. For more complete and more detailed information the reader is referred to the brief reference list on the mind accompanying the end of this chapter.

If it is rational thought that makes us especially human, then it is improvement of these thought processes that should be the focus of becoming a more successful complex problem solver in the New Age. The average human brain has twenty billion cells, called neurons, although some scientists think this number could be 100 to 1000 times larger. Each neuron makes connections with about 50,000 other neurons. Each connection represents a place where information is communicated. We have within our brain a total number of information processors equivalent to all the atoms in our galaxy and more than all the sand grains on every beach on this planet: an impressive tool for knowledge acquisition and application.

The Brain Efficiency Factors- The Foundation of the GMT

The basic tenet of this new paradigm for the science of teaching, the GMT, is that the brain is a supple, plastic, changing organ. The brain is not static. It changes and is changed by the world in which it exists. At the core of this tenet is the premise that the biological-biochemical workings of our brains contribute to the nature of this plastic change.

There are three biological-biochemical components of brain functioning defined within this text as the Brain Efficiency Factors. Within this text these factors are evaluated in terms of how they could contribute, or fail to contribute, to our quest for expanded awareness through increased problem solving efficiency.

The first of these three brain efficiency factors is **NEURON BRANCH DENSITY**. Our brains are composed of millions of nerve cells, an amount that changes little after birth. What does change after birth, and throughout life, is the number of branches from each cell and their destination. These cells, called neurons, are like young trees. They have a central nucleus (a trunk), from which stretch out numerous branches, some over a meter (3 feet) long. Both the number of nerve cells in the brain and the number of nerve branches changes dramatically throughout our lives. Gerald M. Edelmen, Nobel Laureate and physiologist describes the process:

> "They (neurons) send processes out in a profuse fashion, sometimes bunched together in bundles called fasciles. When they reach other neighborhoods and

> sheets they stimulate target cells. These in turn release diffusable substances or signals which, if the ingrowing processes have correlated signals, allow them to branch and make attachments. Those that do not either pass on or retract. Indeed, if they do not meet their targets, their parent cells may die. Finally, as growth and selection operate, a mapped neural structure with a function may form. The number of cells being made, dying, and becoming incorporated is huge. The entire situation is a dynamic one, depending on signals, genes, proteins, cell movement, division, and death, all interacting at many levels. Notice the main features of this drama. It is topobiological, or place dependent. Events occurring in one place require that events have occurred at other places. But it is also inherently dynamic, plastic, or variable at the level of its fundamental units, the cells. Even in genetically identical twins the exact same pattern of nerves is not found at the same place and time. Yet the collective picture is species-specific because the overall constraints acting on the genes are characteristic of that species....Diversity must inevitably result from the dynamic nature of topobiological events. The existence of diversity at the level of the individual animal is of great importance. Indeed, it is likely to be one of the most important features of the morphology that gives rise to mind." (P.64, 1992).

As we grow, develop and mature, the number of the branches decreases in some areas (those not "exercised") and increases in others -- particularly at certain stages of growth (i.e., several times within the first six years of life, and at puberty). The branches grow, or fail to grow, in response to internal and external stimuli and the growth process continues late into adult life. Like the branches of a young tree the growth of the branches of neurons are controlled by the intake of nutrients and oxygen. The tree, if given the right food, energy (sunshine) and air, will develop many branches and bear fruit. The neuron, if given the right food, oxygen and energy (mental exercise) will also develop many branches and bear the fruit of increased brain utilization -- increased awareness. But just as with the tree, pollution or the lack of energy will cause branch growth to stop and may even cause the branches to wither (neuron branch atrophy).

> "...it is worth citing the observation of two talented neuroanatomists, O. and A. Vogt. For many years, the Vogts conducted neuroanatomical studies of the brains of many individuals, including talented artists. One painter whose brain they observed turned out to have a very large fourth layer of cells in his visual cortex; and a musician with perfect pitch from early childhood had an analogously large region of cells in his auditory cortex." (Gardner, 1983, p.43)

Why should neuron branch density be one of the brain efficiency factors? Neurons are the information processors for everything that happens in us, to us and around us. The branches serve to transmit information throughout our body--they are our message wires carrying instructions to various portions of our brain and body. The brain contains most of the body's neurons because of the vast amount of information processing and decision-making that must be accomplished within the brain each day. An increase in neuron branching adds to the amount of information that the brain can

process and store. As the above quote illustrates, the density of neuron branching in any given area within the brain is directly affected by how much that area is used. Added neuron branch density contributes to our ability to handle more complex data by contributing to the overall efficiency of the brain. The relationship of branch density to environment (domain of activity) and to intelligence forms the first brain efficiency principle:

> **Principle:** What we are exposed to affects how we think and what we think affects that to which we become exposed.

The second brain efficiency factor is NEURON JUNCTION EFFICIENCY or **JUNCTION FUNCTION**. Like the wires of a computer each of the neuron branches forms a junction (a synapse) with another branch. Information is passed across this branch-to-branch junction through the use of various chemicals called neurotransmitters. These neurotransmitters pass a "yes" or "no" signal. The intensity of that signal can vary and a "yes" can be changed to a "no" or vice versa. If the junctions cannot transmit information from one neuron to another in an efficient fashion then the system slows down and may even malfunction. We may receive false images (Novocain and other pain killers are examples of chemicals causing our junctions to malfunction) and our brain may send false signals. When our junctions seriously malfunction we may perform at far less than peak capacity (Parkinson's, manic depression, addiction and schizophrenia may be tied to junction malfunction). Many different things affect junction function. In this text the emphasis is on the relationship between thought and junction function.

> **Principle:** The input of chemicals into our body, or any change of internal chemical equilibrium, affects how we think.

The third brain efficiency factor is similar to the computer word "software". It is the overall format in which the wires and junctions of the computer process data to solve the problem. In reference to mind awakening, the term **PATHWAY UTILIZATION** is used for our brain's software package. CAUTION is advised, the brain is not a very good computer, yet it is an efficient creator and monitor of new programs. How we use our cranial capabilities depends on our awareness and utilization of what neural pathways exist, what barriers inhibit usage, and which actions are needed for improved utilization (brain efficiency). We could have all the junctions working well and good branch density but not be able to use any of it properly because of inadequate or inappropriate pathway utilization. In a computer, if our programming is faulty, we will end up with a faulty answer. In our brains, if our pathway utilization is faulty we often end up with an incomplete and sometimes faulty answer.

The particular neuron pathways we have learned to use are shaped by what we think, by heredity and by environmental stimuli. Our actions, thoughts and brain efficiency are tied to neuron activity. Our awareness is linked to neuron pathway usage--to how we use our nerve pathways, how each of us use our brain. A nerve

pathway that is used frequently becomes easier to use. Our nerve activities find it easier to travel an often-used, well-paced road. Biochemically this may be due to increased ionic activity developing a line of lower resistance and our nerve impulses following the path of least resistance. Nerve pathways not used can atrophy--become difficult to use. Lack of use can result in the subtraction of a pathway from our total awareness. In this text the use of the term awareness is synonymous with our use of perceptual abilities and knowledge. It is also synonymous with our usage of neuron pathways.

Principle: The way we think is the way which is most easily thought and that which we do not think is most difficult to think.

Interpreting the three Brain Efficiency Factors (the three BEF principles) means that as we seek to help someone improve their brain utilization we need to address the following: a) the nature of the environment (material, stimulus) to which the learner is exposed, b) the effects of chemistry (internal and external) upon the learner, and, c) the problems of rigid thinking, or, not being able to think in a different way. These three corollaries of the BEF principles should become an integrated part of the practitioner's assessment, training and evaluation.

As a way of visualizing the three brain efficiency factors consider brain utilization as driving into a foreign city. We have a destination (problem solving) and many roads we could travel (neuron branching) to get there. We also have a map (our data base and thought processes). The clarity of the map (awareness) makes getting to our destination either easy or difficult. As we travel along the roads (neuron pathways) we look for signposts (junction function) to help tell us whether we are going the right way. It is clear from this analogy that if there are a large number of roads (neuron branches) leading us to our destination then we have a greater possibility of taking a short cut and arriving sooner. Arriving sooner is also aided by a clear and detailed map (awareness of pathways), clear signposts (junction function) that give us appropriate information, and, certainly taking the actions necessary to complete our journey (pathway utilization). These three factors, along with genetic instruction, act together to make our journey toward increased problem solving efficiency enjoyable and successful. In addition when these brain efficiency factors are not working properly, as is often the case with persons who have a cognitive disability, then the journey is more circuitous and sometimes blocked. The saying, “you can’t get there from here” applies. The task for the C-B-P therapist is to figure out how to go around the blockades, map out the circuitous route, and then teach that to both the learner and their support network.

The Integrated Concept

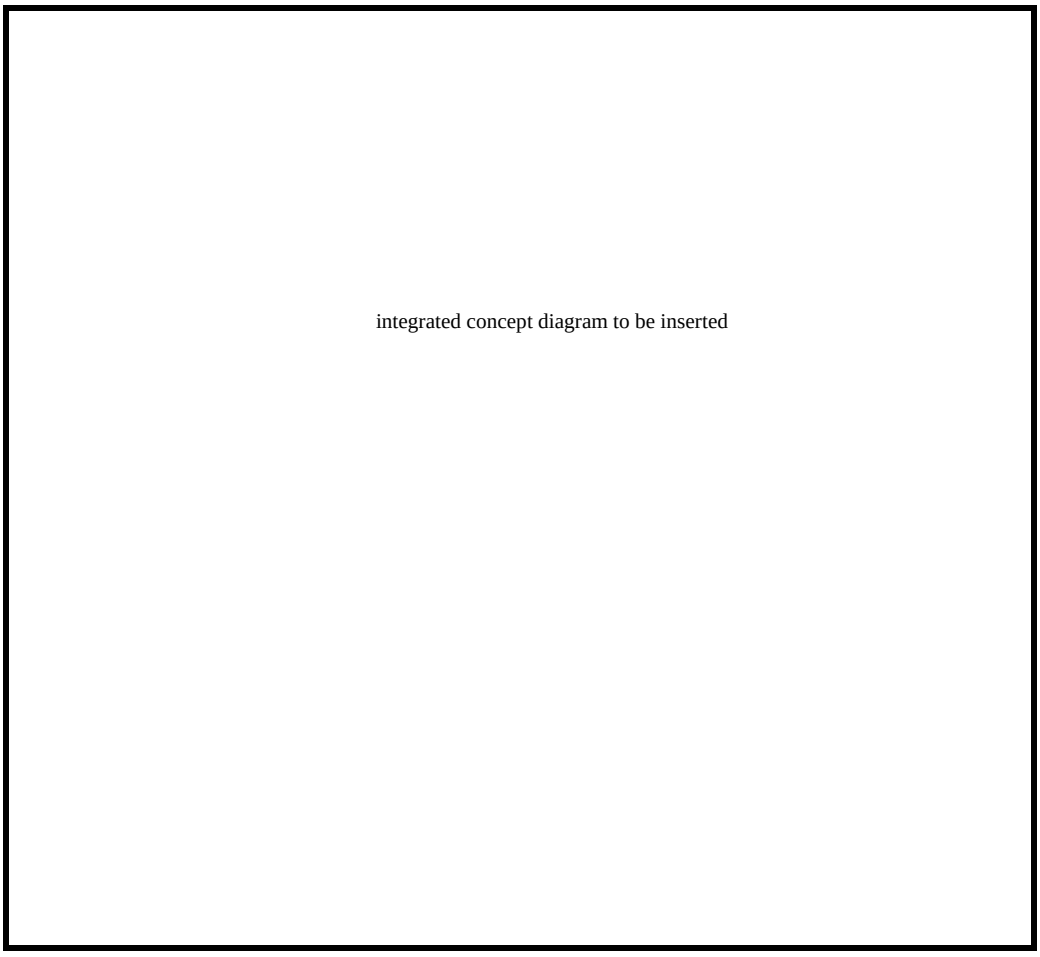

Figure 2: **The Integrated Concept**

The Integrated Concept states that there are separate ways of receiving information about something and that these ways are complimentary. The wheel shape diagram helps to symbolize this concept. In addition all brain data is sent through the brain's biological communication lines, the B.E.F. - brain efficiency factors, which is represented within the center.

The neurological behavior of the brain in relation to cognitive processes can be defined in terms of three **brain efficiency factors** and their interplay with the genetic code. The three brain efficiency factors are 1. branch density, 2. junction function, and 3. pathway utilization (described in more detail within part 1). These three factors, interacting with our genetic code, form the basics of information flow within the human brain. They are the communication lines of our brain. Yet in order for any information to be passed along these biological telephone lines there has to be a source of STIMULI or DATA. Stimuli means that there is some type of energy (information) fed into the brain efficiency factors that triggers them to work as communication lines. These stimuli are both internal and external and are used to mold the brain efficiency factors into a thinking rational human brain. It is the combination of nature (the basic nature of the neurological system to behave in a given manner) and nurture (the

stimulation provided to the neurological system) which shapes the majority of our thinking and behavior.

There are many different types of stimuli that affect mind development. To be successful in improving brain utilization we need to evaluate the internal and external stimuli that affect the three brain efficiency factors. To do this we need a concept with individual parts that describes each of the categories of brain stimuli but also shows how they are all interrelated. These parts, when combined, must represent the realm of stimuli affecting the three brain efficiency factors and yet be concrete enough to be discussed as separate entities. This concept is the **INTEGRATED CONCEPT**.

The Integrated Concept is based on the principle that we are complex beings made of many components, each interfacing to yield a whole person; each component is individual, yet they can work together. The five components of the Integrated Concept are:

1- Physical,
2- Intellect,
3- Emotional,
4 - Environmental, and
5 - Spiritual.

Although the Integrated Concept represents the entire realm of available brain stimuli, each component provides us with its own unique view of life. Niel Bohr (inventor of the atom model) used the term "complementarity" to explain unique and different observations that are integral parts of the same event. For example, light behaves both as a particle and a wave. However, the effects of both cannot be measured simultaneously. As a result, arguments did arise that favored either the wave theory or the particle theory. These two seemingly opposing views occurred because of different perceptions of the same event. Bohr stated that there was no incompatibility between the two observations. They were only different ways of looking at the same thing - the different views complemented each other.

The Law of Complimentarity

The perception of reality is represented by complimentary ways of knowing and the information revealed by one way can not be accurately known through another way.

The Law of Complementarity is directly applicable to the Integrated Concept. The whole, being you or I or any object or event, is more than can be described using a singular point of view. The Law of Complimentarity is also compatible with the paradigm of polar unity - the separate views exist simultaneously with the unified view.

The figure entitled "The Integrated Concept" illustrates the balanced nature of this approach to expanded awareness. The figure shows a wheel with its spokes representing each of the five integrated components. The wheel's protective rim symbolizes our ability to adapt and survive through increased perception and awareness. At the hub lies our brain efficiency factors, for without those we would cease to function as a physical being (persons with damaged brains lose some aspect of

awareness). The wheel is only in balance when all of the spokes (components) are of fairly equal length. If one component is favored then that one spoke grows out of proportion while the remaining spokes weaken. This throws the wheel, and our awareness, out of balance. Often our brains become accustomed to this imbalance. Our own internal homeostasis acts to achieve a pseudo-balance. We begin to believe that no imbalance exists, and no change is needed. We adjust to fool ourselves into believing in the totality of our misperceived reality.

Developing an awakened mind is a total multifaceted process. The difficulty in a single focused approach comes from trying to use that approach (perception style) to simultaneously describe the same thing observed using another approach (perception style). Some examples are listed below:

- Seeing blue and trying to describe it to someone who has never seen blue.
- Tasting a watermelon and trying to describe the experience.
- Being in love and trying to hold it in your hand, taste it, see it, or capture it.
- Having a hunch or an intuition and then trying to share that feeling and describe it to one who has never felt it or felt anything like it.

The list is endless. There are numerous aspects of life that are best known by being rather than explaining. It is simply a fact of nature, and man, that there are times when a single viewpoint will not adequately describe all the properties of reality. This does not mean that there is not truth in perception or that perception is truth. It means that the key variables of the GMT support the contention that there are many different ways of knowing.

It is fairly easy to follow only one of the Integrated Components (or one way of knowing), to gain some wisdom or intelligence along one inquiry path. Many self proclaimed teachers of "enlightenment" have just such a unidimensional program to offer to the searching public. But the Integrated Concept points out that expanded awareness is multifaceted and that each of the facets affect the performance of the other facets. There is no single easy path. Even though the Integrated Concept is divided into five parts: physical, mental, emotional, environmental, and spiritual. The parts are not singular entities. If we forget to work on one component then growth will be incomplete and, as a result, mental awareness will be incomplete. This incomplete development in one component will inhibit the development of the other four components. The five components of the Integrated Concept can be viewed like the five fingers of our hand. Each finger may act independently, or in small groups, or all together. No one with the ability to use their whole hand would choose to proceed through life using only one finger. In this analogy, and in the Integrated Concept, the whole is greater than the sum of the parts, i.e. there are characteristics of the whole not found by examining the separate parts. The whole is the unique essence of the individual learner, that which is the focus of the practitioner's efforts in mind training.

The Flow of Thought - Building the GMT

Thus far the brain efficiency factors and the Integrated Concept have been presented as parts of the GMT. Brain stimulation along the brain efficiency factors and through each of the five components of the Integrated Concept, the five stimuli categories, keeps our brain active and healthy, much like exercise and food help keep our muscles in shape. But stimulation and the brain efficiency factors alone do not define the totality of human thought. They are only pieces that affect and help to shape how we think. Following stimuli reception our brain performs a series of complex interwoven actions in order to "understand" the relevance of the stimuli.

The GMT is a model to help the practitioner understand how our brains accomplish stimuli evaluation. Then with this understanding the practitioner is more equipped to act so as to increase and enhance the learner's understanding, or "knowing". Through the application of the GMT to an individual learner the practitioner can gain a better understanding of how the learner comes to "know" and thus be in a better position to design quality therapy programs.

This paper describes the brain stimuli processing (information processing) portion of the GMT and completes the construction of the simplified version of the GMT. What follows is a description of the unique way in which our brain takes incoming stimuli, how it assigns a level of importance, sifts-sorts-matches stimuli with other data (including memory), decides what should be stored (memory), makes a plan, and acts upon that plan while monitoring the success of our efforts. This is a three step process:

Data+Input - Processing - Action while Monitoring *(feedback loops).*

Most of the time while we are consciously thinking and acting we follow this three step process. The first step, data+input, has been discussed in part through the Integrated Concept. The second steps will be described in this paper and the third described within part three. The following information relating human thought processing to areas in the brain is based on neural Information Processing Models (IPM's) which are based upon scientific research. This scientific research is two fold 1) observation of patients with specific damaged areas of the brain and relating the lost functions to the specific areas of damage (including the experiences of this author) and 2) imaging (using various brain scanning devices) of the brain as it is functioning. This is the foundation of functional neuroanatomy upon which most of the following description is based (see Brief Reference List - Mind).

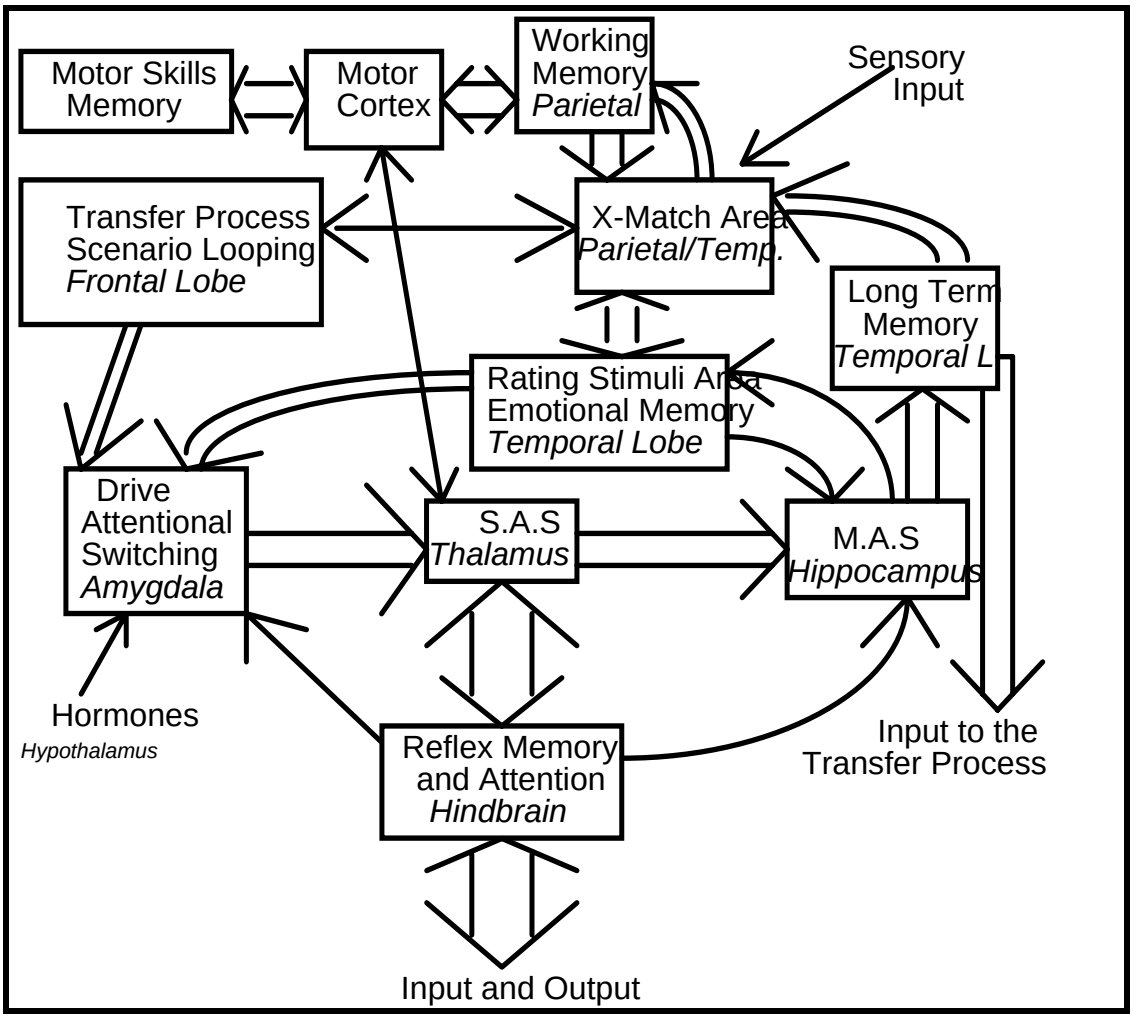

Figure: **Thought/Action Information Processing Model (I.P.M)**

The basics of functional neuroanatomy are presented here only to serve as a foundation for further discussion on how we think and what the practitioner can do to improve the support relationship. This information is not meant to act as a replacement for a more formal neurologically based understanding of the human brain. The reader is referred to the accompanying brief reference list on the mind for this additional information. The following flow charts (Thought/Action IPM and Sensory IPM) are simplified "wiring" diagrams used to illustrate how our brain processes information. All possible nerve connections are not shown. The emphasis is on the major, most frequently used, pathways and describing the influence of these pathways on the process of learning.

The Model of Perception

The first flow chart-wiring diagram is called the **Model of Perception** (diagram below). The model does not show all the intricacies of the three stage processes of data-input-processing. A detailed input - processing - output model of the senses is beyond the scope of this text. Instead the focus of the Model of Perception is on the

automatic survival feedback loops, on input of sensory stimuli, and on the hierarchy of these two brain functions. The model places emphasis on the first step of the three stage process; data input. The model illustrates the following: the **Hierarchy of Function,** and the **Survival Feedback Loops.**

Hierarchy of Function:

The brain processes stimuli through a hierarchy (a sequential stacking) of neural systems with each system responsible for evaluating a particular aspect of the stimuli it receives from our senses. The hierarchy is designed so that simple components of the stimuli (like line or edge definition of visual stimuli) are evaluated prior to more complex components (like the 3-D character of visual stimuli). The brain just doesn't receive stimuli about our world all at once. Instead it builds up its reception by stacking the more complex aspects of the stimuli interpretation on top of the simple aspects. It is like doing a drawing; start with a line sketch, add shading, then add color. This part of the hierarchy is illustrated on the Sensory IPM by following the path from sensory input to Thalamus, and the neocortex by following the path from sensory input to Thalamus, and to the numbers I, II, and III at the top of the diagram above the Primary (neocortex) Areas, the Secondary (neocortex) Areas, and finally the Association Areas (neocortex). The information is then sent to other association cortex areas (represented by the looping arrow) which are labeled on the Thought/Action IPM and described later in this paper.

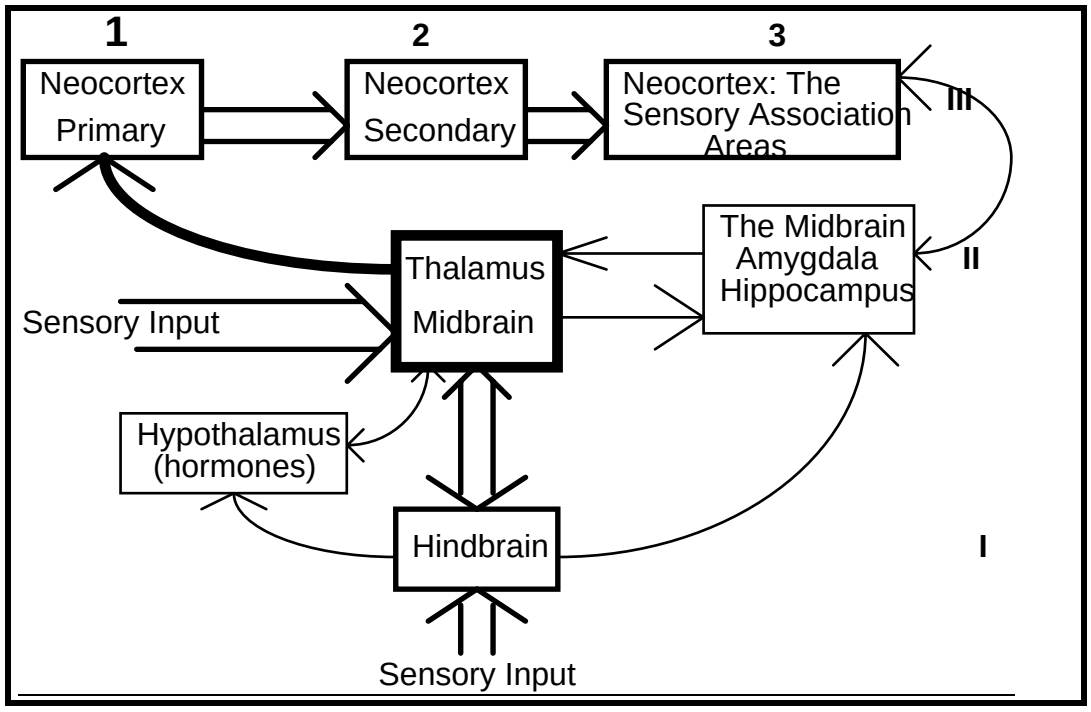

Figure 3: **The Model of Perception**

This "build up" of sensory information happens following the brain efficiency factors through time as effected by our genetic code. This results in varying degrees of sensory strengths and weaknesses for different learners.

The Law of Sensory Information

Each learner's ability to processes the sensory information associated with learning is affected by their sensory strengths and their rate of sensory integration.

The second function of hierarchy (numbers I, II, and III on the side of the diagram) is to evaluate the survival importance of the stimuli prior to "thinking" about it. A subconscious monitoring of survival needs and a focusing of sensory attention to that need. This survival monitoring hierarchy is illustrated by the numbers on the right hand side of the Sensory IPM diagram. These numbers refer to the information flow path after Stimulus reception from the senses, that is; 1-Hindbrain/Thalamus, 2-Midbrain system/Hypothalamus, and then, 3-Neocortex - a stacking of neuroprocessors in the brain. The importance of this three step hierarchy will become clear in the discussions on emotion and survival.

Survival Feedback Loops:

The brain has within it numerous circular interconnections that act as monitors of the survival importance of stimuli. A quick perusal of the Sensory IPM and the reader will be able to notice many circular loops along which information could travel. If we exclude the neocortex association areas then most of these survival feedback loops happen on their own with little conscious intervention. As we will see latter, feedback loops are also dominant in our conscious thought processes (loops that exist within the neocortex association areas described in the Thought/Action IPM). Pringle (1982) suggests that this "loop" structure of the human brain is a fundamental part of its construction and that these neural feedback loops act much like oscillators emitting electrical activity. The structure of this neural oscillator "...consists of a closed loop of neurons which oscillates because of a small amplitude and phase shift introduced by each neuron (the E/I system). Since each cell in the cortex has synaptic connections to a large number of other cells, the spatial localization of such a loop oscillator will be extremely plastic, depending on the amplification and the phase shifts of every cell in the network. One cell can be a component part of more than one oscillatory loop at the same time..." (p.278-79).

Both the survival feedback loops and the hierarchy of functions work together to process stimuli in an organized and interconnected fashion that puts survival ahead of daydreaming. The mid/hindbrain system is responsible for altering the chemically induced signal to noise ratio represented by incoming stimuli. Stimuli arrive with certain chemical "topography" with certain stimuli signals are higher than the background noise. The mid/hindbrain system alters that topography so that valleys of an event signal (the amplitude and phase shifts imparted on a given neural loop) causes our attention to be focused in the right direction. These attentional systems are in constant feedback relationship with each other. They "talk" to each other and

monitor the flow of information constantly in order to make the adjustments in the flow whenever and where ever they are needed.

The Law of Feedback Relationships

Each neural system, or network, has a feedback relationship with its adjacent networks and changes in these relationships affect thought.

Sensory input is altered by the feedback relationships which direct attention and which are also linked to our survival drives. Problems arise when this survival dominated processing system is "artificially" triggered. This happens because a stimulus is exaggerated (the intensity of the neural signal is increased) in terms of its survival importance. This exaggeration can be the result of chemical imbalances (as with alcohol) or due to the triggering of memory (conscious or subconscious) that relates the new stimuli with old stimuli that had survival importance. This artificial triggering of the survival loops causes physiological changes, changes in attention, changes in perception, and changes in how we think and act.

> **Principle**: There are survival drives which affect our attention, perception and thought.

This type of triggering often results in what is here termed an inefficient feedback loop. The nature of inefficient feedback loops in the form of barriers to efficient complex problem solving is discussed in more detail in part 4. As the survival feedback loop is working (efficiently or inefficiently) what stimuli are being monitored as survival related? All stimuli are monitored but not all stimuli are deemed of survival importance. Only those stimuli which are related to the **FIVE DRIVES TO SURVIVE** are then considered related to our survival (consciously and subconsciously).

The Five Drives to Survive are as follows:

1- Sexual (species survival)
2 - Eating/Drinking
3 - Fear (related to losing physical well being)
4 - Nurturing (care-bond response)
5 - Fighting (to maintain the above four drives)

Additional instinctual reflex reactions (ancestral memory, genetic imprinting) and cognitive motivators (MMS - mimicry, modeling, stimulation as discussed in part 5) are also likely to be part of this survival loop as are pain/pleasure reflex reactions stored in the hindbrain.

Monitoring the survival importance, how the input relates to the five drives, is the chief responsibility of the hindbrain and the midbrain system (linked together with the neocortex particularly the interior portions of the temporal and frontal lobes; see next IPM), and the hypothalamus- the moderator of our hormone/body chemistry balance. The thalamus is part of the survival feedback loop but does not play a significant role in survival stimuli evaluation (but it is strongly affected by such evaluation). The

thalamus serves as the "Grand Central Station" of neural signals, with most of its connections being two way. It is a "pacemaker" that rhythmically switches signals from one brain functional area to another. The thalamus may be responsible for synchronization of the many feedback loops (Thatcher and John 1977). It may also be largely responsible for a function here termed **SAS - Sensory Attentional Switching**, that is being able to switch attentional focus from one set of incoming sensory stimuli to another set (example: you are really engrossed in an exciting book and during that time little or no attention is being paid to other sensory stimuli, in fact even time perception is changed). The thalamus probably serves as a link between the midbrain and hindbrain inputs and a link with the sensory association areas of the neocortex. The reader may have observed in the previous IPMs that the Midbrain and the Hindbrain structures are so intricately looped together that they could be referred to as the MID-HINDBRAIN SYSTEM.

As previously stated the initial evaluation of the Five Drives to Survive happens within the above described Mid-Hindbrain System. This system has its own memory, a way of remembering those things that are survival related. It's unlikely that the midbrain has its own midbrain memory. Although the temporal lobe is often called the midbrain memory it is not a midbrain structure but part of the neocortex. Experiments on mammals with only hindbrains remaining show that they can still learn, be trained using classical conditioning techniques (Mayes, 1983). Research by Richard F. Thompson of Stanford University found that the memory of a classical conditioning event, a learned stimulus-reflex response, could be surgically removed from the hindbrain without removing any other function. In this text this type of memory is termed this memory **Reflex Memory.** In addition to reflex memory the hindbrain is a signal booster. Those signals that are matched exactly to important reflex memories (a yes/no response) elicit a larger response, a signal boost, that is proportional to the demand of the memory. Its purpose is one of arousal, of directing attention. This means that more serious survival stimuli receive immediate attention from other areas of the brain because their signal is "louder" due to the input from the Reflex Memory.

This does not mean that all habitual behavior is stored as reflex memories (there are many memory storage areas in the neocortex), and it doesn't mean that emotional memories are stored in this region of the brain (although a stimulus component related to pain/pleasure may be stored). The reflex memory records instances of strong pain/pleasure and intercedes early in the chain of stimuli processing so we can react more instantly, with a reflex. This ability to rapidly respond to certain stimuli enhances our survival. In addition the hindbrain has a genetic (ancestral) memory related to instinctual patterns and an autonomic memory related to the functioning of our autonomic nervous system. Each of these memory traits (and those described above) are part of the hindbrain system and each can have direct influence on the midbrain system (and vise versa).

The midbrain and the hindbrain work together in a constant feedback process. Built into the mid-hindbrain system is a series of checks and balances for each of the five drives. It is a balance maintained by ***excitation*** versus ***inhibition*** as delivered by the brain efficiency factors. As a thought (perception, feeling) moves through the human brain (is being processed) the cortical structures assign a code, enhance the

signal, as it is being processed. There are signals that excite us to pursue drive fulfillment (excitation) and signals for stopping us (inhibition). This ***excitation/inhibition (E/I) balance*** is strongly influenced by hindbrain input, but is also influenced by input from the neocortex. The excitation/inhibition of the five drives provide the basis for our emotions, thus the midbrain system has often been called the seat of emotion. It is in the midbrain system where the battle between hindbrain input (subconscious) and neocortex input (conscious) takes place, determining the type of action to be taken, based on the E/I balance, and the intensity of the signal as it is received by the neocortex. The interplay between the E/I balance and the flow of the neural signal within a given neural network establishes a feedback within that network - a feedback loop. It is within this basic brain process hierarchical feedback loop, midbrain - hindbrain system - neocortex association areas, that ALL stimuli must be evaluated first in terms of their survival (emotional) importance. It is emotion/drive/instinct monitoring that answers the questions "Is this input related to my survival and how much attention needs to be given?".

> **Principle:** Our thoughts are affected by the balance of excitation and inhibition throughout our nervous system.

It is worthwhile to point out that a mammal can survive with ONLY the mid-hindbrain structures (Kolb and Whishaw, 1980). After surgery the animal functions on a simple survival level, acting upon stimuli related to the five drives. There is no rational order to these actions (no prioritization, no planning). Instead the order is based upon the intensity of the signal sent by the hindbrain. The most intense signal gets acted upon first regardless of the consequences. It is an impulse driven system with the strongest impulses eliciting the first action. Because the neocortex has been removed there is no moderator in the emotion/drive/instinct evaluation process. Without the neocortex decisions are based solely on the E/I balance. As we will see later in this text it is neocortex moderation that helps us to control emotions and impulsivity.

> **Principle:** The Hierarchical Feedback Principle - Information flowing through the neural systems of our brain does so in a hierarchical manner while maintaining feedback relationships.

It should be clear to the reader that the human brain processes information in a hierarchical fashion and that it does so while also maintaining feedback loops. If these two concepts are combined with the law of recursion (patterns represented on one level can also be seen at smaller and larger levels, e.g. the patterns made by water running down slope which are nearly the same in the smallest creek as they are in the large rivers) and then applied to human thought the result is the **Hierarchical Feedback Principle**.

> **Principle:** Any inefficiency in a particular neural network directly affects the processing of that network and those networks connected to it.

The details of this intricate, yet simple, relationship between hierarchical feedback and the wide variety of matter-energy interactions is beyond the scope of these writings. Yet is important for the reader to understand that hierarchical feedback is viewed as a crucial and founding principle in the discovery and understanding of how we come to know truth. Even though this book uses the reductionist approach to represent the human brain and training of the human brain it is important that the reader always keep the above fundamental principle in mind. Restated a different way the hierarchical feedback principle means that ***any inefficiency in the system may appear to affect the entire system***.

Treatment (teaching, training) approaches which simply address the observed externally displayed effects may not be addressing the cause of the problem and thus will be less successful than focused treatment. The principle also reminds us that the reductionist approach has its limitations due to the fact that all the parts are interconnected and when they are separated for description purposes some of the qualities of interconnectedness become lost.

The Thought/Action IPM - The SmART Processes

The human brain is a wonderfully complex biological system responsible for sequencing, setting priorities, planning, and conscious remembering. These are functions of the neocortex involving the bulk of our brain. It is a systems process containing many feedback loops - similar to the survival loops described earlier. This complexity is schematically illustrated in the flow chart/wiring diagram labeled the Thought/Action IPM which was presented earlier. This diagram is presented again later in this text after the following description of its component parts. Because of the complex nature of this diagram it has been divided into four parts, or "loops", in order to facilitate description. Each of these four loops work simultaneously to create human consciousness. The four loops are as follows:

IPM		SmART Process
Autopilot Loop	=	**Sm** - Sensorimotor.
Emotion Loop	=	**A** - Attention
Memory Loop	=	**R** - Recall.
Transfer Loop	=	**T** - Transfer.

The four loop diagrams correspond to the SmART processes as discussed above (in addition the information flow diagrammed in the Sensory IPM affects Sm and A). The reader should remember that ***the mnemonic SmART is a simplified representation for the simplified GMT (which is also a simplified representation of the brain).*** The remaining portion of this text is dedicated to describing the fundamental components contained within the SmART Processes. This knowledge provides a foundation for the practitioner of C-B-P Therapist to help him/her come to understand the learner.

The Interplay of Numerous Feedback Loops

Even with this breakdown it is impossible to present all the complexities of the human brain using a simplified model. The goal in developing this model was to stay true to known science regarding functional neuroanatomy and yet be clear enough to be under-stood by persons outside the field of neurology. The key point to remember is the change in how we view the brain. ***Instead of having cortical areas that are responsible for a skill or a personality trait the learner has areas that perform specific FUNCTIONS which are looped together to complete a given task.***

Any task may or may not be seriously affected by neural loss within a given functional area depending on the task demands in relation to the function of that area. In the diagram labeled IPM Thought and Action these specific functions are represented within boxes that approximate their location within the brain (except for the motor cortex). If the reader looks at this IPM they are likely to be confused by its complexity. This final diagram can seem overwhelming. There are arrows everywhere, some big (representing the more frequently used thought pathways), some small, some one-way, and some two-way. It is hoped that through the following four part description that the reader will come to understand the IPM - Thought and Action, its representation of functional centers, or information processing centers, within the brain (as opposed to areas housing specific skills or traits).

The following description will help show how these processes are looped together to form larger processes. When all the process are looped together to form the GMT it yields an adequate model of how we think and one which can be used to better predict the relationship between thought and observed behavior. Research by Dr. Daniel Dennett, director of the Institute for Cognitive Studies at Tufts University, supports the concept of multiple loops which run simultaneously and present to our mind "multiple drafts" of our experience. Dennett (1991) states:

> According to the multiple drafts model, all varieties of perception - indeed all varieties of thought or mental activity - are accomplished in the brain by parallel, multitrack processes of interpretation and elaboration of sensory inputs. Information entering the nervous is under continuous "editorial revision". (p. 111)...Feature detection's or discriminations only have to be made once. That is, once a particular "observation" of some feature has been, by a specialized, localized portion of the brain (a functional center) it doesn't have to be sent somewhere else to be rediscriminated (for the same discrimination)...(p.113)...The natural question to ask is where does it all come together? The answer is nowhere." (p.169, parenthetical comments added).

In this portion of the GMT the "multiple drafts" model is exemplified by the four loops which are simplified divisions of the more complex Thought/Action IPM. It is important for the reader to realize that just as consciousness is not located in any one part of the brain, neither are global processes, like judgment, attention, memory, language, perception, and creativity. These global processes require each of the four loops interacting with each other in ways specifically tailored to an individual situation. Karl Pribram (1982) describes consciousness as being composed of either states (usually described as states of mind) or functions (of the brain) and that process involves one state becoming another while encompassing function. Efficient

performance of the global processes, such as consciousness and memory, requires multiple states of mind developed through the efficient utilization of multiple brain loops interacting with multiple functional centers. A breakdown in any one of the loops and/or any one of the functional centers will result in a change in one's "state of mind" and a change in the efficiency of the global process.

Utilization of each of the four loops in response to a given stimuli is, for the most part learned. Assignment of functional responsibility to given neural centers is largely genetic. They interact with each other, the well known nurture-nature process (cortical plasticity), to form a totally unique individual. No book on human thought could possibly describe all the characteristics and variations found amongst the average populace. In fact the more reductionist we become in our quest for a model which represents human thought in neurological space the more ambiguous appear the data. Yet if we attempt to stay on the Gestalt, holistic, side of model building, the model often lacks enough definition to be useful. The model presented here is an attempt to merge both the Gestalt and reductionist views into a balanced model which can be functionally applied by all practitioners seeking to help teach new skills. The emphasis of the GMT is more on the function of various feedback loops than on their accurate location in neurological space.

In the GMT the brain is presented as more of a process model then a phenomena model AND it is process which is tied to neurologic space but in a plastic manner - that is, each individual brain is molded by the hierarchy feedback principle throughout their lives - throughout TIME. When we attempt to search for specific phenomena which can reliably be attributed to a spot in neurological space which is also consistent across our population we often discover inconclusive results. Pringle (1982) states the following:

> "There are large regions of the human cerebral cortex...which have no function that can be defined in terms of localized effects. Yet the information is being transformed into some other form, such as a pattern in time (process) rather than (one) in space (localized phenomena)...(p.278).. consciousness occurs when complex time patterns spread over a sufficiently large region of (neurological) space. The physiological correlate of consciousness does not need to be localized at all, since the information which a conscious thought contains is present in the brain as a time pattern (as a process, such as a feedback loop)..." (p. 280, parenthetical comments added)

The extent and nature of these "time patterns", brain processes, is dependent on the extent and nature of the neural loops and their relation to all the parameters of the GMT. But the problems with locating phenomena in neurologic space do not mean that we can not make predictions about the relationship between human thought and human behavior across the population. Fairly accurate predictions about the relationship between thought and behavior can be made if we use a process model and if we identify the boundary conditions of our comparison. When using the GMT as a predictor model for the relationship between thought and behavior it is possible to discover increased efficiencies and deficiencies which will appear as changes in processes which affect phenomena. The changes will not present themselves as highly predictable phenomena but instead as highly predictable process effects with some

variation in the phenomena due to individual variation. These process effects will lead to a consistent observed phenomena that is unique to the individual. The interplay of localization and non-localization is another example of polar unity. The GMT supports the view that there is an intricate interplay between phenomena location and process interaction and that ***the best approach for modeling thought*** across setting, person, and time, ***is from the perspective of polar unity*** not the Cartesian perspective.

> **Principle:** The flow of thought is an interconnected process which can not be located in any one place in space or time.

There are some fairly accurate predictions which can be made about the functions of given areas of the brain, and the more accurately we define the boundary conditions of our comparison the more accurate become our predictions. Under some conditions we can predict the relationship between a specific area in neurologic space and a given behavior and also generalize that prediction across our species. But this occurs because of specific definitions of the relationships between process and phenomena combined with the effects of other aspects of the GMT - it does not mean that a thought has an pinpoint location in neurological space. Applying the paradigm of polar unity - thought is both affected by specific processing centers in the brain and at the same time thought is not located in any specific center.

The GMT starts with a global view, looking at large number of feedback loops between various processing centers, as exemplified by the IPMs. This is then reduced into smaller feedback loops. In this text the division of the GMT into four sub-models is supported by functional neuroanatomy and by the vertical stacking of neural networks (Churchland, 1986). One such division is illustrated by the four parts, "loops", of the Thought/Action IPM: Autopilot Loop, Emotion Loop, Memory Loop, and the Transfer Loop. In the following loop diagrams the dark highlighted areas (boxes and arrows) represent those neural networks, functional areas, most frequently used during information flow within this loop - the primary pathways. The non-highlighted areas and open arrows represent the secondary pathways which can influence the information flow within the primary pathways. All other pathways (those not shown in the loop IPMs but shown in the Thought/Action IPM) should be considered tertiary pathways as all components of the GMT may affect all other components (Hierarchical Feedback Principle).

The Autopilot Loop*:*

The first portion of the four part description of the Thought/Action IPM is entitled **Autopilot Loop** (see diagram below). The title describes something we have all experienced when taking a walk, riding a bike, or driving a car. It can also include things like reading (automatic reading), and writing (copying), and automatic verbal responses. These are physical things we can do almost "automatically" while the rest of our mind is off daydreaming, singing to a tune on the radio, planning for the future, or having a friendly conversation with the person next to you.

Principle: Over learned motor sequences can function while other thought processes are occurring.

The Autopilot loop works for any SKILLS sequence that has been repeated enough times, overlearned, to become part of a special memory area called **Motor Skills Memory** (frontal lobe-prefrontal cortex, Lauria, 1973, also called the Supplementary Motor Area, SMA). This Motor Skills Memory area is linked with the motor cortex

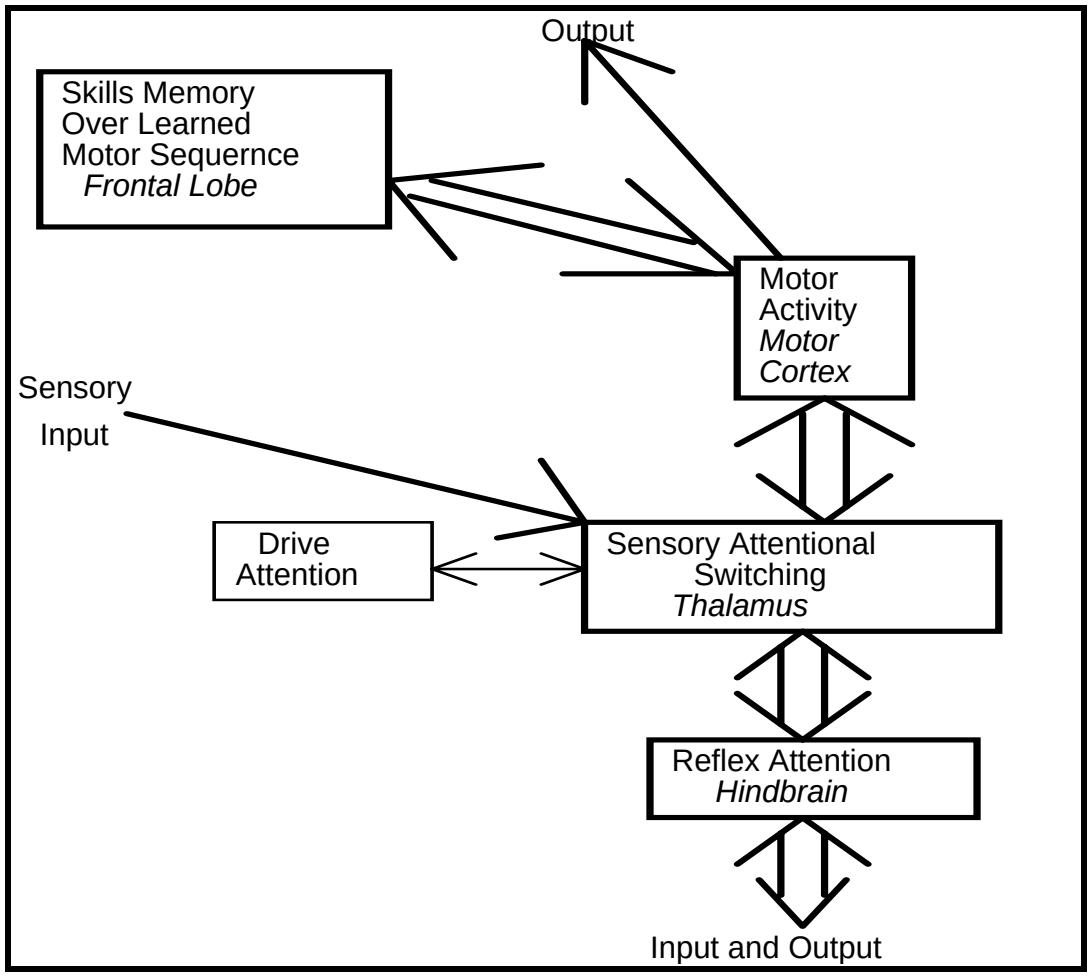

Figure 4: **The Autopilot Loop**

(responsible for moving muscles), the "felt self"-parietal lobe (responsible for body sensing and movement through space and time) and linked to the hindbrain (through the and is distinguished from motor memory by its **site specific/survival stimulus (4S) evaluation,** and it remembers things learned early that are related to the five drives to survive. The hindbrain is responsible for autonomic activity, some motor function (reflex) and level of arousal, but the 4S evaluation is perhaps its most important "thinking" related function. The ***4S evaluation is a yes/no response to a site specific matching of incoming stimuli to memory regarding survival***. This can include a series of learned actions (classical conditioning) when the actions are tied to survival

(including pain/pleasure). But loss of motor memory does not have any particular special survival significance but loss of this area can result in decreased task performance (Lauria, 1966). It's just a convenient way to store and access skills that we use frequently thus allowing other parts of our brain to develop other survival skills.

Of course, as is true with all aspects of brain functioning, the link between the higher level (motor) functions and the midbrain-hindbrain system serves as a constant survival monitor. Picture yourself driving down the road singing a tune with the radio when all of a sudden a deer darts in front of the car. Almost instantly you respond (reflex memory): 4S evaluation, the boosted intensity of the signal, and the E/I system all working within an instant, like pulling your hand away from a fire. Without this 4S monitoring we most likely would not survive. There is also a link to our emotions so that attention may be quickly shifted to that which is considered emotionally and/or physically important.

The Emotion Loop*:*

The second portion of the four part description of the Thought/Action IPM is entitled the **Emotion Loop**. Much of the emotion loop has been described in the previous sections addressing mid/hindbrain responses. The survival feedback loops described and shown in the Sensory IPM should be considered a part of the Emotion Loop. Added to these responses are the responses of the neocortex. Of course because the mid-hindbrain system calls attention to survival related stimuli, the signals it sends out usually take priority. They can dominate the things we think about. But this is moderated, using the E/I system which is distributed throughout the entire brain.

The Law of Attention

Each learner has attentional strengths and weaknesses specific to their learning style which affect the learner's attention directed to the given task.

The input from two areas is especially influential for moderating emotion:

1- the area responsible for making plans (frontal lobe, scenario looping), and

2- the areas tied to emotion memory (interior temporal lobe, the hindbrain and the amygdala/hippocampus).

The areas responsible for affecting emotion are illustrated in the accompanying diagram

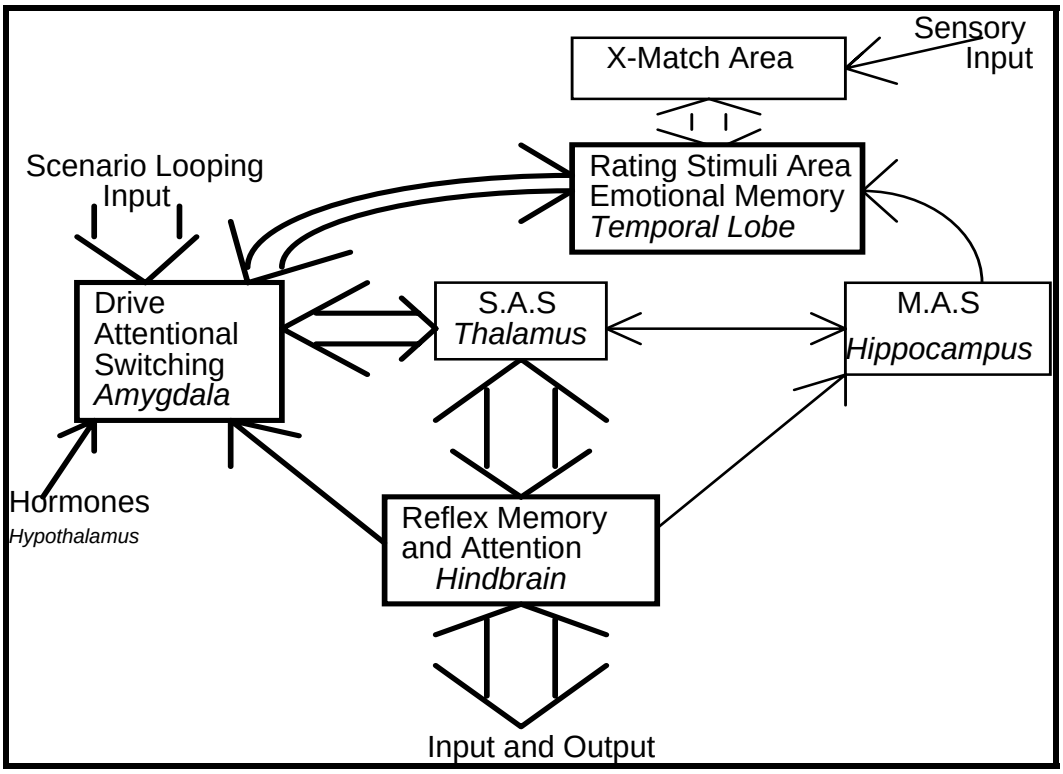

Figure 5: **The Emotion Loop**

of the emotion loop. The higher cortical areas work in tandem to further evaluate the importance (need in order to direct attention) of stimuli received from other structures in the mid-hindbrain system. It's another feedback loop and it has strong attentional impact - we pay more attention to that which has emotional importance to us. The area of emotional memory, the temporal lobe (particularly the interior medial right side), is often called the association area for the mid/hindbrain system (Kolb and Wishaw, 1980). Here it is termed the **Rating Stimuli area**. As with other neocortex association areas, this area is responsible for taking multiple stimuli from a situation, forming a more coherent picture of the character of the situation, comparing it to memory of similar situations, and then attaching an E/I signal (or code) that rates the importance of the event (how much attention should be given). It is directly tied to, and overlaps with the X-Match area that is part of the memory loop. Without this emotion rating system in smooth working order (due to damage and/or chemical imbalance), the individual may exaggerate the importance of emotional stimuli, may act impulsively, may demonstrate egocentric and frequently religious preoccupations or may have a very flat affect. Individuals who suffer from uncontrolled neuron firing in this area of the brain often experience an infusion of emotional laden experiences and find it difficult to separate fantasy from reality. But emotion rating inadequacies can also be due to the over-generalization or under-generalization of stored memories. It is the process of applying too much emotional significance or too little significance to an event or perception only to find out later that our interpretation was incorrect. It may have felt real at the time (self real) but the consequences of our action/non-action at a later date showed that it was not valid in terms of the environment (environmentally valid).

The other area responsible for emotional evaluation is the frontal lobe: the area responsible for making plans. There are numerous frontal lobe - limbic and midbrain connections, connections to areas that directly affect emotions. This makes sense because the frontal lobe is responsible for planning and when we plan, initiate and sequence thought or action, we need to be aware of the survival priority that has been attached to the E/I signal of every action and its potential consequence with relation to the Five Drives to Survive. Plans are made first to address survival and then later we attend to other thought processes. This is why many human plans of action have at their roots one or more of the five drives to survive. But the frontal lobe is also responsible for activating the inhibition of emotions (E/I system) in order to accomplish some goal that is designated of higher importance than the emotion. The functions of the frontal lobe are discussed in more detail latter in this paper.

The planning activity of the frontal lobe combined with the rating by the temporal lobe (Rating Stimuli Area) provides us with an excellent way to moderate (inhibit) our emotive desires (mid-hindbrain system) in order to complete goals and contribute to the well being of society and self. It is important to note here that ***emotion is both a process, with its own neural networks, and a source of information***. Emotion is strongly linked to attention and attention strongly affects memory.

The Memory Loop:

The third portion of the Thought/Action IPM is entitled the **Memory Loop**. As previously discussed there is memory for the Autopilot loop (motor skills memory) and memory for the mid/hindbrain system (reflex memory). In addition there is a direct connection between the rating of stimuli, modifying the E/I intensity of incoming stimuli, and our storage of similar stimuli (including events, actions, and symbols). This portion of the Thought/Action IPM, the Memory Loop, is designed to illustrate the workings of the memory we are most familiar with: the memory that can recite a sequence of 7-8 digits or words, the memory that recalls what we have read or studied, and, the memory that we constantly use to compare our daily perceptions of things, to those we had in the past. After the memory loop is added to the building of the Thought/Action IPM the diagram begins to look confusing. This is because there are so many different aspects to memory (see table - Different Types of Memory). Memory plays such an important role in every thing we do. Even moving our arm and hand to grab a pencil requires that we remember where our arm is, where it is going, and where it has been. It sounds simple but in terms of the flow chart/wiring diagram (IPM) of the human brain even the simplest of actions use many different brain areas.

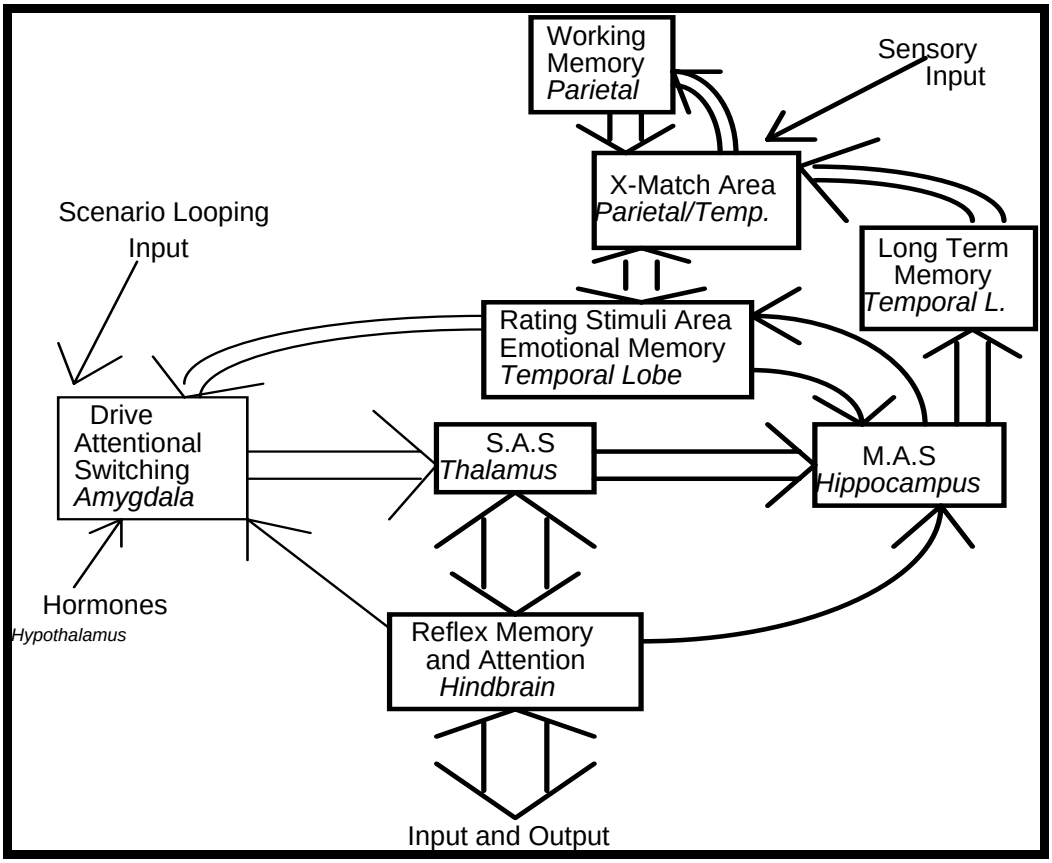

Figure 6 **The Memory Loop**

Perhaps the best way to start the description of memory is to describe the following three areas:

Working Memory - W.M., ***Long Term Memory - L.T.M.***, and, ***Recall.***

WORKING MEMORY (WM) is sometimes called short term memory, digit span memory or immediate recall. WM is a short-lived memory of a sequence, 7 (+/-2) pieces long (Miller, 1956), that can be composed of numbers, letters, words, pictures, body movements or (perhaps) feelings. The memory lasts less than a minute before it is replaced by another (Baddely, 1983, Broadbent, 1954, 1983). The aiming movement function is part of working memory and its connection to the motor cortex. The WM that we are conscious of is seen through a 7 to 9 digit immediate recall, but it is NOT a static process. The recall process moves through time and space. A way to view the "movement" of the process is to consider our hand reaching to grab a pencil. In order to complete this simple exercise, we need to know where our hand is, where it had been (in order to aim its movement) and where we want it to go. This is in part the responsibility of our WM. Feeling where our hand is in time, and aiming its movements comes from the link between the motor cortex , the tactile sensory association are (also called the somatosensory strip) and WM. Each movement of the hand is remembered as we reach toward the pencil and then seconds later forgotten as the hand picks up the pencil and puts it to use. WM is not a static memory but one that constantly changes, like a scanner through a small portion of time and space.

Considering the WM as a constant scanner that has a built-in feedback and feedforward mechanism helps to clarify its function. It is a 7-9 piece memory scanner sequence that "moves" as we act or as we think. WM is constantly monitoring our thoughts and actions. This happens with language, math skills, pictorial events, and numbers. As we add a new event on the end of the 7-9 piece sequence (making it 8 to 10) then the first piece starts to fade from memory (keeping it a constant 7 to 9 pieces long). In this way, "movement" of immediate memory, or a working memory, is established.

The usefulness of WM is clear. It helps us to monitor language by remembering what we have just said so it can be connected with what we are going to say. It helps us monitor body movement and math calculations in the same way. In thinking of WM as a "scanner" working memory can be visualized as composed of memory for the very recent past, attention to the present, predictive attention to the immediate future and memory of what was predicted - an anticipation response. This anticipation response is a natural part of the working memory - X-match memory functioning which helps to increase the speed of information processing and may be the prime candidate for sources of certain types of error, e.g. the "Stroop Effect" and "Spoonerisms".

Working memory is our daily memory system that is used almost "automatically" as we speak and act. It is an important system in helping us monitor the immediate flow of language (internal and external) and movement through space and time (Broadbent, 1983). This movement processed by WM does not have to be stored by LONG TERM MEMORY (LTM) although it may. In fact most of the time we do not want to store all that our working memory processes. Our mind would get so cluttered that it would have trouble sorting and selecting the information that was important. But there are special times when LTM does store information. LTM, Long Term Memory, is a memory that is reserved for remembering things that have more importance. A detailed discussion of LTM is presented elsewhere (see chapter nine). The things that are considered important enough to store in LTM depend upon the brain's evaluation of the level of importance (an assigned valence) based upon **Relevance, Intensity and Rehearsal - RIR**. Every memory representation is stored with an RIR value, a valence, in relation to all other memories already stored.

The use of RIR helps LTM to be an efficient memory storage bank so that we do not have to store every minute detail of each thing we did each day. RIR makes it easier to remember the important things (strategies, rules, events, word meanings, etc.) that contribute to our finding a way to enhance our probability of survival. There are significant hemispheric differences in the way the right side of our brain stores information versus the way our left side stores it. The left side uses symbolic categorization and the right side uses spatial/thematic mapping (Caine and Caine, 1991) but both sides use RIR for encoding information, for assigning a "memory valence" which strongly influences short term and long term memory.

Different Types of Human Memory

Memory Type	Brain Location	Description
Long Term Memory (LTM) - symbolic, language	Left hemisphere, temporal lobe	Storage of symbolic information e.g., that used in language, which is to be retrieved some time later.
Long Term Memory (LTM)- visual/spatial, thematic.	Right hemisphere, temporal lobe	Storage of symbolic information e.g., that used in remembering past events, music, and some aspects of math.
Working Memory (WM) - symbolic, language.	Left Hemisphere, parietal lobe	Storage of 5 to 9 bits of symbolic information for seconds in a "scanner like" manner which monitors the daily use of language. Direct interface with the X-Match area. "Aiming" language.
Working Memory (WM) - visual/spatial, thematic.	Right Hemisphere, parietal lobe	Storage of 5 to 9 bits of visual/spatial (thematic) information for seconds in a "scanner like" manner which monitors the daily movement through space and time. Direct interface with the X-Match area. Also has an attentional component for "aiming" action.
X-Match Area (memory) - visual/spatial, thematic	Right hemisphere, parietal - temporal lobe region (posterior)	Storage of multi-sensory input and memory input in order to build a representation of a visual spatial event. Direct interface with the sensory association areas, LTM and WM.
X-Match Area (memory) - symbolic, language.	Left hemisphere, parietal - temporal lobe region (posterior)	Storage of multi-sensory input and memory input to build a representation of basic language meaning and simple sentence construction. Interface with sensory association areas, LTM and WM.
Transfer Memory* and Time Line Memory* - Global Situational Awareness	Frontal lobe, right hemisphere	Memory duration of minutes inter- facing with LTM, and X-Match, to evaluate the meaning of incoming stimuli in relation to some plan of action. Also contributes to self awareness, self insight, and under-standing of social/emotional meaning from the environment.
Transfer Memory* and Time Line Memory* - Construct Processing	Frontal lobe, left hemisphere	Memory duration of minutes which works with LTM, and X-Match, to evaluate the meaning of incoming stimuli in relation to some plan of action. Also contributes to self awareness, self insight complex language construction and the understanding of abstract language concepts.
Rating Stimuli Area (emotional memory) - visual/spatial, thematic	Temporal lobe, right hemisphere, interior (medial)	Long term storage of emotional images, themes, concepts AND provides input back to the DAS system.
Rating Stimuli Area (emotional memory) - symbolic, language	Temporal lobe, left hemisphere, interior (medial)	Long term storage of language which has emotional meaning AND provides input back to the DAS system.
Sensory Memory	Each of the individual sensory association areas	A storage of sensory input for seconds in order to build a sensory representation.
Reflex Memory	The hindbrain, in particular the cerebellum.	Storage of sharp pain and pleasure and instinctual patterns.

*Note: The Transfer Memory is used as an extended working memory and assists in finding meaning, planning, sequencing, and the transfer of known information to new situations. **Time line memory** is the ability to accurately recall a chain of multiple events which occurred in ones past (over days or longer). The frontal lobe uses scenario looping (a description of the workings of the Transfer Process) and its extended working memory capabilities to build such a time line and to evaluate its accuracy.

The term "short term memory" needs to be clarified. It is a term that has a great deal of ambiguity. WM has a short term memory component but also has other

attentional component which are equally as important for its functioning. LTM has both short term and long term characteristics and special differences between the processes of storage and the processes of retrieval. WM forgets after less than a minute, whereas LTM forgets over a wide time frame from minutes to months, even years, after initially remembering. The term "short term memory" could be applied to the functioning of several areas (e.g., WM, LTM, X-Match, and the memory used in Scenario Looping) depending on what phenomena one used to measure the recall process.

Recall is remembering. But as we have pointed out, there are many types of remembering. 1 There many types of recall. Generally recall is used when fact memory is being evaluated, i.e., how much we remember from studying, from interactions with people and from various forms of media. Recall can be of things that happened recently or a long time ago. Recall effectiveness is also affected by those things that affect LTM - in particular RIR encoding and hierarchical categorization. In the flow chart showing the memory loop there are three main processes, brain area, that compose the bulk of the memory of the memory process (in addition to the mid-hindbrain system). Two of these have just been described WM and LTM. The third area is responsible for trying to match various sensory and memory input. This is here termed the **Cross Match area (X-Match area).**

Moving information from WM to LTM almost always involves the X-Match area and its overlap with the rating stimuli area. As the stimuli is processed by the cross - match area it is given an RIR value that governs its storage and eventual retrieval. Extremely important survival (emotional) stimuli may bypass this area and be encoded (told where to be stored) directly in LTM after passing through the hippocampus (or amygdala). As stated previously there are two areas established for the emotional "cross-match"; 1- the Rating Stimuli area (which overlaps with the cross-match area), and, 2- the Reflex Memory used for 4S evaluation. The cross-match area illustrated on the memory loop diagrams the area which acts to perform multiple modality integrations of the various sensory stimuli we receive while also comparing these integrations to our memories in order to build a representation. This means that input from each of our five senses (the senses association areas) is channeled into this cross-match area. Then each sensory aspect of an object, symbol or event (i.e., touch, smell, sight) is molded together to form a complete picture of our environment while simultaneously performing a continual review of our memories of similar stimuli and their characteristics. The cross-match area helps us to form more complete, integrated, pictures of our world. It is also responsible for man's constant searching for unity, structure, rules, continuity, and regularity in his mental portrayal of his immediate environment. It is the "pigeonholing" process - both in terms of symbolic categorization and spatial/thematic mapping.

1 There are many different areas in the brain responsible for memory, as described in the accompanying table. This is supported by functional neuroanotomical research and supported in part by PET scan research by Larry Squire, University of California, and Marcus Raichle, Washington Medical Center at St. Louis, which showed that people used different areas of there brains to perform different types of memory tasks (Sci.News, Nov. 23, 1991, p. 333).

The Law of Memory

The ability to learn new information is affected by how the learner uses the strengths and weaknesses of their memory capabilities.

The construction of a sensory-memory representation of reality is strongly influenced by the cross-match area, and by the access of information from LTM. The meaning of the representation is established as soon as a "reasonable" correlation is made with the information in LTM. The speed of this process is aided by the RIR encoding process and by the hierarchical categorization within LTM. But the speed of finding a "reasonable" match (establishing meaning and/or direction) can be increased further through the use of the anticipation response. This means that regular patterns in stimuli received are rapidly matched to memories with a high valence and then an anticipation response is made. The use of this feedback system can increase the brain's efficiency - particularly in situations which are fairly familiar. But there can be a problem with this processing acceleration due to the anticipation response - ***information bias*** . The problem of information bias can be compensated for by learning when and how to use the Scenario Looping process (see next section). As with any portion of the GMT their are inefficient and efficient feedback loops - information bias is simply an effect of these loops acting inefficiently.

When the loop is acting efficiently, with the cross-match area (which draws information from LTM, the senses, and the emotion loop) linked with WM and LTM, it provides us with a powerful mechanism for stimuli analysis both during storage and during recall (Eccles and Robinson, 1984). Instead of just looking at one object, event, or symbol we can look at a series composed of 7 to 9 "pieces" (or icons).

When the loop is acting efficiently, with the cross-match area (which draws information from LTM, the senses, and the emotion loop) linked with WM and LTM, it provides us with a powerful mechanism for stimuli analysis both during storage and during recall (Eccles and Robinson, 1984). Instead of just looking at one object, event, or symbol we can look at a series composed of 7 to 9 "pieces" (or icons). And as was stated earlier WM is not static, so this 7-9 icon string is constantly changing as the input of memories and sensory stimuli changes. It is this complete loop (X-match+WM+LTM) that allows us to do the basic academic functions termed the three R's (given that other brain and motor functions are healthy), allows us to speak, and allows us to move and act through space and time.

The cross-match area is linked directly with the Rating Stimuli area helping to place an RIR value on each potential memory and thus aid in efficient memory storage. When stimuli are found to match with something perceived as important they are rated as being more important - they are given a higher RIR value. They are given a larger E/I signal and then sent on to LTM, through the hippocampus (and amygdala), to be stored for latter usage. The duration of this memory depends upon the assigned RIR value, the relevance - intensity - rehearsal of the potential memory. Understanding the processes involved in LTM storage and retrieval is a critical aspect of teaching memory utilization. Without LTM (either storage or retrieval) we would need to start every day like it was the first day of a new life. Everything we learned the day before would have

to be learned again. This is what many amnesia victims face each morning. LTM and some other aspects of memory are discussed in more detail later within this text.

The cross-match area also has input from the frontal lobe. As we recall memories to match with incoming sensory data we may be doing so because we wish to complete some plan of action, some goal. If so, then the frontal lobe's special sequencing memory ability links with the cross-match area to help us evaluate the temporal (timing) appropriateness of the cross-match information with reference to the desired goals. The effects of the final RIR value are assigned to the perception. This is done through a process here termed **Scenario Looping** described in the following section on the Transfer Process Loop. It is easy to confuse some of the functions of the memory loop or the emotion loop with those functions attributed to the **Transfer Process Loop** because the Transfer Loop has both memory and attentional characteristics.

The Transfer Process Loop:

The fourth and final portion of the IPM is called the **Transfer Processes Loop** and when combined with the previous three IPM's it will form the IPM named Thought and Action. This Transfer Process Loop is centrally located within the frontal lobe, the largest of all the lobes and the part of our brain that has more connections to other brain areas than any area in the brain. These numerous connections are illustrated in the Transfer Process Loop IPM. Kolb and Wishaw, 1980, state, "there is no cerebral structure in which lesions (damage) can produce such a wide variety of symptoms and thus a more bewildering range of interpretations".

The difficulty frontal lobe damaged individuals have in remembering the order of past events, and the order of current events, like those needed to complete a multi-step project, is due to their inability to sequence any chains of events/information which are longer then 9 bits. This same sequence inability often results in problems in understanding puns, jokes, and abstract concepts. When sequencing problems are combined with emotion inhibition problems then there are great difficulties in responding appropriately to social situations or acting according to some set of established rules or guidelines. Timing in every day activities, when to do what at what time, becomes very difficult.

The frontal lobe can be considered the source of complex planning and the source of E/I signals needed to complete such a plan. The frontal lobe is linked to all areas and when necessary (a conscious, not automatic, decision) it "loops in" information from the other areas, and sends information back, so as to accomplish some complex task or goal, particularly those in new and novel situations. It is as if the frontal lobe is always asking the question, "is this the right thing to do at this moment in order for me to attain my desired goal". This "doing" includes everything - complex sequencing in body movement, complex sequencing in language (such as abstract thought, in depth conversation, and parallel listening), judging the appropriateness of emotional feelings and responses, processing multiple visual/spatial stimuli and understanding the delicate sensitivity of Situational comedy and diplomacy.

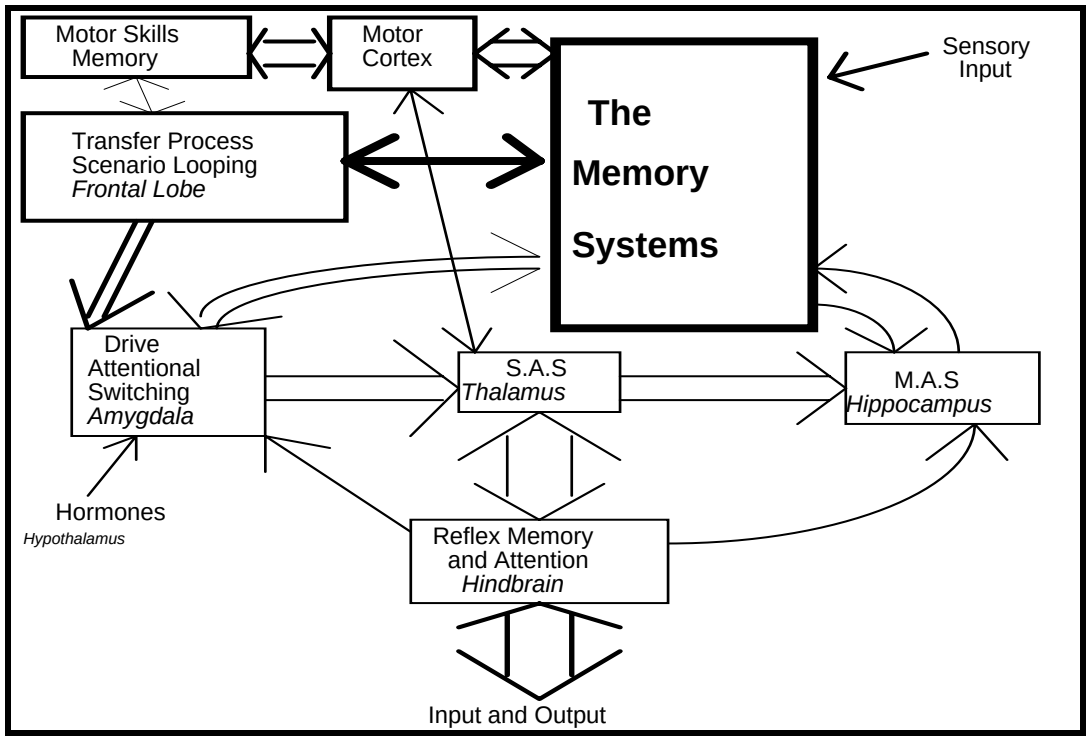

Figure 7: **The Transfer Process Loop**

The previous loop portions of the IPM showed us the survival functions (Sensory IPM and the Emotion loop), the Autopilot, and the WM+X-Match+LTM (memory) loop. When these functions are combined (without the frontal lobe) an individual is still able to work and interact in his or her world. People with severe frontal lobe damage often show little decrease in IQ test scores (Hebb 1945, Jefferson 1937). It is likely that loss of frontal lobe function may not effect performance on the typical recall of facts testing given in most classrooms. That is because these tests don't test for life related problem solving abilities that require the individual to process through a complex sequence of items in a new and novel situation. Most tests simply ask for the recall of information already learned and or the application of that information to simple sequential (linear) tasks. These types of test do not evaluate the functions of the frontal lobe. An individual without a working frontal lobe can still access all the memory functions (recall information) and use the limited planning capabilities of WM to complete such tests. The WM has a small amount of sequencing ability (6-9 bits) but it is limited and short lived. In addition the WM has no system set up for choosing between competing E/I signals, or RIR values, of equal intensity.

The WM is designed for dealing with the here and now not for thinking about tomorrow or even an hour from now. Complex planning is the responsibility of the frontal lobe. When we daydream or plan about what we are going to do in the future it's the frontal lobe hard at work. When we have finished formulating the plan and when we decide to act, it is the Scenario Looping Process (Construct Processing for the left hemisphere and Global Environmental Awareness for the right) that helps us to get where we desire. The frontal lobe, the largest of all lobes, is the major contributor to

the "higher functions" of man. It is through man's ability to plan, inhibit or act, and regulate actions along the way, in order to complete a plan, that he makes his most significant contributions to society. It is the seat of creativity and the reason for our species dominance on this planet. The question we need to continually ask ourselves is are we, as practitioners, providing training for this part of the brain?

In order for practitioners to provide training to this portion of the brain they will need to have some understanding of how this portion functions. Basically the Transfer Process happens through what is called the **Scenario Looping Process.** The scenario looping process happens in both hemispheres and there is a considerable number of overlapping effects. The right frontal hemisphere is responsible for **Global Environmental Awareness** or the visual/spatial portion of Scenario Looping and the left hemisphere is responsible for **Construct Processing** (the language portion of scenario looping) and the two intertwine and together form the scenario looping process which most of us use during thought. Separation of the two aspects of scenario looping into two distinct and separate processes is almost impossible (according to lateralization). Throughout this text the term scenario looping should be equated with the a process which incorporates both global environmental awareness and construct processing.

Whether reacting to situational cues or thinking about the future we often create a scenario of action and language in our mind and compare it to what is already stored in our LTM. Then we might change it a little by replacing portions of the scene/language forming a new scenario. We continue to "loop through" replacing pieces and forming new scenes until we establish what we consider the best plan thus hopefully avoiding the difficulties we may have encountered in the past. With this modified scene, plan, in mind we begin to act while continually interacting with (receiving input) other brain functions in order to complete the scene we envisioned. By planning and acting we continually "loop" through our scene, that is, we mentally rehearse the scene over and over, making adjustments in our mental plan according to, 1) the match of the input of stimuli to our memories, and 2) our perception of how this input changes our mental scenario with respect to our desires and the costs to fulfill those desires. This scenario looping process can happen on the smallest scale, as in a friendly conversation (deciding what to say) or deciding what to do with leisure time, or on a larger scale, such as planning out our life for a month or a year. The depth of our scenario looping ability depends upon the availability of stored data (LTM) and the amount of practice we have had in dealing with similar scenarios (domain and process interactions).

The Law of Transfer

The learner's ability to modify existing knowledge stored in memory to solve a new and novel problem is affected by the effectiveness of the learner's Transfer Process.

Principle: Remembering information is a brain process which differs from applying that information, particularly in new and novel situations.

A well trained and fully functional brain uses all aspects of the IPM as diagrammed in the Thought and Action IPM. As we develop and mature we gain strengths in particular areas, those that have become part of our collection of experiences, the interplay of the brain efficiency factors. As we are thrown into life's classroom we become skilled at those things we deal with most frequently, and more than that, we become skilled in the unique way in which we choose to act. It is through actions that neuron pathways are built and utilized (branch density + pathway utilization). Each of us has built our own particular pathways in our own Thought and Action IPM, even though we share the common grounds of all having to use similar materials.

Thus far this author has described the simplified version of the GMT which included three models, each portions of how we think:

DATA	-	The Integrated Concept,
INPUT	-	The Senses and the Sensory IPM, and,
PROCESSING	-	The Thought and Action IPM.

The Integrated Concept looks at the wide variety of stimuli that have impact on our perceptions and thought processes. The sensory IPM and the thought and action IPM are models describing the input and processing of information within the brain. These models can be mneumonically simplified into the **SmART** process: Sm- sensorimotor, A- attention, R- recall and T- transfer. In order to arrive at a complete model of thought processes, we need to add to these models two other factors - brain lateralization and the effects of domain and process through time. We can use the model as a foundation for the design of our improvements in mind training (in all the education environments). The GMT uses this systems approach in an attempt to impart to the audience a new level of understanding regarding the brain's functioning. This model is a simplified overview designed to improve the counseling and educational efforts of the practitioner. For more complete and more detailed information the reader is referred to the brief reference list on the mind accompanying the end of this paper.

The complete GMT (as opposed to the simplified GMT) contains of the following components:

The **brain efficiency factors** (describing the basic neural structure),
Data- **The Integrated Concept** (describing categories of available brain stimuli),
Input- **The Sensory IPM** (information processing model),
Processing- **The Thought/Action IPM**, (yielding the SmART Processes), and,
The **Hierarchical Feedback Principle**, (the feedback effect of domain, process, and time).

These four components (the Integrated Concept, the IPM's , plus the senses and left/right brain processing) are shown in the accompanying diagram entitled **GMT - General Model of Thought**.

The GMT is a Data - Input - Process - Action analogy. The data is represented by the Integrated Concept. The input is controlled by our senses (and their association areas shown in the Sensory IPM), with each of us having different strengths and

weaknesses. The processing, and the command to act, is described using the IPM. But as illustrated in the GMT diagram, the IPM must be applied twice. The Thought/Action IPM is duplicated here so that the reader may more easily compare the characteristics of hemispheric lateralization to the functional areas of the brain.

Like most of our body, our brain is divided into a left and right halves. In the majority of cases the two brain sides, or hemispheres, have different responsibilities. These responsibilities are shown in the table labeled "Hemispheric Functions Divided According to Functional Area". The right hemisphere processes parts of stimuli that are different from those processed by the left hemisphere. In general the right is responsible for context evaluation (emotion, situational meaning, situational rules, themes, space, pictorial/holistic) and the left for literal evaluation (words, symbols, language rules and meanings). Of course any situation we encounter in our daily activities uses both a "dictionary translation" and a situational interpretation. We juggle these two views and hopefully end with a combined view that presents a more complete picture. We are whole brain thinkers, even when we lean toward the literal or toward the situational interpretation. Both hemisphere work together to build representations from sensory input.

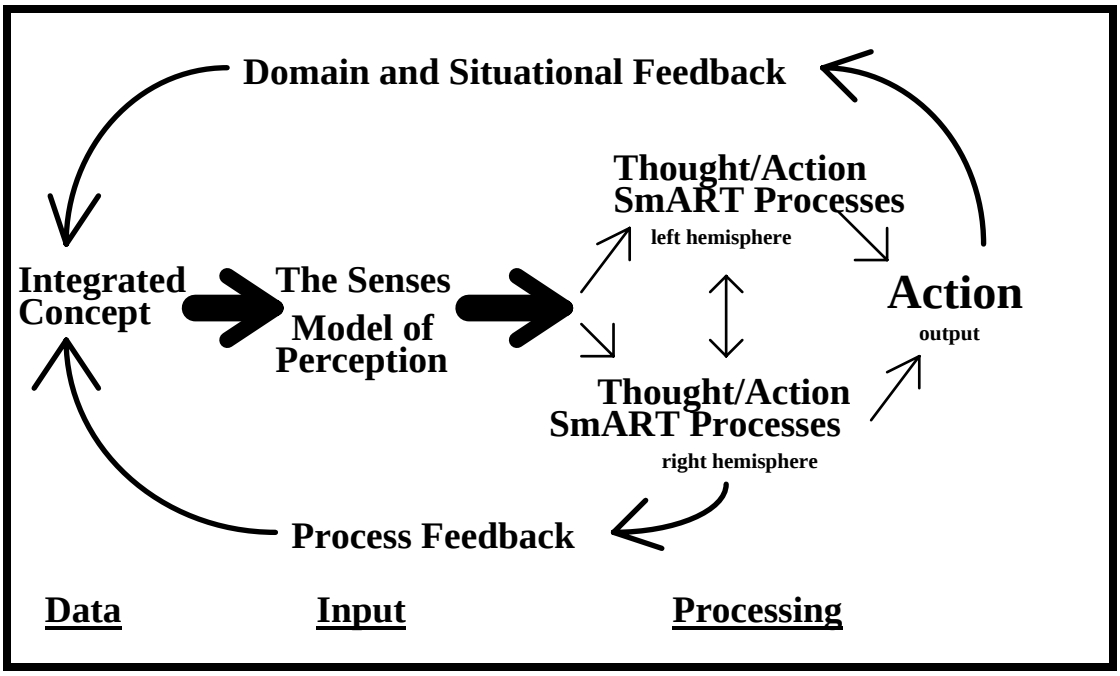

Figure 8: **The General Model of Thought - GMT**

This division of the brain's functions into two hemispheres is still not completely understood. It happens most at the top of the hierarchy of brain function (neocortex association areas) and least at the bottom of the hierarchy of functions (hindbrain). The accompanying table, entitled "Hemispheric Lateralization", describes brain lateralization in terms of each of the neocortex areas as described in the

Thought/Action IPM (note that the structures of the Mid-hindbrain are not included in this list).

Hemispheric Lateralization: Brief Description of Functions

Functional Area	Left Hemisphere	Right Hemisphere
Motor Cortex	***Motor movement*** on the right side.	***Motor movement*** on the left side.
Supplementary Motor Area - prefrontal cortex (top of frontal lobe). **Motor Skills Memory**	***Motor skills memory***, memory for overlearned motor skills (e.g., riding a bike).	***Motor skills memory***, memory for overlearned motor skills (e.g., riding a bike).
Somatasensory Strip	***Tactile input*** from the right side.	***Tactile input*** from the left side.
Parietal Lobe- anterior- **WM**	***Aiming movement*** on the right side.	***Aiming movement*** on the left side.
Parietal Lobe- **WM**	Keeping track of the flow of language - a 7 bit scanner.	Keeping track of the flow of action through space and time.
Temporal/Parietal Area - **X-Match Memory**	Temporary storage of incoming sensory information and memories in order to build simple language construction (sentences and coherency). **OL***	Temporary storage of incoming sensory information and memories in order to build simple representations of the events occurring in space and time. **OL***
Temporal Lobe - **LTM**	Long term storage of symbolic, language, information in a hierarchical manner.	Long term storage of visual spatial, information in a thematic manner (linked by event context).
Temporal Lobe - medial **The Rating Stimuli Area**	***Emotional memory***: the long term storage of emotional meaning attached to language. Also provides feedback to the DAS system. **OL**	***Emotional memory:*** the long term storage of emotional meaning attached to events. Also provides feedback to the DAS system. **OL**
Frontal Lobe - **The Transfer Process**	***Construct Processing***: Transferring the rules and known meanings of language to the interpretation of situational need - interpretation of abstracts, monitoring the flow of language (topic maintenance). **OL**	***Global Environmental Awareness***: Transferring the rules and known meanings of society (or a given domain) to the interpretation of situational unknown, the interpretation of social demands. **OL**

*Note: **OL** refers to overlap and points out that the functions of these lateralized areas strongly influence each other, that are the functions of the right hemisphere influence the functions of the left. It may also be noted that these OL functional areas are those which are located in nearest proximity to the corpus callosum (the bundle of nerve fibers linking the right and left halves of the cerebral cortex).

The "OL" in the table below refers to **O**ver**L**ap and is particularly applicable to the areas that serve as memory that are also linked to the corpus callosum (the bundle of nerve fibers connecting the two hemispheres). The areas signified with OL probably draw heavily on information from their hemispheric counterpart - there is constant cross hemispheric communication and this cross hemispheric looping is a necessary part of the function of each of these individual functional area. The OL also means that given our current level of knowledge of brain functioning it appears that the left hemisphere is not clearly divided from the right when considering the functions listed with an OL. It is likely that as our knowledge of the brain improves so will our knowledge of lateralization. As it stands now there are many unknowns.

Hemispheric lateralization is not as clear cut as it was thought in the 1970's. The simplistic myth that one could be "right braintrained" or "left braintrained" does

not fit the paradigm of polar unity nor does it work in practice. Other interesting aspects of lateralization are that the right hemisphere extends further forward than the left and the occipital horns (the brains contact's with the eyes) are often larger on the right side (Kolb and Wishaw 1980). In addition left handers may have lateralization that is different in that language, symbol, processing is often located in the hemisphere closest to the motor cortex responsible for its communication (Levy, Nebes and Sperry, 1971). Left handers use their left hand for writing and thus may also process some symbolic data in the right hemisphere. This is because the process of writing language with the left hand contributes to partial language processing by the right hemisphere (responsible for muscle control of the left hand). There may also be some hemispheric differences in the way we process emotions through the Rating Stimuli Area as indicated by persons with TLE, Temporal Lobe Epilepsy (Lopez and Seastrunk, 1980). There are also slight differences in the emotional responses of right hemisphere injuries versus left hemisphere injuries (when view as a large population). Right hemisphere injuries tend to be more aggressive and left more paranoid and depressive. There may also be lateralization differences due to sex, culture, and genetics, although the effects of these later variables have yet to be clearly separated from each other. The seperatreness and the unity of hemispheric lateralization is another example of polar unity.

The GMT focuses on neuron pathway usage and the increased branch density often accompanies increased brain utilization. Implicit in the model construction is the fact that signals must be sent along the pathways in order to have each of the brain areas work properly. Each area must be able to receive a proper (not exaggerated or lessened) E/I signal. This is not only affected by the number of neurons available, how many branches they have and how frequently they are used but also by the nerves' internal chemistry. Here we see again the three brain efficiency factors at work - pathway usage, branch density and junction function. These three factors should always be kept in mind when evaluating the relationship between mind and behavior. There are also two important feedback loops which are part of the GMT and an integral part of how human thought probably functions.

The two feedback loops are described below:

- ***Processing Feedback***: As our brain is processing the stimuli it receives it is also producing more stimuli, and, the nature of the stimuli it produces affects the selection of stimuli included for data entry. For instance, when we daydream, or talk internally to ourselves, we are involved in the loop of processing feedback.
- ***Domain and Situational Feedback***: As we act we also react to the changing domain and situational variables in our environment and these changes, as well as the reactions to these changes, affect the selection of stimuli included for data entry. Bandura (1986) call the process of learning through interaction with our environment reciprocal determinism, meaning that there is a constant feedback loop between our actions, our thoughts (attitudes, beliefs, etc.) and the environment. When one aspect of this feedback loop changes it cause changes in other portions of the loop. In the GMT the feedback loop is composed of the characteristics of the Data-Input-Processing model and the

characteristics of our action in relation to the situation and our level of domain understanding (specific knowledge important for problem solving).

The development of the human potential through awakening the mind is a multifaceted feedback process with each of the facets affecting the other. Dr. Feldman from Tuffts University in his study of child prodigies (1986) uses the term co-incidence to describe this multifaceted process:

> "(It is) the melding of many sets of forces that interact in the development and expression of human potential...the convergence is not simply between two unitary, looming giants - an individual and an environment - but between a number of elements in a very delicate interplay: it includes a cultural milieu: the presence of a patroller domain which is itself at a particular level of development; the availability of master teachers; family recognition of extreme talent and commitment to support it; large doses of encouragement and understanding...understanding co-incidence requires consideration of at least four different time frames that bear on the prodigy's appearance and development: the individual's life span; the developmental history of the field or domain; cultural and historical trends that bear on both individuals and fields and finally evolutionary time." (pgs. 11-12).

In describing the interactions between the prodigy and the environment as a crucial aspect of the development of human potential Feldman includes Domain Characteristics. The domain should have the following characteristics:

1) the information needed to be learned (including content and application) should be systematic, well categorized, with various levels of information acquisition prior to mastery,

2) there should be well established performance standards (content and application), understood by practitioner and learner, which signal the completion of each level,

3) the performance demands of each level should be age, and learner, appropriate,

4) the learner should find "reinforcement" from interaction with the domain, and,

5) there should be community support.

The GMT, although simple in its appearance, when broken down and analyzed in detail, is a fairly complex. The GMT, given our current state of knowledge, is also a fairly accurate representation of the complexity of the human brain. Given the validity of the model's components and the validity of the Hierarchical Feedback Principle then it can be stated that every component of the model affects every other component in some way. These component to component process effects are here termed the **Key Relationship Variables.** A key relationship variable is simply the process effects due to the relationship between two component parts of the GMT - for example the effects of auditory input on verbal long term memory.

Each of these key relationship variables affects how we come to know something and each can be considered as a way of knowing something. Each of the key relationship variables can be examined in detail but this is far beyond the scope of this text. Even if all the key relationship variables were described in detail this would not be the final description of the model for human thought for it would not include *TIME*

(as discussed in part by Feldman, see above quote). Man's thought develops over time, our thought processes evolve through a series of developmental stages. These stages of intelligence are correlated with the SmART processes and are described in more detail later in this text.

Because the human brain develops over time, because the three brain efficiency factors change in response to an individual's unique experience and their genetic predisposition, each individual has their own unique brain characteristics. These characteristics fall into patterns and it is these patterns that are represented by the GMT model. The GMT is only an approximation for what actually transpires within each individual mind. Variations will happen based on the interplay between the key relationship variables of the GMT, and various time affected components such as genetic predisposition, the development of society (including family), the development of a given domain, and the individual's experience through time. If these individual variations are always kept in mind when using the GMT then the model can prove to be a useful tool.

Principle: Thought processes develop relationship process patterns over time through an interactive relationship between domain, situation, process and biology.

This means that brain researchers, behaviorists, therapists, teachers, counselors, and other professionals in the field of thought training can, through the use of the GMT, develop new tools that will improve the efficiency of human thought. We could use an action that changes the nature of any one of the key relationship variables the stimuli, e.g., we could change the relationship of stimuli to each other, or the way we have learned to "take in" stimuli or we could change the way we use each of the functional areas of the IPM. Each of these different changes could result in a change in thought and/or action. Some will even be duplicate approaches to the same problem (i.e., we can see similar changes in behavior due to different causes). There are many different ways of knowing and many different ways of enhancing how we come to know, how we can help to awaken learner's minds. The GMT provides a foundation upon which a rational mind awakening program can be built.

The model should also be viewed not as a collection of separate "boxes" or pieces but as a working whole in which each piece affects and is affected by the movement of information through the system.

> "...all the programs of the brain constitute one single model or structured system, whose parts are interrelated....The brain has many distinct parts but there is increasing evidence that they are interrelated to make one functioning whole, which gives a unique and characteristic direction to the pattern of life of that one individual." (p.265, Young, 1978).

Combining the Law of Complimentarity, The Law of Neuronal Influence, and The Law of Feedback Relationships along with the components of the GMT begins to shed light on this vast interconnected relationship of variables which affect human thought.

The Law of Connectivism

All actions are connected to consequences which require some action.

The word "action" refers to any action which occurs within the realm which will affect cognition - from the molecular level to actions happening in our solar system and our galaxy. But the Law of Connectivism is also a way of thinking which is geared away from the analysis of a single moment to a systems analysis which evaluates the effects of the action through space and time. This is supported by the paradigm of polar unity. This has a direct impact on the process of teaching in that teaching is an action. Even more than that teaching is an action which by nature of its definition is already connected to the actions of another - the learner. The learner's actions are then connected to other actions and so the process of teaching must by definition succumb to the Law of Connectivism.

What does this model of mind mean to you and me?

This model should not be used as the "final say" but as a working tool to be applied in problem solving regarding training human thought processes. No single model of the human brain can accurately describe all the intricacies of an individual's thought processes. The subdivision of the brain into functional areas is only an approximation. There is considerable apparent overlap (more accurately stated as functional influence) from one functional area to another. That is why the relationships between components of the GMT are considered as key variables. Only through skilled application, interpretation, and extrapolation will the GMT find usefulness by the practitioners in the field of brain training. As long as a model is viewed as a model and not "gospel", and then put to practical use to guide the development of new tools then we have nothing to fear. When the models are misused, not used, and abused is when the greatest problems arise. A model as something rigid and inflexible will quickly cause difficulty and then fade into obscurity. It is in the model's application to thought training of a learner that its weaknesses and strengths will be assessed.

What does the GMT mean to the average working person in today's society? The most obvious answer is that there are many ways of knowing and that an efficient problem solver is one who is capable of efficiently accessing these many ways of knowing. Thought training (mind awakening) should focus on providing the learner with a foundation, a basic exposure, to these many ways of knowing so that s/he may come to develop their own path to efficient brain utilization (mind awakening). When designing a mind awakening program the following factors should be considered:

- 1. The three brain efficiency factors and their effects on human thought are environmentally influenced while following a genetically determined path. In other words, brain development is "plastic", shaped in reaction to the combined interplay of environment and genetics. This results in unique individuals with similar patterns but individual characteristics.
- 2. The Integrated Concept and the Sensory IPM illustrate that different information is inputted into the brain differently and that most individuals

develop a sense strength, i.e., they preferentially acquire new information by using their strongest avenue of input. Learners are often sense and component biased. A sound mind awakening program needs to consider this when delivering information. Both the learner and the practitioner need to come to understand this and its effects on thought/action.

- 3. Thought/action is composed of feedback loops, at all levels. Everything which affects our thinking is, in some way, connected to everything through key relationship variables. These key relationship variables are fundamental parts of our thought processes and each individual should come to know how the key relationship variables affect their particular thinking/acting.
- 4. The Thought/Action IPM describes separate functions; the IPM is applicable to both hemispheres and describes numerous individual functions that, although related, can each be assessed and treated individually. These include the following (SmART Processes in parenthesis):

Reflex memory (Sm, A)	Hormonal system (Sm, A)
Sensory attentional switching (Sm, A)	Drive attentional switching (A)
Memory attentional switching (A, R)	Felt self - W.M.: movement plus tactile input (Sm, A)
Muscle control (Sm)	Motor skills memory (Sm, A, R)
Stimuli rating area (A)	Cross-match area (R, A)
Long term memory ® (spatial/thematic, symbolic, and movement)	
Short term/working memory ® (spatial/thematic, symbolic and movement)	
Scenario looping (T)	

- The combination of all the above 4 factors, as developed through time and space defines the GMT and what is here equated with mind. Brain is equated with biology and the mind with experience.

The above functional divisions of the IPM are the key cognitive processes we each use to satisfy our appetite for self improvement through increased brain utilization. These functional divisions are not the same as the performance of a skill (e.g. tennis, painting, writing, reading, singing, math or acting). A skill frequently involves more than one brain function and some skills may not require the same usage of functions required by other skills. This means that an individual who has a lower level of brain function performance, for some specific brain function, due to injury or non-use, will show a decrease in the performance of all skills which require the use of that function, but not in the skills that do not use that function (Luria, 1966). It is much like describing the performance of a car. We can describe the "skills" of a car in term of its overall performance on the road. We can also describe the function of each of the car parts (tires, engine, transmission, etc.) and their contribution to overall performance. We also know that the performance of the engine is not dependent on the tires (unless our testing process links the two together) but that certain "car skills" are more directly linked to the process output of certain "car functional areas". In addition each functional area does not serve as one step in a linear sequence of steps needed to perform an action. Instead each brain functional area should be viewed as a

step connected to a series of many loops (see previous IPM diagrams), and each of these loops can be running simultaneously, independently, automatically and/or in harmony. These loops involve both consciously (neocortex) and subconsciously (mid-hind brain) directed activities.

The model is only a representation of probability, meaning that given normal human development there is a high probability that the GMT representation can be applied to the bulk of the population. But the strength of the model lies in its emphasis on process not place. Rather than trying to pin point precise phenomena locations in the brain the model attempts to describe processes (feedback loops) which utilize functional centers which in themselves are utilizing feedback loops. It may not be possible, nor practical, to describe the "absolute" brain model in terms of neurological space. But it will be useful to describe the human brain in terms of neurological processes. The model's categorization of the brain's processes into the four simple categories of the SmART Processes has its strengths and weaknesses. Its strengths are that it is easy to remember the SmART processes and to develop treatment plans that address each of the SmART processes. The weakness lies in that the simplification doesn't address each of the functional components and the wide variety of feedback loops (processes) which incorporate them. Yet the practitioner can use the functional component process approach as part of the SmART process assessment and teaching. The functional model calls for a modular view of the brain. These modules are presented within an oversimplified schematic as "boxes" within the IPM. There are probably thousands of these modules with each having hundreds of connections to other modules (Eccles, 1980, Foder, 1983). Each of the "modules" (functional areas) may be used at a different time during the completion of a certain task OR a given functional area may not be used OR the functional area may be used for several purposes during the completion of one or more tasks.

Cognitive neuroscience researchers Kossslyn and Koenig (1992) describe the similarities between these "modules" (functional areas) in the brain and neural networks used in artificial intelligence. The key points from their work can be summarized as follows:

- Neural networks (functional areas) are not independent discrete modules but are networks of cells which are linked to other networks.
- Each network transmits and receives information through feedback and feedforward with other networks.
- The function of a given network can be used a part of several different subsystems (a subsystem is a loop of several networks) which in turn can be used by several different systems (a larger loop incorporating more networks)
- Different networks in different areas of the brain may provide very similar functions.
- Each subsystem (smaller loop) accepts a variety of inputs from other networks in order to determine the relation between constraint satisfaction (through use of the E/I system the constraints of various signals as they interact affects the level of attention) and output demand.

- The precision of matching input to stored representation is sacrificed for the ability to generalize (application of information to a new situation). Anticipation response and information bias occur because the speed of "coarse matching" is designed more for the transfer process then for absolute accuracy.
- All subsystems (smaller loops) are parts of larger systems (the four loops - SmART) which are parts of still larger loops (IPMs - GMT). These larger systems are able to parallel process, i.e., process certain types of information separately from other types simultaneously in the brain. During this parallel processing larger systems "race" with each other (affected by the E/I balance and the brain efficiency factors) to achieve a desired output.
- Each subsystem also alters the nature of the data it receives before sending it on to the next neural network and to the next subsystem. Due to this "passed on" information flow the reliability of the information decreases (like in the childhood game of telephone). For this reason there are numerous feedback loops throughout the entire system of subsystem each checking and re-checking the validity of the information received (note the relationship to the Hierarchical Feedback Principle).

Despite the physical differences the systems similarities are useful and should be incorporated into any model of the human brain. Although the GMT is a simplified model, the model holds true to the above statements regarding the behavior of neural networks. The characteristics as outlined above sternly support the Hierarchical Feedback Principle and indicate that a breakdown in the functional performance of a given neural network will affect the performance of a set of tasks in a way that is unique to the function of that given network BUT that other tasks may be unaffected. An individual can have a weakness, a functional area not as well developed as others, in any one of the functional areas described in the IPMs. This weakness in one area can effect the performance of any skill that uses this area even if the performance of other functional areas is strong. It is difficult using the current set of home, work and school, educational assessment tools to clarify the exact functional nature of an individual's strengths and weaknesses. The goal during assessment should be to determine exactly what it is that is causing a decrease in task performance. The best assessment is one that links decreased performance, and the desire to increase performance, to specific parts of the GMT rather than simply teaching a skill. Once the GMT is linked to how we assess what learners need to improve their performance then it will be easier to provide a treatment (training) program with a high probability of increasing performance efficiency.

In a support relationship we are often asked to help someone with a request to change. Change often involves the mind, and exercising it in a different way. If you wanted to become a better swimmer you wouldn't train by jogging every day. You would swim. Similar types of focused training are important for achieving changes in one's state of mind. Specific areas of neurons in our brain respond to specific types of mental exercise. The more we perform these specific mental exercises the more we strengthen the associated brain functional area. But if we exercise the wrong area in an effort to remove a weakness, or if we forget to exercise a particular area, then we are

not likely to see substantial increases in our current measure of brain efficiency as related to that functional area.

The practitioner of mind awakening learns how to identify the strengths and weaknesses of the learner's information processing. It is important to:

> ***view the learner not as a person with a "disorder" but as a person with a process that is inefficient - as a result of damage and/or poor training.***

It is important that practitioners become involved in this paradigm shift within the field of psychology - a shift away from the ambiguity and "labels" associated with "disorders" to a more scientific description based on the biology of the human brain and the new paradigm of polar unity. This is what the GMT attempts to offer. Using the GMT the practitioner can then act to design a mind awakening program which helps the learner to develop skills which decrease the negative effects of their inefficient feedback loops (which can be described to the learner through the GMT), and, utilize the strengths of their efficient feedback loops (also described using the GMT). They may even be taught to create new, more efficient, feedback loops. The functional component and process approach of the GMT provides many tools for mind awakening and is useful in its own right. It is up to the practitioner to become very familiar with the GMT (all the key relationship variables) and its potential applications so s/he will be able to best serve the learner. The practitioner should also be aware that although the GMT has a strong biological foundation it also has a strong link to environmental input - ***both environment and biology need to be part of learner assessment and treatment.*** This is another example of polar unity. In addition the practitioner should also know that the human mind is more than just its components. When acting as a whole, growing and developing through time, it gains new properties, whole mind/being properties, personality and intelligence.

The idea of emergent properties needs also to be considered within this model of mind. A thought, or action, can not be located in one part of the brain. Our consciousness is not located in any one place. Instead these are properties that emerge from the interaction of all the components of the mind. Yet at the same time they are properties that can be affected by the functioning of the various feedback loops.

Although spirituality was only briefly discussed in this presentation on mind, this author sees an interconnection between mind and soul. But the definition of soul, and its connection to the helping relationship (the main focus of this author's writing) is a topic that needs to be addressed in detail and within a separate book. The reader is referred to other writing by this author.

Summary

Within this paper the GMT has been built to its simplified level where the basic internal cognitive processing systems have been described. In part three these systems will be described in term of right brain/left brain and put into motion through time and space. In addition a detailed summary of the ramifications of the GMT are presented at

the end of part three. The ideas contained within this paper, in particular the laws of teaching, the Integrated Concept, and the SmART processes (Sm- sensorimotor, A- attention, R- recall, and T- transfer), can be used to help the eclectic rehabilitation counselor come to understand the disabled learner and from this understanding to then match the appropriate counseling technique to the learners need. Each of the components of the Integrated Concept and the SmART processes can be defined separately yet they also exist in unity with each other as part of our being. Each component is interconnected with each other component. All parts of the GMT can be viewed both separately and in unity. There are properties that emerge from the interaction of numerous feedback loops. There is no single location for a given thought or feeling. This is also true with regard to the relationship between mind and soul. This is the interplay of polar unity, emergence and the components of mind with the helping relationship.

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