Appendix B

Brain Structures, Functions, and Processes

Purposes

This appendix contains the foundations for understanding the brain's functions and the mental processes involved in learning, thought, conscious and unconscious activities. It is a simplified, general review of principles of psychology that numerous readers may have already learned. Each reader, however, will have his own particular background in this area of knowledge. Since the "what," "why," and "how to" of various chapters' methods will be explained in psychological terms, our first objective must be to develop a generally accepted, common frame of reference for all readers to use. A second objective is to introduce some experts' findings concerning mental activities that are not widely known and may come as surprises to many readers. The third objective is to present a frame of reference that explicitly illustrates the interrelationships and interdependencies among mental processes. These perspectives will be the basis for integrating seemingly separate methods into a comprehensive system. The chapter will be enlightening to some readers and perhaps fascinating to others.

Recommendations

Learning techniques are discussed in Chapter 5 . For the time being, we suggest that the reader take several simple steps. First, preview the chapter sub-headings and text briefly to get an idea what is in it and where it is going. Then, concentrate as you read for detail, paying particular attention to underlined phrases or sentences. The ideas they contain will be referred to later.

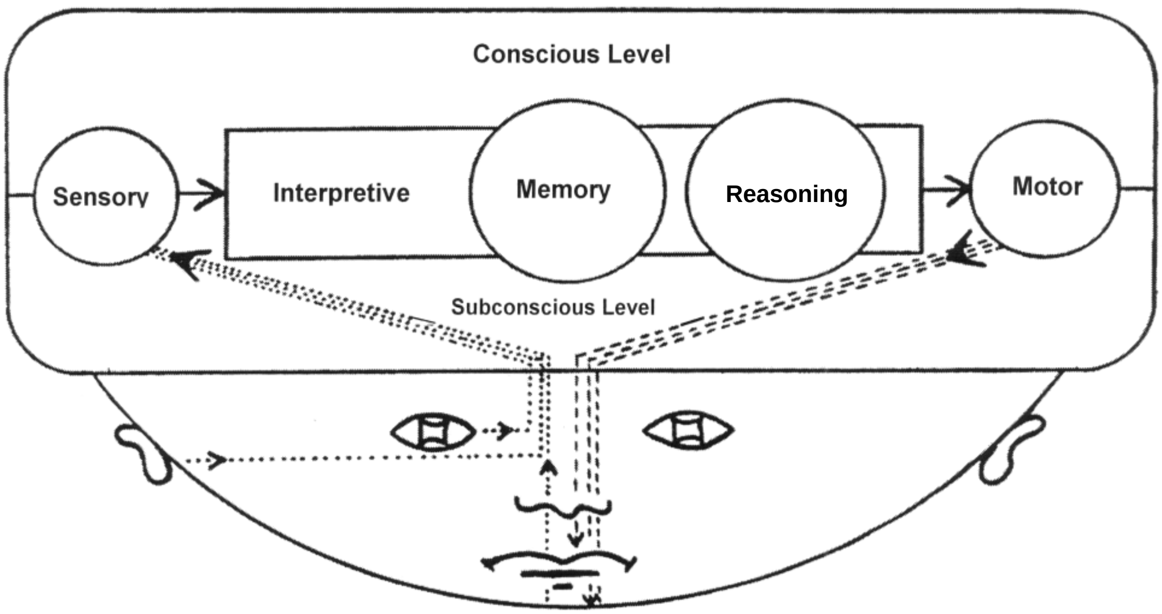
Program instructors may wish to present this material in abbreviated form. This can be accomplished by explaining ***Figure B.7*** (page B-10) step by step, and making reference to important points raised in this appendix.

Reviewing What You Already Know

Try to answer the following questions mentally or by filling in the blanks before proceeding. They cover the content of this appendix. How much do you already know?

1. The *integrative process* is accomplished mostly by the three main regions of the brain, which are: _________ , ____________________ , and _________________.
2. Energy changes (e.g., as in light or sound) in the environment that excite our sensory nerves are called ___________ .
3. ___________ is where previously recorded sensations are retained in the form of organized patterns of neurons (brain cells).
4. _____________ is a matter of recording information (sensations) in organized patterns of brain cells in memory areas.
5. (Underline the most correct of the three choices.) Meaningfulness of what we sense occurs in [reasoning – conscious - interpretive] areas of the brain with the help of information already in the [subconscious - memory areas - sensory areas].
6. Subconscious levels of integration select sensations for conscious awareness or attention partially based upon our ________________ , and the attitudes associated with them, which have been recorded in one or more areas of _______________ .
7. We think in terms of three basic modes: ___________ , ________________, and ________________.
8. Thought amounts to juggling information back and forth between _________ and ___________ areas, both of which lie within areas of the brain.
9. Is what we think or say recorded well in memory?
10. (Underline the most correct of the three choices.) We can respond [consciously - unconsciously - both consciously and unconsciously] to environmental stimuli.
11. We can think [deductively - inductively - both deductively and inductively] at conscious levels.
12. What are the relationships or interdependencies existing between:
    - memory and learning?
    - memory and thought?
    - learning and thought?
    - conscious attention and subconscious processes?

Figure B.1: Conceptual Illustration of Major Brain Regions



General

A traffic light changes - a door slams shut - the aroma of pizza comes from a shop - you bite into a juicy steak - someone in a crowd bumps you. These are all examples of environmental energy changes in light, sound, odor, taste, and touch, which we see, hear, smell, taste, or feel. These energy changes, or "stimuli," excite nerves in our eyes, ears, nose, taste buds, or skin—our sensory organs. This stimulation or excitation of sensory nerves creates impulses or "messages" that are relayed through the spinal cord and into the brain by nerve pathways.

The brain has approximately ten billion interconnected brain cells, or about one hundred million per cubic inch! This mass of living "circuits" is much like a telephone switchboard. Messages from nerves in our sensory organs are like incoming calls. They enter the switchboard over circuits of nerve pathways. Once these messages (impulses) reach the brain, they are channeled through the three main regions illustrated in ***Figure B.1*** for processing. These three regions—*sensory*, *interpretive*, and *motor*—work together to enable us to sense, interpret, and react to what is happening around us.

After we have sensed what is happening, interpreted it, and decided what to do, messages are then relayed from the brain through other sets of nerve pathways to special nerves throughout the body. These nerves trigger muscular movement in arms, legs, speech apparatus, and so forth, causing "behavior." All the activity within this "*nervous system*" is electro-chemical; that is, tiny electrical impulses are conducted from each nerve in the system to the next by instantaneous chemical reactions within and between them.

There are many stimuli exciting our sense organs at any one moment. There can be thousands of sensory nerves in each of these organs. So, there are literally thousands of messages (impulses) reaching the brain in each fraction of a second. But we cannot react to all these messages or "take all these calls" at the same time. Therefore, our awareness of them, and our responses to them, must be coordinated or "integrated." Thus, the *nervous system* is often referred to as the "*integrative system*." Although nerve pathways to and from the brain are essential to this system, it is within the brain itself that integration of our most complex responses to the environment take place.

Mental Activity

Sensitivities and Sensations

At this moment, light reflected from this page is exciting nerves in your eyes. All sorts of sounds are stimulating nerves in your ears. Various types of *stimuli* (plural of one *stimulus*) are also affecting nerves in your hands, feet, and other parts of your body. The resulting impulses or messages are being conducted by nerve pathways to separate, specialized **sensory areas** of the brain. These are the areas where sensitivity exists for sight, hearing, taste, touch, and smell. Lights are flashing all over your neural switchboard telling you of incoming calls.

These sensitive sensory areas translate impulses from stimuli into *sensations*, sometimes called “sensitivities.” Sensations have several dimensions common to all sensory modes: quality (e.g., hue of color, or pitch of sound); intensity (e.g., brightness or loudness); and duration (the length of time the quality exists).

Thus, sensations occur in sensory areas of the brain. We do not really see in our eyes, hear in our ears, or feel in our hands. Rather, sensations in sensory areas are attributed by the brain to the sense organs or part of the body from which they are coming. At this point in the process, however, the sensations are not meaningful to us, nor are we necessarily aware of them. Other brain areas are responsible for translating these impulses into meaningful experience and making us consciously aware of them.

Memory, Learning, and Recall

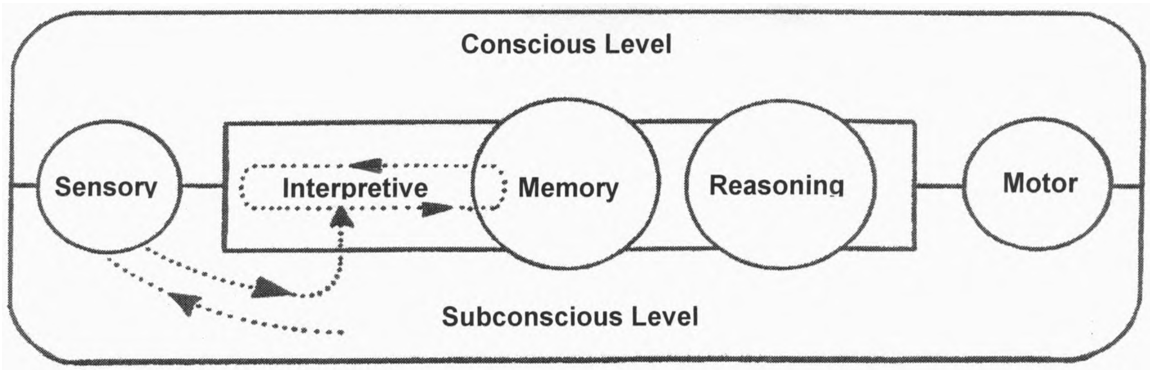
What has already been recorded in memory is the key to giving new or fresh sensations meaning. Basically, memory is the record of our previously experienced sensations. You will note in ***Figure B.1*** that memory regions lie primarily within the **interpretive areas**. However, other parts of the brain involved in recording sensations are thought to be located in “lower” brain areas. It has been known for some time (a) how sensations (electro-chemical impulses) are recorded, and (b) in what form they are retained in memory areas. According to Eccles (19__), every recorded sensation is represented and retained in memory as some very complex pattern of interconnected neurons (brain cells).

To form some sort of mental picture of such patterns, imagine a large bottle two-thirds full of clear alcohol hand sanitizer (gel). Now imagine shaking it up very vigorously, so that hundreds if not thousands of very tiny bubbles are formed and suspended throughout the gel. The tiny bubbles represent microscopic neurons (brain cells). Now imagine microscopically tiny fibers connecting groups of bubbles—something like a spider’s web. Think of some complex pattern of interconnected brain cells as a representation of a sensation that was previously recorded in memory. There are supposedly millions, even billions of such patterns in memory regions. One set of these neural patterns might represent, for example, sensations for the spoken word “car.”

In simple terms, then, **learning** is the brain’s process of recording a sensation (or stream of sensations) in memory by organizing (interconnecting) brain cells into a complex pattern that represents that sensation (or stream of sensations)—below our conscious awareness. Learning can also be a matter of adding to and/or reorganizing existing patterns to include new information (a new sensation or stream of sensations)—especially if the new sensation (or stream) is somehow related to, or can be associated with, one or more existing patterns in memory. ***For example***: Say that the new pattern represents the spoken words “race car.” Since “car” and race car” have a characteristic in common (i.e., “car”), the new sensations will more than likely be recorded in patterns that become interconnected to, or reorganized with, the original patterns representing “car.” Now you can begin to imagine how really complex memory actually is. With virtually constant formation and reorganization of patterns taking place, things you learned in the past can become obscured by changes in the patterns that once represented them. This is a major reason why recalling something you once learned can be somewhat difficult.

All sorts of things are recorded in memory. What you have seen is recorded in **visual areas** of memory. What you have heard has been recorded in **auditory areas**. (In fact, according to Dr. David Cheek, Dr. L.S. Wolfe, and others, auditory sensations are recorded unconsciously in memory even during sleep and drug anesthesia.) Because there are also specialized nerves in your body that tell your brain what your muscles are doing (called *kinesthetic feedback*), there are also sensations recorded in **motor areas** of memory. Emotional responses to what has been experienced can cause physical reactions such as a “sinking feeling” in the stomach and “weak knees” when we see an accident. These emotional reactions are internal sensations that can be associated with (and interconnected to) the patterns representing what has been seen or heard. Emotional reactions to the environment tend to become attitudes. So even attitudes toward people, activities, and objects are recorded. Therefore, keep in mind that not only what has been experienced is recorded in memory, but also “how you feel about” what has been experienced.

Figure B.2: Sensory Information Is Interpreted



Memories can be brief or enduring. Brief memories last only seconds to minutes. Sequences of (telephone) numbers are examples. Numbers are abstract and are generally not recorded in meaningful patterns unless they are repeated over and over. Most experiences, however, can be recorded in enduring patterns in memory. As mentioned above, these patterns lie within vast systems having, it is believed, multiple representation in memory regions. Furthermore, it is believed that any single memory region brain cell can belong to a number of complex patterns. These interconnections among memory area brain cells are evidenced by the fact that we can be recalling a given experience and suddenly "switch" to recollection of a similar experience or another facet of the experience being remembered. There are, however, some experiences that are not necessarily recorded permanently in long-term memory. These are discussed shortly.

Recall is a matter of retrieving to conscious awareness and attention what has been retained in memory. Recall ability, therefore, depends upon how well the information has been recorded and retained in memory. Many factors influence learning and retention. For example, more intelligent or rapid learners retain more than less intelligent or slower learners. Meaningful material is recorded and retained much better than non-meaningful material. Retention is also greater when material is learned with the intent or need to remember it. (These and other factors will be discussed more fully in the Chapter 5.) Not everything can be easily recalled. Often, however, what cannot be immediately recalled can be *recognized* if it is seen or heard again. Thus, **recognition** can be considered to be "incomplete" or "assisted" recall.

Interpretation

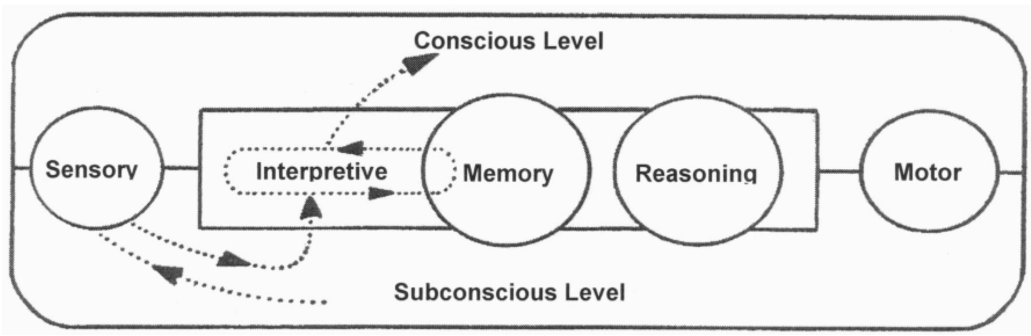
We perceive stimuli as meaningful events and objects, not as sensations or electro-chemical impulses. This requires translation of sensations into meaningful experience. As shown in Figure B.2, the translation or interpretation of sensations occurs within the **interpretive (**or **associative) areas** of the brain—with the assistance of memory.

If, as the operator of a telephone switchboard, you connect an incoming call to a particular office phone, the call goes through. Imagine now that there is an important sensation waiting on the line in one of the specialized sensory areas. Let us say that you connect the (visual) sensory area to the (visual) interpretive area. The visual interpretive area now has the call.

As soon as the message reaches the interpretive area, a signal instantly goes to memory. In a sense, the call is being "put on hold" while someone checks around the office to find out whether or not anything is known about the caller (sensation) on the line. There is an instantaneous search through recorded sensations in memory. If there are one or more retained sensations with which the new sensation can be associated, then the new sensation will have some meaning. In fact, the more you have learned with which the new sensation can be associated, the more meaning it will have.

For instance, if you have seen a motorcycle, an automobile, a pair of skis, and snow, and have heard the words for these objects, then the word "snowmobile" would have some meaning to you. So meaningfulness occurs when new sensations (or a stream of them) are compared successfully with sensations already recorded in memory. This comparative or associative process happens automatically and with-

Figure B.3: Interpreted Sensations Gain Conscious Awareness and Attention



out our conscious awareness. It has been occurring as you read each word or group of words on this page. First, the words were seen; second, sensations were generated in visual sensory areas; third, the sensory areas were connected to visual interpretive areas, fourth, there was an instantaneous search of visual (and also verbal) areas of memory, and fifth, the visual stimuli became meaningful.

Because we have an established "repertoire" of information and experience in memory, there are few sensations that do not have some meaning for us. It therefore becomes more a matter of the degree of meaningfulness of each moment's experience. So, the more you know, the more meaningful the world around you becomes.

Also keep in mind that when a new sensation is recorded in memory, its representative pattern is very likely to be "organized into" the pattern(s) with which it was associated and gave it meaning. Thus, the more meaningful, the better it will be recorded, and the better it will be learned. This, in turn, means that the more you know, the more you learn and the better you learn it.

Conscious Awareness and Perception

To this point, then, one of the sense organs has sent messages (electro-chemical impulses) to the brain's related (visual) sensory area. Next, the sensory area has been connected to the related (visual) interpretive area, where the sensations impulses have been translated in conjunction with memory and have become meaningful. However, this does not mean that you are aware of these brain activities. So far, you, the "boss in the office," are unaware (unconscious) of them. They only have meaning at subconscious levels.

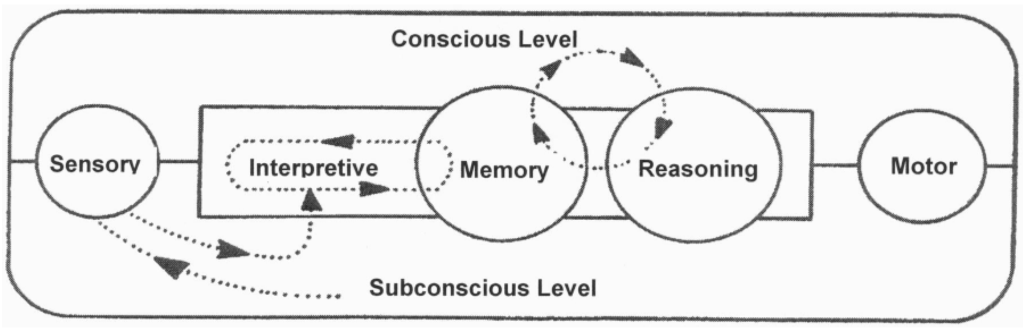
If, however, the switchboard simultaneously connects the sensory and interpretive areas to areas involved in "consciousness," you will consciously perceive meaningful sensations. As shown in ***Figure B.3***, they will have gained your conscious awareness and you will be "paying attention" to them.

Listen for a moment to the sounds around you. You probably have not been paying conscious attention to them. Instead, as you have been reading, visual sensory and interpretive areas have been connected with brain functions involved in consciousness. But when you focused attention on the sounds, auditory sensory and interpretive areas were connected with the conscious level of integration, and visual areas were at least temporarily "disconnected." Thus, focus of attention can shift back and forth between sensory modes very quickly. It can also shift within the same mode—for example, from a whole page to a specific part of a page, and back again to the whole page. In other words, we cannot pay attention to more than one stream or mode of sensations at a time—at the conscious level, at least.

Therefore, consciousness is a stream of meaningful sensations, each sensation lasting only a fraction of a second. Focus of attention determines which sequence of (stream of) sensory information (visual, auditory, etc.) will become the content of conscious experience.

As you began to read this page you voluntarily focused attention on the words at the top of the page. The impulses from your eyes became sensations in visual sensory areas and were automatically translated into meaningful sensations by visual interpretive areas. You were conscious of them because your mental switchboard had sensory, interpretive, and areas constituting "consciousness" all connected at the same time. However, as you kept reading you

Figure B.4: Thought = Information Being Juggled Between Memory and Reasoning Areas



did not have to concentrate on focusing your eyes from one group of words to the next.

This is because reading has become a habit. And because your awareness was led down the page from idea to idea, your attention, in a sense, was habitual. But if a door were to slam shut at this moment, you would undoubtedly look up. Since the stimulus was loud, it got your attention. In this case, focus of attention was involuntary. So, focus of attention can be voluntary, involuntary, or habitual.

Thought

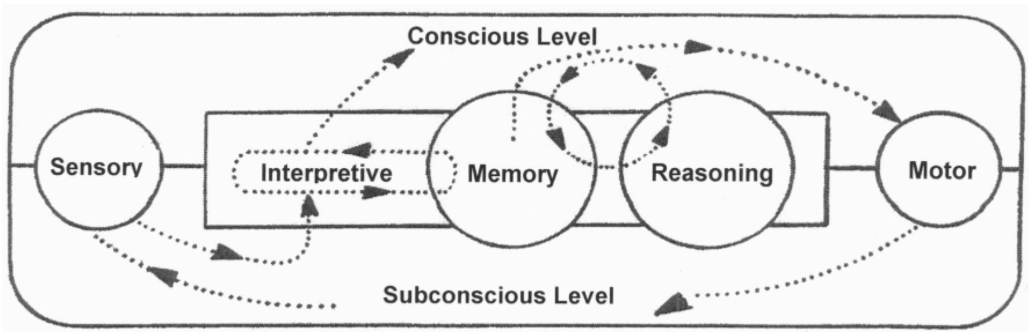
Are we conscious of stimuli around us every moment? No, not necessarily. As a matter of fact, in order to be able to decide what to do about the situation being experienced, we must "disconnect" sensory and interpretive areas from conscious levels. Thought concerning an immediate situation is called "ideation." Instead of new sensations arriving at the level of conscious awareness, recorded sensations in memory are being recalled to consciousness. Of course one of these recorded sensations already in "short-term memory" is what was just perceived before the "disconnection" (between sensory and interpretive areas). Conscious attention can also be focused on thought regarding something totally unrelated to what is happening at the moment. This is called "*imagination*." Daydreaming is a good example, but even creative thought falls into this category.

We think in three modes. **Visual imagery** is one. If you were asked to think about a good friend, you might start recalling what he or she looks like. It would be natural to, for example, imagine the whole face first, and then recall individual features one at a time, relating each back to the whole face. You would be "seeing" the person in your "mind's eye." Thus, one thinks in terms of **visual images** when thinking about an **object or activity** that can be seen (sensed visually) and has been recorded in visual areas of memory. However, if you were asked to think about your position on contextual or subjective matters such as politics or economics, you would have to think mostly in terms of **language**. This is because such topics are **more conceptual or subjective**. They cannot be seen like an object is seen; but when they are described or discussed verbally, the sensations will be recorded in auditory areas of memory. If, on the other hand, you were asked to think about throwing a football, you would tend to think in terms of **motor** (muscular) activity. You would imagine (recall) what it feels like to bring the ball up and over the shoulder and then loft it into the air.

In the three examples above, thought has required recall of previously recorded information from either visual, auditory (verbal), or motor areas of memory.

Now, if you were asked to add three to six and subtract seven (3+6-7), and then look away from the problem, what would happen? First, the sensations for three, six, and seven are recorded in short-term memory (like a computer's RAM), and also the fact that the first two figures are to be added and the last figure subtracted from the total of the first two. Next, you would probably recall to consciousness the numbers three and six and the fact that they are to be added. Then you would use your reasoning abilities (like a computer's processor chip) to arrive at the sum of nine. This answer is momentarily stored in short-term memory. Next, you would recall the number seven and the fact that it is to be subtracted from the sum stored in memory. You then subtract seven from nine using reasoning abilities and arrive at two, This is a relatively simple example of how, just like a computer, thinking involves juggling information

Figure B-5: Motor Areas Effect an Integrated Response Under Conscious Control



back and forth between memory and reasoning areas. However, this juggling must occur in a succession of instantaneous, separate processes. The information cannot be recalled and processed all at once. (Note in ***Figure B.4*** that reasoning areas are located in interpretive regions along with memory.) While you are thinking (using previously recorded information in memory), the conscious level is "disconnected" from sensory and interpretive regions. However, it could be reconnected again at any point during thought if some stimulus caught your attention.

According to Penfield (1959), there are some conscious experiences that are not recorded well in long-term memory. These include: (a) attention focused on our own efforts, (b) thinking, (c) speaking, (d) writing, (e) working with numbers, and (f) periods of skilled activity. (So far, enduring records of these experiences have not been elicited from people experimentally subjected to electrical stimulation of known memory areas with special probes. This does not necessarily mean that what we think and say are not recorded at all, but it would seem that they are not well recorded.) This may be because internal and external stimuli are sensed, interpreted, and recorded in memory, whereas thinking, speaking, learning, and so forth involve recall of sensations already recorded in memory (even though environmental stimuli may have induced conscious thought). Our conclusion is that what we think and say is recorded in "short term memory" as we think or speak, and that it can be recorded more permanently in long-term memory if (a) it is particularly important, (b) we are particularly attentive to it, (c) we continue to think about it, and/or (d) we use what we are thinking so that it can be sensed and recorded better.

It is possible at the conscious level to think both deductively and inductively. **Deductive** reasoning (or logic) enables us to arrive at a conclusion that is implied by accepted theories, assumptions, or principles. *For example*: "All young boys get into a little bit of trouble - Jimmy is a young boy - therefore, Jimmy is going to get into a bit of trouble." **Inductive** reasoning enables one to theorize a conclusion about something unknown, based upon information that is known. *For example*: "The sun shined sometime during each Saturday for the last year - therefore, it will (probably) shine this coming Saturday." Logical reasoning is discussed further in *Appendix C* on the process of mental development.

After we have thought about the situation we were experiencing, and have decided what action, if any, to take, the switchboard makes a new set of connections. (See ***Figure B.5*** above.) If, for example, muscular activity is desired, a connection is made between **motor areas of memory**, where the repertoire of muscular responses is stored, and the **motor areas of the brain**. The brain's motor areas translate consciously desired muscular responses into messages that are relayed to nerves in the muscles. These nerves, in turn, discharge the impulses making you speak, move arms, legs, fingers, and so on.

That was the last step in the sequence of integrative mental activity. First, there was excitation of sensory nerves by stimuli. Then there was integration of sensory information into a mental response. Finally, there was an integrated motor (physical) response to the environment. (**S**timulation - ***I***ntegration – **R**esponse, which is called the **"S - I – R"** formula.)

The Switchboard Operator

Have you been wondering, "What is connecting sensory areas to interpretive areas — interpretive areas to areas involved in consciousness — memory and reasoning areas — memory areas to motor areas? What is operating the "switchboard?" What keeps us from reacting to thousands of stimuli at one time? What keeps behavior from being completely disorganized, disoriented, and even erratic? The answer is some neurological system involved in levels of integration other than consciousness. These levels of integration are commonly called the "subconscious" or "unconscious." (We prefer the word "subconscious," which is "below consciousness." "Unconscious" can too easily be construed as "asleep," "out of it," or "knocked out cold.")

The neurological system within subconscious levels has been designated the centrencephalic or reticular system by Penfield and Roberts (1959), Jasper (1958), and others. This system is believed to be made up of parts of the brain stem and memory and reasoning areas of the interpretive cortex. It is thought to be our "mental switchboard," since it reportedly starts and stops specific brain mechanisms or processes, and connects brain areas in the ways we have been describing. Although it has not been pointed out so far, have you noticed in the conceptual diagrams that, just as at the conscious level, subconscious levels have connections with, and access to, all the major brain areas? It could not accomplish switchboard functions otherwise. Apparently this neurological system determines two things: (a) which mental activities will be under conscious control, and (b) which sensations will reach conscious awareness. For these reasons it seems to be **our overriding control and coordinating system—a system that organizes all mental activity**. Thus, it has also been called the "meta-organizer" by McKay (1959, 1966). We are not conscious of any of this system's activity. Therefore, we consider it to be part of the "subconscious levels of integration."

A major question unanswered by the above discussion is, "How are the thousands of sensations reaching the brain sifted through and filtered, and only certain ones selected for conscious attention? To answer this question, let us look at basic factors that are instrumental in calling attention to stimuli. These are:

1. change in the quality of the stimulus (like a traffic light changing from red to green);
2. size, magnitude, or intensity of a stimulus (like the loudness of a horn or a firecracker exploding);
3. difference or novelty of a stimulus (a fifty foot tree amidst saplings, or a man in a white dinner jacket when everyone else is wearing a black tuxedo);
4. repetition of a stimulus (a little boy's tugging at his mother's skirt until she pays attention);
5. basic physiological needs and drives for which the "limbic system" is reportedly responsible (when you are hungry, food is noticed); and
6. interests and goals (if you are a skiing enthusiast, you will be quick to spot such equipment in a sports store).

It is easy enough to understand how stimuli of great intensity would be selected for conscious attention. For example, if one were to hear a loud explosion or see a flash of light, thousands of strong auditory or visual impulses would bombard sensory and subconscious level systems, and would elicit involuntary attention. Change, novelty, repetition, and physiological needs and drives such as hunger and thirst are also selected for conscious attention in much the same manner. Each of the above factors tends to signify to our filtration and selection system that something important enough to deserve conscious attention is happening or may be about to happen. Conscious attention is generally focused on the stream of sensitivities of the sensory mode whose information is, or may be, most important at the moment.

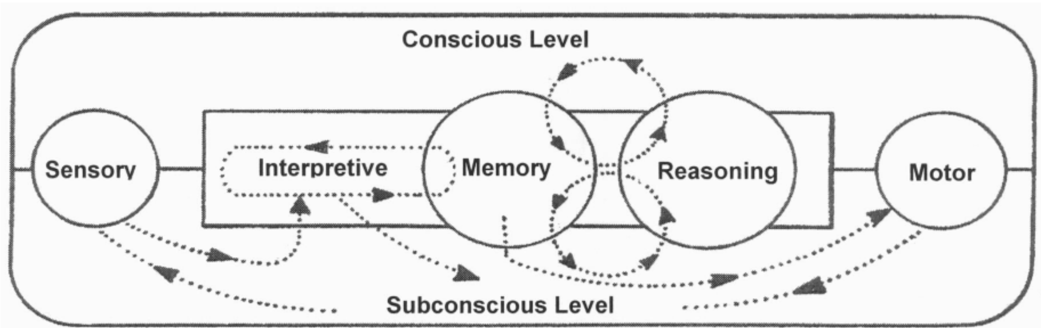
However, if conscious attention were constantly focused on stimuli of present importance such as needs, drives, or interests, would there not be a tendency to behave contrary to longer-term self-interests? Should not our behavior also be integrated within the context of the future? One would certainly think so. However, the future is not very important unless we have goals.

If we simply think about our goals will they be recorded in long-term memory? Possibly, but not necessarily, since what we think is certainly better recorded if it is written down so that it can be sensed, interpreted, and then recorded. If specific goals have been effectively recorded in memory, this makes a great difference, as the following discussion attests.

Wells (19058) and Prince (1929) have reported that arithmetic problems can be solved at subconscious levels. Other psychological, neurological, and psychiatric research tends to confirm that there is thought at other than conscious levels. People often experience going to bed with a problem on their minds, and waking up with an answer. Many researchers believe, however, that we can think deductively at subconscious levels, but not inductively, which means that unconscious thought has important limitations.

Why can we think at these levels? Have you noticed in previous pages' diagrams that subconscious levels are connected with, and have access to, reasoning and memory

Figure B.6: Subconscious Integration of Stimuli and the Effecting of Ideomotor or Conditioned Responses



areas between which thought occurs? As we mentioned earlier, these areas are believed to be parts of the centrencephalic or meta-organizational system (Penfield, Roberts, Jasper, Lawson).

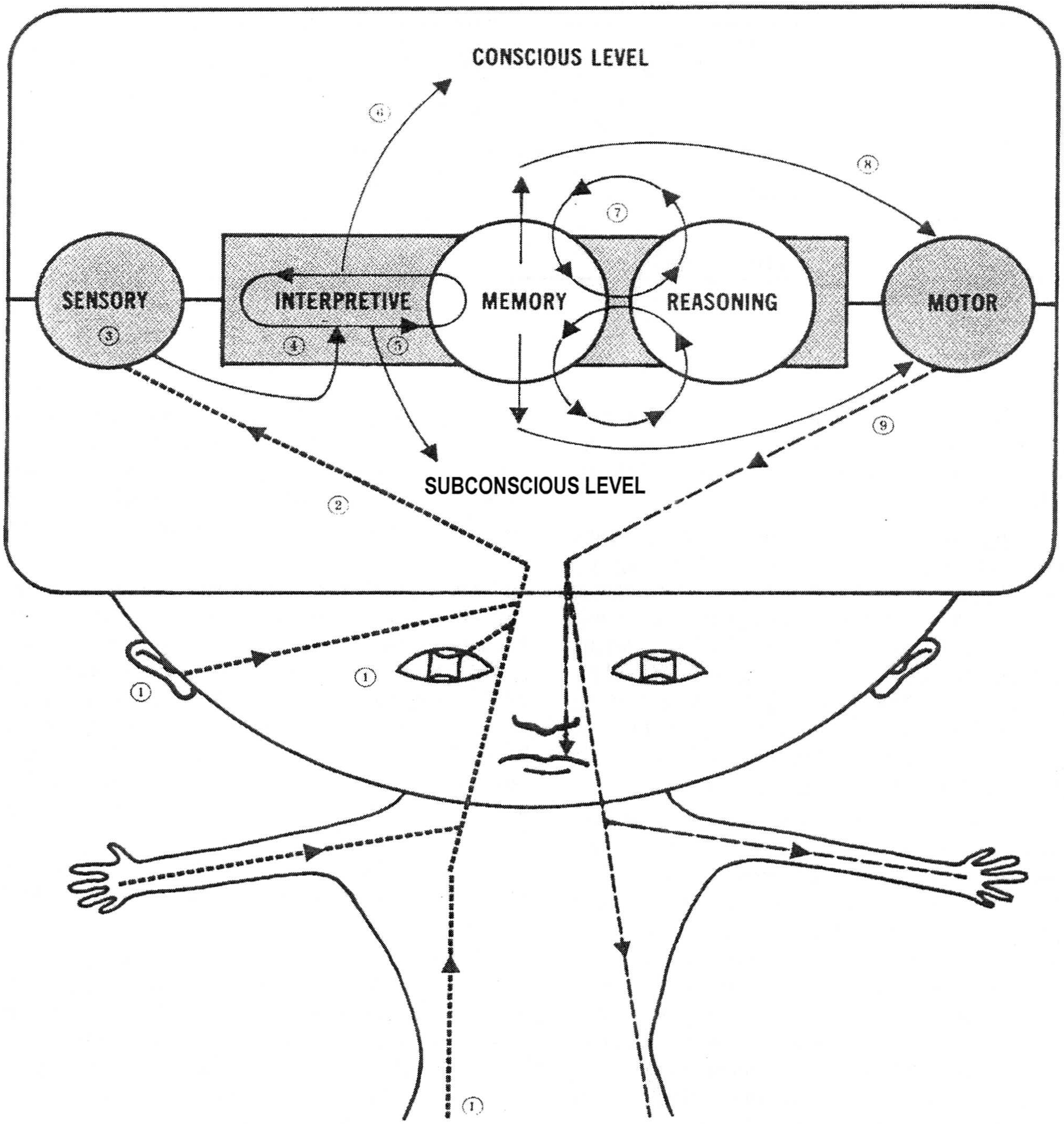
That thought is possible at subconscious levels means that mechanisms at these levels can determine not only the importance of present sensations, but also the importance of recorded sensations such as explicit goals and the attitudes associated with them in memory. This in turn means that the importance of present stimuli can be compared to, or weighed against, recorded sensations dealing with the future (goals). Thus, we would expect that stimuli associated with long-term goals could be selected for conscious attention over less important, competing stimuli.

Not only can unconscious levels perceive meaningful sensations and think, they also have access to motor areas of the brain (as shown in previous figures). This means that it can also integrate physical responses to stimuli without conscious thought or effort. For example, have you ever been driving along and suddenly become aware that your conscious mind has been "a million miles away?" You have not consciously been aware of, or paying attention to the visual stimuli of the road ahead. Sensory and interpretive areas have been "disconnected" from consciousness in order to allow conscious ideation or imagination (wherein recorded sensations are being "juggled" between memory and reasoning areas at the conscious level). However, your subconscious levels were "seeing" the road. These sensations were still circuiting through sensory and interpretive areas. While the conscious mind was elsewhere, subconscious levels were (1) connecting sensory and interpretive areas, (2) enabling thought between memory and reasoning areas (or at least accessing motor areas in memory), and (3) sending messages from motor areas of memory to motor (muscular movement) areas so that you could still drive the car. These subconscious phenomena are illustrated in ***Figure B.6*** above.

Subconsciously directed responses are called "ideomotor," conditioned, or habitual responses. Driving generally becomes a habit as muscular activities such as coordinated arm, hand, and eye movement are recorded in memory and reinforced through practice. So the subconscious, when it sees that you must steer right or left, connects impulses recorded in memory to motor areas that tell the muscles to respond. If, however, a car were to come careening back and forth down the highway toward you, subconscious levels would connect the incoming sensations to the conscious level and your attention would become alerted to them. Obviously, this focus of attention would be important at the moment.

The discussion above indicates that unconscious integration of stimuli can occur simultaneously with conscious activity. Another example: A pianist can play the piano and still talk to someone. In fact, M.H. Erickson (1941) has reported research findings that someone can consciously spell words while at the same time counting pump handle strokes unconsciously (under hypnosis). So, as you can see, subconscious activity is extremely complex, and the roles of subconscious levels of integration are tremendously important to us. They allow us to respond to the environment in a purposeful manner that is consistent with what is important to us both in the present and in the future. In order to do so,

Figure B.7: Conceptualized Model of Basic Mental Activity



they act as our mental switchboard—screening incoming messages, connecting appropriate brain areas, and starting and stopping various brain mechanisms and mental processes.

Recap

To pull together the frame of reference we have been describing and explaining, let us briefly summarize the basic sequence of mental processes. Please refer to ***Figure B.7*** on page B-10, which diagrammatically depicts this summary.

Step 1: Stimuli excite nerves in sensory organs. Impulses are generated in the eyes, ears, nose, skin, and so forth.

Step 2: Most of the thousands of messages being generated in sensory nerves are being conducted by nerve pathways through the spinal cord and on into the brain.

Step 3: The eyes' messages go to *visual sensory areas*, the ears' messages go to *auditory sensory areas*—and so on for all sensory modes. These thousands of impulses become streams of sensations within the several dedicated sensory areas.

Even at this point, brain mechanisms below the conscious level have begun to sift through, filter, and select certain (groups or streams of) sensations for translation in interpretive areas.

Step 4: As one reads, for example, unconscious mechanisms connect *visual sensory areas* to *visual interpretive areas*, where visual sensations are instantaneously compared with sensations already recorded in *visual areas of memory*. If memory regions contain information with which the new sensations can be associated, the new sensations are interpreted and become meaningful.

Step 5 or 5a: At this point, subconscious levels can further determine (a) which group or stream of sensations (visual, auditory, touch, smell, or taste) are important for conscious attention, and (b) which should be integrated at subconscious levels. This determination is made on the basis of the strength of the impulses, change, novelty, repetition, and, to a significant extent, the sensations' importance in terms of goals, interests, and attitudes recorded in memory.

Step 6: If, say, *visual sensations* have been selected as most important for conscious awareness and attention, subconscious mechanisms connect *visual sensory and interpretive areas* to consciousness. So, as sensations occur in sensory areas and are instantly interpreted, they are immediately perceived (they become *perceptions*) at the conscious level.

Step 7: As the conscious level of the mind experiences meaningful perceptions, it can think about the experience. Thought, whether at conscious or subconscious levels, amounts to juggling information back and forth between *memory and reasoning areas*. Because we cannot focus conscious attention on immediate stimuli and think at the same time, subconscious mechanisms have "disconnected" sensory input from the conscious level.

Step 8: If thought results in a decision to take some physical action, impulses representing the desired activity (stored in *motor areas of memory*) would be connected to the appropriate *motor areas* by subconscious mechanisms.

Step 9: *Motor areas* would next translate the impulses from memory into messages that would then be conducted through nerve pathways to nerves in the muscles. These nerves would trigger the desired muscular activity.

Integration of present stimuli could have gone another route starting at Step 5a. Subconscious levels could have integrated behavior while conscious levels were accomplishing thought activity.

Step 6a: One is in the process of conscious thought (ideation or imagination when *sensory and motor areas* are not connected to the conscious level. Thus, immediate sensations are not gaining conscious awareness. This leaves sensory and motor areas available for subconscious integration of responses. Subconscious mechanisms are still monitoring meaningful experience.

Step 7a: As subconscious levels experience meaningful perceptions, apparently they too can think about sensations. Remember, however, that the nature of thought at subconscious levels may be of a slightly different character than at conscious levels.

Step 8a: If subconscious levels perceive that a physical response is appropriate, but not necessarily requiring integration at the conscious level, conditioned or habitual responses in memory would be connected to motor areas.

Step 9a: *Motor areas* would next translate stored impulses into messages that would be conducted to nerves in muscles. In turn, these nerves would trigger muscular activity.

All of these processes are phenomenally complex. None of them are fully understood. Therefore, the reader must understand that the above description may not be entirely accurate. On the other hand, it is based upon the findings of many researchers, and is an attempt to mold different opinions into a single frame of reference. Let us now use this frame of reference to further develop the rationale for "synergistic personal development."

Perspectives on Interrelationships and Interdependencies

As you can see, there are definite interrelationships and interdependencies among brain areas and among mental processes. These are certainly worth explicit enumeration, inasmuch as the concept of psycho-synergy lies in integrated activity - within the Integrative System.

First, purposeful behavior does not just depend on conscious awareness, but on goal-oriented conscious awareness. Since subconscious mechanisms use memory and reasoning areas (within the interpretive cortex) in order to select sensations for conscious attention, whether or not goals have been identified and recorded in memory is highly important. Goal setting, therefore, provides input to memory that will be used to override attention to less important stimuli that constantly compete for conscious awareness.

Second, we can respond more effectively or successfully to our environment the better we understand what is occurring around us and why—that is, what we are experiencing. Experience, however, can only become meaningful within *interpretive areas* through its association with information already recorded in memory. Thus, meaningfulness depends upon prior learning. In turn, how well something is learned depends upon its meaningfulness. Therefore, learning efficiency and effectiveness are highly dependent upon prior learning, also. **The more we know, the more we learn, and the better we learn it**.

Third, thought generally occurs when a problem has been recognized. Problem recognition depends upon the mental comparison of actual results (stimuli) with desired, intended, or expected results that have been recorded in short- or long-term memory. This is more or less like saying that without goals, desires, or intentions, there are no problems. So, problem recognition and subsequent thought depend upon whether or not goals or intentions have been identified and recorded in memory.

Fourth, thought involves juggling information back and forth between reasoning areas and short and long-term memory. Therefore, the more information stored in memory, the more informational input that is available for thought processes. This is tantamount to saying that effective thought depends upon how much has been learned—and how well.

Fifth, the effectiveness with which we learn, think, and respond depends upon how effectively we focus, concentrate, and sustain attention and effort on what we are doing. In turn, concentrated attention and effort are dependent on motivation. Motivation is not only a function of needs, drives, values, and interests, but also of goals.

These fundamental relationships and interdependencies among learning, thought, and goal setting demonstrate very conclusively that the effectiveness and efficiency of any one mental process depends upon the effectiveness and efficiencv of all the others. Therefore, to truly improve any one process, all must be improved. These and other interdependencies are discussed further throughout Chapters 2 through 10.