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A READER'S JOURNAL
The Emotional Brain
by
Joseph LeDoux
The Mysterious Underpinnings of Emotional Life
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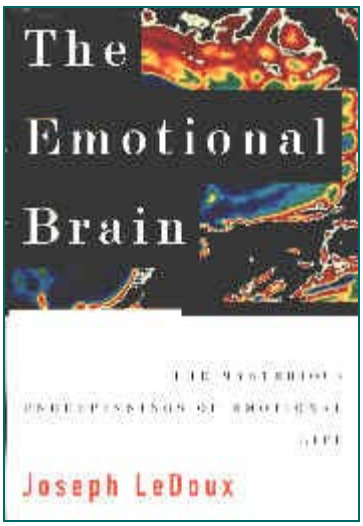
A Book Review by Bobby Matherne ©1997



LeDoux says in the beginning of this book that he wanted to know how brains make emotions. He ends his book with this statement: "The brain states and bodily responses are the fundamental facts of an emotion."

Before I review the contents of the book, let me provide the reader a brief summary of how the bodily responses comprise emotions based on the nascent science of doyletics . Brain states are accessible by neural researchers with micro-electrodes; our physical body states are accessible by everyone. Physical body states comprise the substrata of the human capability known as emotions or feelings. [See ARJ: *PANACEA!*, *Emotional Intelligence*, *Passion&Reason*, *Emergence: Labeled Autistic*, and *Thinking in Pictures*.] LeDoux's work dramatically demonstrates that physical body states are stored in and retrieved from the amygdala.

The amygdala consists of two almond-shaped structures in the brain's limbic region. From three months after conception until five-years-old all of a human's physical body states are stored in the amygdala together with the perceptual contexts which accompanied the states. An example will help: if a pregnant mother slipped and became frightened, the physical body state of the mother [pounding heart, muscle tension, etc] is experienced by the baby in her womb. The physical body states associated with fright are then stored in the baby's amygdala along with the perceptual context of the falling motion when its mother slipped. During a subsequent slip, the baby will experience the same pounding heart, etc, regardless of whether the mother does. The fright experience is re-triggered by its amygdala automatically. This same pounding heart will be experienced thirty or forty years later when, as an adult, the person is flying in a jet airliner that experiences momentary turbulence. Same perceptual context, same physical body state, only this time it is experienced as a "fear of flying."

The amygdala has two jobs, two processes to perform:

1.) store any novel physical body state with its associated perceptual context,

2.) when presented with a familiar perceptual context later, to re-trigger its associated physical body state.

At the age of five the amygdala stops the first process, and continues the second process for the remainder of the person's life. After five years old, an age known in doyletics as the Memory Transition Age [MTA], it is as if the cache memory of the amygdala had been filled and no new physical body states can be added again. This finding is substantiated by thousands of doyle traces with no known exception. This makes it an observation about empirical results (relying solely on practical experience) not theoretical expectations. [See ARJ: *PANACEA!*.]

To keep from repeating the phrase *physical body state* over and over, I call them *doyles* after the creator

of the basic theory, Doyle P. Henderson. The memory capability in the amygdala that stores the doyle is thus called *doylic memory*, and the trace that removes a doyle, a *doyle trace*. The nascent science described herein I call *doyletics*, which I define as the science that studies the acquisition and transmission of emotional traits. As genetics is the study of genes, so doyletics is the study of doyles.

The basis for the second process is empirical also: during a doyle trace the physical body state (doyle) that comprises the unwanted emotion is traced back to before its first occurrence and is thereby converted from a physical body state in doylic memory into a brain state in "cognitive memory", also known in recent years as "declarative memory". Converting an automatic physical body state (in doylic memory) into a brain state (in cognitive memory) has the very practical effect of completely eliminating the unconscious affect associated with the perceptual context. For the person with the "fear of flying" mentioned above, the pounding heart and muscle tension will disappear. They will perhaps remember doing the doyle trace instead. The mere presence of a physical body state is evidence that process 2.) exists.

The evidence for the existence of process 1.) is that whenever a doyle trace is stopped before reaching the Memory Transition Age (about five-years-old for most people), the unwanted physical body state disappears for a time and returns later. *Only* if the trace goes back to *before* the MTA is the removal permanent. Again this is not a theoretical prediction, but an empirical result of a myriad of doyle traces without a single variance. [See *Amazing New Truths* by Doyle P. Henderson for details of some of these traces.]

The observed result is that after the Memory Transition Age (five) one's amygdaloid or doylic storage cache for emotions, feelings, and automatic motor operations seems completely filled. It will never be added to during one's entire life. This prediction is a result of many doyle traces. If the post-MTA addition of doyles was common, it would not be necessary to proceed before the MTA in every doyle trace. There may be exceptions to the no-new-doyles-post-MTA rule, such as survivors of lightning strikes and other extraordinary events, but the research to prove this is yet to be done. The hypothesis that doyles can be acquired post-MTA is unnecessary at this point.

What does happen post-MTA is that your physical body states or doyles will be combined with other doyles or attached to new perceptual contexts. This is the process known as *anchoring* in the Neuro-linguistic Programming field developed by Bandler and Grinder. When such a *combiner* event happens (two or more doyles get connected) you will likely experience it as a new emotion — a novel feeling — such is the power of the combination of the two physical body states. A simple physical body state of disgust (e.g., a curled-up lip, stored as a doyle at age three) may get attached to broccoli at age seven. Your experience from then on will be, "I hate broccoli!" Any work that is done to remove the doyle stored at age three will remove the broccoli food dislike, and any work done to remove the combiner event at seven will remove the broccoli dislike. What's important to notice is that the doyle removal at age seven will leave the curled-lip doyle intact, and it will still be attached to perhaps many other perceptual contexts. Without the theory of doyletics as a guide, many pop therapists are providing temporary and incomplete relief by removing only the surface symptoms. This may seem trivial for a broccoli dislike, but when the symptom is an intense heart-pounding that leaves a person incapacitated for an hour or so, it is rather important. Removing all the combiner events can take a lifetime of weekly therapy sessions for some people and can provide a nice retirement plan for some therapists, all the while leaving the root doyles *intact*!

The offending doyle is like the root of a tree and its associated perceptual contexts are like the leaves of the tree. Removal of the root doyle by going back before the MTA will remove the entire tree of unwanted responses.

It is a common experience that some of food dislikes disappear past age thirty or so. This seems to indicate that some infantile doyles disappear of their own accord, by some sort of unconscious doyle tracing process that we all have. Since the process is not consciousness, it is useful to have some conscious, predictable process available for removing unwanted doyles. This is exactly what the speed

trace provides. [See the Introduction webpage for details.]

With this brief description of doyletics, let us examine LeDoux's book for data and experiments that would confirm or deny the basic tenets of doyletics, which are:

> **1.) All emotions, feelings, and automatic motor operations are composed of physical body states or doyles.**
>
> **2.) Doyles are stored in and retrieved from the amygdala together with their associated perceptual contexts.**
>
> **3.) Storage of doyles stops at age five and retrieval continues indefinitely whenever an associated perceptual context is encountered.**

On page 23 LeDoux sets the tone for his research into a scientific basis of emotions when he says:

> **I believe that we can get a unique and advantageous view of this puzzling part of the mental terrain by peering at it from inside the nervous system.**

Confirmation that emotions are composed of physical body states comes on page 44:

> **The mental aspect of emotion, the feeling, is a slave to the physiology, not vice versa: we do not tremble because we are afraid or cry because we feel sad; we are afraid because we tremble and sad because we cry.**

This is another way of saying that emotions are the labels that we have given to the various physical body states (doyles) so that we humans may communicate about our subjective experiences with one another.

Magda Arnold's appraisal theory is presented on page 51:

STIMULUS => APPRAISAL => ACTION TENDENCY => FEELING

If we substitute **PATTERN RECOGNITION** in the place of **APPRAISAL**, and understand that we are referring to the pattern recognition of a perceptual context by the amygdala, we get the following basic diagram of doyletics:

STIMULUS =>PATTERN RECOGNITION => TRIGGER DOYLE => FEELING

This shows that the pattern recognition by the amygdala of the perceptual context triggers a physical body state (doyle) that creates what we call an emotion or feeling.

In 1980 Robert Zajonc's *exposure effect* experiments showed that what Arnold called appraisal occurs independent of cognition, and thus is more consonant with amygdaloid memory than with cognitive appraisal or memory retrieval. From page 53:

> **If the subjects are exposed to some novel visual patterns (like Chinese ideograms) and then asked to choose whether they prefer the previously exposed or new patterns, they reliably tend to prefer the preexposed ones. Mere exposure to stimuli is enough to create preferences.**

The novel visual patterns, when presented a second time, trigger a physical body state or doyle of recognition that leads to a preference for the preexposed patterns. If we combine the **PATTERN RECOGNITION => TRIGGER DOYLE** into one state and label it **UNCONSCIOUS AFFECT**, we get Figure 3-7 on page 54, which describes Zajonc's Affective Primacy Theory:

STIMULUS =>UNCONSCIOUS AFFECT => FEELING

If we add a conscious cognition feedback loop as in the diagram below, we demonstrate the interdependence of cognition and emotions.

|<=CONSCIOUS COGNITION <=|
\/~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~\/
STIMULUS => ~~~~UNCONSCIOUS AFFECT => FEELING

A stimulus creates an unconscious affect (doyle) which creates a conscious cognitive response (after a short delay), which in turn creates a new unconscious affect that modifies the unconscious affect. This is the feedback loop that is utilized during the process known as cognitive therapy. It allows someone to assess or appraise the meaning of an unwanted emotion and to move quickly to a more desirable feeling state or emotion. Cognitive therapy allows one to move from an unwanted emotion to a more desirable emotional state quickly; it does not remove the *substrate* of the unwanted emotion. The doyle trace allows someone to remove the substrate, the doyle, so that it never returns. That is the power of doyletics , simply stated.

On page 69 LeDoux summarizes the brain organization of emotion contained in the rest of his book. He says that these key points justify his "belief that emotion and cognition are best thought of as separate but interacting mental functions mediated by separate but interacting brain systems." Below I restate his summary points using the terminology and concepts I have introduced above:

- The stimulus recognition and doyle triggering [UNCONSCIOUS AFFECT] occurs in a different part of the brain from the CONSCIOUS COGNITION.
- The stimulus recognition and doyle triggering [UNCONSCIOUS AFFECT] begins before any CONSCIOUS COGNITION can start.
- Doylic memories and cognitive memories are provided by different brain mechanisms.
- Stimulus recognition and doyle triggering [UNCONSCIOUS AFFECT] are fixed and automatic, whereas CONSCIOUS COGNITION processes provide the highest flexibility of response.
- Stimulus recognition and doyle triggering [UNCONSCIOUS AFFECT] necessarily create emotions, whereas CONSCIOUS COGNITION processes do not necessarily create emotions. (An example of when CONSCIOUS COGNITION processes may create emotions is during a doyle trace. Note in the diagram above CONSCIOUS COGNITION exists in the feedback loop. It creates emotions by activating UNCONSCIOUS AFFECT when it accesses emotionally charged cognitive memories.)

From page 118:

> **Some people end up being stoics and show little emotion, even in situations where society allows emotions to flow freely.**

Each person has a unique history from conception to age five. If someone had only a few doyles stored for facial expressions, that person will have a natural poker face. If someone had few doyles stored for emotional expressiveness, that person will be considered a stoic. Some professions, e.g., medical doctors, continue in the same family for generations. Given that the children of a doctor will be exposed to the appropriate doyles for being a doctor by its parents, it makes sense that such children would feel comfortable growing up to become a doctor.

From page 120:

> **Ortony and Turner caused quite a stir in the world of basic emotions. They made it painfully clear that basic emotions theorists could no longer continue to agree that basic emotions exist and at the same time disagree about what the basic ones are.**

The problem with trying to identify the basic emotions is that emotions cannot be typed the way plants and animals have been. There is some similarity: emotion is like tree: elm names a specific type of tree just as

joy names a specific type of emotion. But that is as far as the similarity goes. We live in one world with a single ecology of plants and animals, no matter how diverse their species might be. We each live in a different world of emotions; we each have a completely different ecology of emotional responses. Thus the joy of one person may bear only superficial resemblance to the joy of someone else.

To a person that was severely abused as a child, joy might be the simple absence of externally afflicted pain or discomfort. Joy is the name that each person gives to some exceptional state that they prefer — it is the label given to an idiosyncratic doylic memory, a re-created physical body state. Some might liken joy to the state of Adam and Eve in Paradise, but each one of us lived in our individual Garden of Eden before five years old. Such joyful emotions as we experienced then, we later label joy. Each human being, as the product of its own pre-MTA emotional history, has a unique emotional ecology. With the advent of doyletics the nature-vs-nurture basis of our emotional life weighs in heavily in favor of nurture.

In Chapter 6 LeDoux pinpoints the amygdala as the portion of the brain responsible for emotional fear responses. The sensory signals go from the hypothalamus to the amygdala in 15 milliseconds and from the hypothalamus to the cortex in 25 milliseconds. As a result, the amygdala is creating emotional responses before the cortex has even received the signal to be processed. The amygdala has limited pattern recognition capabilities compared to the cortex, however, and performs a quick and dirty pattern recognition and response. The cortex applies its refined cognitive processes to the same signal and provides the amygdala with signals for a more reasoned approach to the same sensory input. If we consider the thalamocortical path as the high road and the thalamoamygdalic path as the low road, one is reminded of the old Scottish song, Loch Lomond, which goes:

> ***"Oh, ye'll take the high road and I'll take the low road,***
> ***and I'll be in Scotland afore ye."***

Taking the low road from the hypothalamus to the amygdala, we respond before we know it. A dark shadow and noise in the alley at night, and our heart begins racing an instant before we realize that it's only an alley cat. During the evolution of our species, at a time when the local cats were saber-tooth tigers, those humans who reacted without thinking to such shadows lived longer than those who thought first.

The effect of the automatic response is so strong that Charles Darwin in his study of human emotions once tried an experiment at the local zoo. He placed his face against the thick glass of the puff adder's cage and steeled himself to ignore the inevitable strike against the glass. When it came, Darwin was chagrined to find that he had jumped three feet back from the glass.

Earlier in this essay I claimed that children acquire physical body states from their mothers in utero and up until the age of five-years-old. On page 237 LeDoux presents some experimental data from Susan Mineka which confirms that the process of doylic transmission between mothers and children occurs in primates.

> **It had long been thought that monkeys have an inherited fear of snakes, so that the first time a monkey saw a snake it would act afraid and protect itself. However, Mineka showed that laboratory-raised monkeys are in fact not afraid on the first exposure to a snake. Most of the earlier work had involved testing of the young monkeys in the presence of their mothers. If the young monkey is shown the snake when separated from its mother, it doesn't act afraid. It appears that the infant learns to be afraid of the snakes by seeing its mother acting afraid.**

Quoted from Mineka article: [RJM: edited slightly for readability.]

> **Marks and Nesse (1994: 255), following Mineka and Al (1984), describe such a case in which fear does not emerges instinctively, but only after a specific learning experiment:**
>
> > **"Rhesus monkeys are born without snake fear. Enduring fear develops after**

> **a few observations of another rhesus monkey taking fright at a snake. . . Likewise, a fawn is not born with fear of a Wolf — its lifelong panic is conditioned by seeing its mother flee just once from a Wolf."**
>
> **At least in the case of rhesus monkeys and snakes, this is a clear example of learning, rather than innate response. Rhesus monkeys learn to fear any moving object in this way, and to less extent non-moving objects too.**

The presence of such generational transmission of doyles in primates provides strong evidence for an equivalent process in humans. Any caretaker of a child until it reaches the age of five may be responsible for the storage of a doylic response that may stay with the individual for their entire lifetime.

On page 243 there is an interesting diagram of two hippocampal neurons from a stressed and an unstressed primate. The unstressed one has a richer set of dendritic connections. This corresponds to Bruce McEwen's findings that "severe but temporary stress can result in a shriveling up of the hippocampus." The experiments with stressed primates involved exposing a subordinate male to a dominant male. Apparently coercion has permanent effects on the hippocampus and reduces brain capacity. (This will not come as a surprise to anyone who's watched the United States Congress in action on C-SPAN.)

On page 248 LeDoux says: [Note: In the quote below, *lesioned* refers to removal by a scalpel.]

> **Several years ago we were examining the effects of damage to visual areas of the cortex on the ability of rats to be conditioned to visual stimuli. The lesioned rats learned just fine, supporting our contention that there are subcortical pathways that take sensory information to the amygdala during conditioning. But when we tried to extinguish the fear responses in these animals, something unusual happened. We couldn't do it. Normal rats, after several days of seeing the light without the shock, stopped acting afraid in the presence of the light. But the rats with lesions of the visual cortex were like the Energizer batteries — they just kept going and going.**

These experiments confirm that the amygdala provides visual pattern recognition because when the visual cortex was disabled, the rats were able to conditioned to a fear response by shocking them with the light signal was turned on. The amygdala stored a fear doyle and re- triggered it every time the light was subsequently turned on, even though no shock was applied. In normal rats the CONSCIOUS COGNITION feedback loop corrected the amygdala's UNCONSCIOUS AFFECT after a few days of seeing the light (via the visual cortex) without the shock. In the rats with the lesioned visual cortex, the CONSCIOUS COGNITION feedback loop was effectively broken: no light signals could reach the cortex because visual cortex damage. The amygdala had no choice but to continue to respond to the light by re-triggering fear doyle.

LeDoux uses the expression "emotional perseveration" to describe the behavior of the rats with the lesioned visual cortex. He points out on page 249:

> **One of the hallmarks of frontal lobe damage in humans is perseveration, the inability to stop doing something once it is no longer appropriate.**

The experiment with lesioned visual cortex in rats suggests to me that perhaps the perseveration that is so prevalent in autistics may be due, not to some malfunction of their visual cortex, but to a differentially heightened functioning of their amygdala. (Recent autopsies of autistic brains have shown that such brain stems have smaller neurons with an attendant higher packing density. Higher density of neurons could provide the heightened functioning.)

In a human subject with a lesioned visual cortex, the fear response to the light signals could be extinguished by a doyle trace, but this is not an option with the rats.

Another interesting quote from page 250:

> **Extinction, in other words, involves the cortical control over the amygdala's output rather than a wiping clean of the amygdala's slate.**

The CONSCIOUS COGNITION feedback path in the above diagram provides cortical control over the amygdala's output. When applied during the process of cognitive therapy, cortical control will modulate the amygdala's output. A simple doyle trace, however, be able to wipe the slate clean by completely removing the offending fear doyle.

Two related quotes:

> **Unconscious fear memories established through the amygdala appear to be indelibly burned into the brain. (page 252)**

> **The amygdala's emotional memories, as we've seen, are indelibly burned into its circuits. The best we can hope to do is to regulate their expression. And the way we do this by getting the cortex to control the amygdala. (page 265)**

Emotional memories of all types are with us for life, until they are removed either consciously or unconsciously. Some may be removed unconsciously during the maturation process, and the others may be removed by a conscious doyle trace. Some regulation of the expression of these emotional memories is possible through cognitive therapy, but the permanent removal of recalcitrant and resistant unwanted emotional memories requires a doyle trace. The expression, "indelibly burnt into the brain," reminds me of what, in computers terms, is called a read-only memory or ROM. It can only be read and not written, therefore it stays exactly the same forever. With the advent of doyletics , we must re-examine whether emotional memories in the amygdala are stored as PROM instead, that is, a programmable (changeable) read-only memory, one that is changeable only by some special process, for example, a doyle trace.

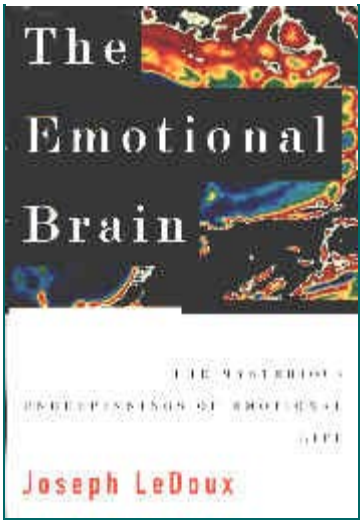
To complete this extensive review of LeDoux's book, let us examine three additional related quotes:

> **Although this may seem obvious, the study of emotion has been so focused on the problem of emotional consciousness that the basic underlying emotional mechanisms have often been given short shrift. (page 282)**

> **It's hard to believe that after all these years we actually still don't have a clear and definitive understanding of the role of body states in emotions. (page 295)**

> **Although thoughts can easily trigger emotions (by activating the amygdala), we are not very effective at willfully turning off emotions (by deactivating the amygdala). Telling yourself that you should not be anxious or depressed does not help much. (page 303)**

These quotes point out that the basic emotional mechanism involves the amygdala's storage and retrieval of physical body states. By doing a doyle trace one can be quickly convinced that it is possible to remove indelible, burnt-in emotional memories like anxiety and depression. One cannot judge the food by eating the menu; one must taste the food.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