The Brain And Behavior

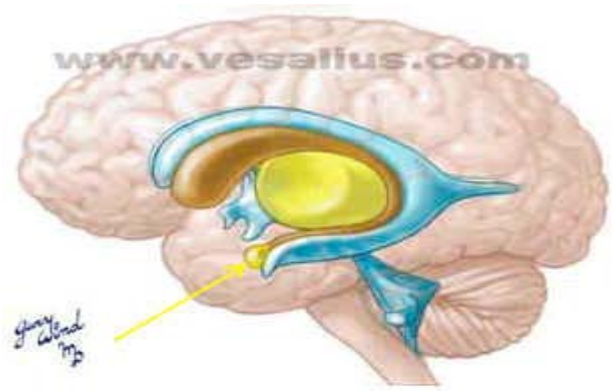
Fear “amygdala”

When you are afraid, you are likely to have:

- worried *thoughts*; and
- physical *sensations* like a faster heart rate, sweating, increased breathing; and
- *behaviors*, like trying to escape the situation that made you afraid in the first place!

There is a complicated series of events in the nervous system that leads to the physical sensations and behaviors of fear (the thought, we can't localize so well). Below you'll find details of the anatomy of this process -- but for a simple look at the "fear circuitry" of the brain,

The brain structure which appears to be at the very center of most of the brain events associated with fear is the "amygdala" (Greek for "almond", its shape). The amygdala seems to respond to severe traumas with an un-erasable fear response ("post-traumatic stress disorder", or PTSD; It seems to be genetically different and "wired" for a higher level of fear in some individuals, such as those with panic disorder. And it recently has been shown to be *larger* in some people with bipolar disorder, though what that means is still a mystery.



You can see the amygdala clearly in this drawing: it's the small (almond-shaped, almost) bulge at the lower tip of the gold loop (yellow arrow).

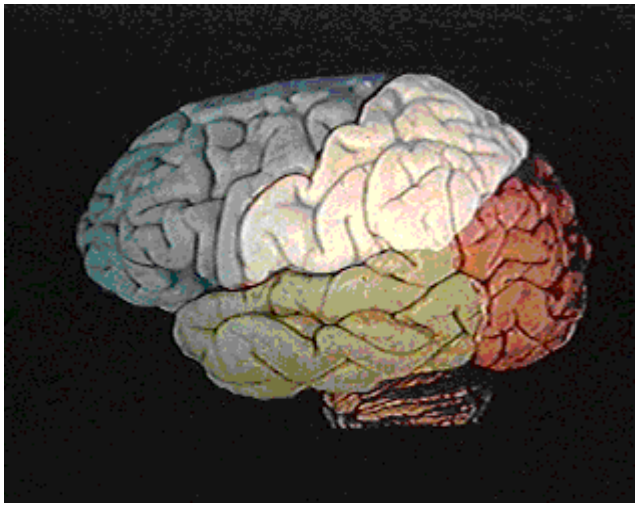
Memory, Learning, and Emotion: the *Hippocampus*

Emotion and memory are very closely related. You know this from your experience. Go to a party; meet a bunch of new people. Which faces are you going to remember? The woman who made you laugh, the man who made you feel embarrassed, and your new boss -- the ones who had an emotional impact.

So perhaps you would not be surprised to learn that the portion of the emotion system of the brain (the "limbic system") is in charge of transferring information into memory. From years of experiments and surgical experience, we now know that the main location for this transfer is a portion of the temporal lobe called the *hippocampus*.

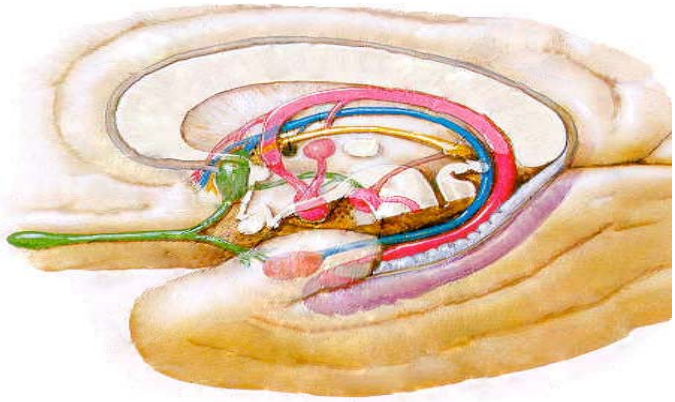
You won't particularly impressed by its appearance. The hippocampus is included here because it is always cited as part of the "limbic system", and because there is striking new "news" about:

- how it works;
- its vulnerability to stress; and
- its rich supply of estrogen and progesterone receptors.



Notice the green portion of the brain: this is called the temporal lobe. It lies right under your temple. Memories of names live in this left temporal lobe: particularly *people's* names, names of *animals*, and names of *tools*. If you would like two paragraphs on "why *these* names?"

The portion of the brain that helps those names get into memory in the first place, this *hippocampus* thing we are talking about, is also part of this temporal lobe. But you can't see it here, because it's an *inside* fold, not these outside folds you see above.



First, this part of the brain appears to be absolutely necessary for making new memories. If you didn't have it, you couldn't live in the present: you'd be stuck in the past of old memories. And this is common: Alzheimer's disease first and severely, before other parts of the cortex (later, the frontal lobes too). So memory is usually the first thing to start to falter in Alzheimer's -- the ability to make new ones, that is. Who visited yesterday? Where did I put the car keys? Why isn't there any mail today (when you brought it in 3 hours ago)?

Secondly, the hippocampus seems to be involved in severe mental illnesses. In both schizophrenia and some severe depressions, the hippocampus *appears to shrink*. However, **there is recent evidence that this shrinkage can be reversed and perhaps prevented in people with depression and bipolar disorder, with effective treatment**.

Brain Differences

Summary:
The bottom line: psychiatry is making progress. Although it is hard to spot differences in the brain by doing simple tests like a CT scan, or even an MRI, there are now consistent differences which are being shown that confirm the working hunch **about bipolar disorder -- namely, that this is a condition in which emotions gain too much power over behavior.** I know, is that not obvious? True, we already knew that just from experience, as you surely know as well. But what we can now see is at least a glimpse of the brain *mechanisms* by which this occurs: too much activity in emotional centers, and too little in the frontal lobes that are supposed to be able to inhibit action. Moreover, these differences are present even when no symptoms are present.

Differences in size

First the good news: many of the differences in brain size which have been shown in many studies of patients with **mood problems can be reversed at least in part with effective treatment**. Second, the take-home message for now: growing evidence suggests that each episode of severe mood symptoms is associated with increases in these brain size differences, and therefore aggressive pursuit of good symptom control may be associated with preventing some of the brain changes that unfortunately seem to progress in at least some forms of bipolar disorder. There are many more reasons for SPECT scan and multiple evaluations for effective treatment.

Although it has taken years to be certain, because not all studies have shown the same results, there is now fairly good agreement that the frontal cortex (**which is associated with decision-making and controlling impulsive behavior**) shrinks in size *when bipolar disorder is allowed to progress*. This is basically the same result which has been seen in severe forms of depression which remain untreated. Several studies have now shown that lithium appears to be capable of reversing this trend toward frontal atrophy.

The Biologic Basis of Depression

Summary:
In contrast to mania, depression is now quite well understood at a molecular and cellular level. Even some of the genes which are associated with susceptibility to depression have been connected into this molecular-cellular story. A general mechanism by which many antidepressant treatments work, even exercise, has been mapped out.

In brief, this turns out to be a story about cell growth and cell death. The brain is highly "plastic", a jargon term meaning that the brain is very changeable in response to the demands placed upon it. Brand-new cells can grow in certain regions of the brain. (I know that's not what you learned once upon a time, it is a recent discovery). The bad news is that a sustained depression appears to be associated with a decrease in the number of brain cells, and in the number of connections each brain cell makes with others.

The good news is that **proper treatment appears to be able to halt and even reverse this decrease in neuron number and connections**. Indeed, this seems to be the fundamental way that effective treatments work.

We have come a long way from understanding depression to be a problem with neurotransmitters like serotonin and norepinephrine. The story is vastly more complicated, and yet a good portion of that complexity is now understood.

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EMOTION, MEMORY, AND THE BRAIN:

Why We Do It

How does the brain form memories of life's significant events?

We have used classical fear conditioning as a behavioral assay for studying emotional memories. In fear conditioning, if you were bitten by your neighbor's dog yesterday, the sight of the beast today (and for some time to come) will certainly put you on guard, causing you, for example, to freeze dead in your tracks, or perhaps to run away, and will also lead to a host of physiological responses.

Learning and responding to stimuli that warn of danger involves neural pathways that send information about the outside world to the amygdala, which determines the significance of the stimulus and triggers emotional responses, like freezing or fleeing, as well changes in the inner workings of the body's organs and glands.

Many of the most common psychiatric disorders that afflict humans are emotional disorders, and many of these are related to brain's fear system. According to the Public Health Service, about 50% of mental problems reported in the U.S. (other than those related to substance abuse) are accounted for by the anxiety disorders, including phobias, panic attacks, post-traumatic stress disorder, obsessive compulsive disorder, and generalized anxiety. Research into the brain mechanisms of fear help us understand why these emotional conditions are so hard to control. Neuroanatomists have shown that the pathways that connect the emotional processing system of fear, the amygdala, with the thinking brain, the neocortex, are not symmetrical -the connections from the cortex to the amygdala are considerably weaker than those from the amygdala to the cortex. This may explain why, once an emotion is aroused, it is so hard for us to turn it off at will. The asymmetry of these connections may also help us understand why psychotherapy is often such a difficult and prolonged process- it relies on imperfect channels of communication between brain systems involved in cognition and emotion.

> Having read all this, you can see why it is significant to have a brain SPECT scan of your brain for accurate diagnose before you experiment with various medications. We encourage you to consider the choices of treatments and the long term benefits of diagnosis treatment recovery opposed to medicated protocols and the long term side effects that may compromise your health. Today with new technology, disorders can be clearly identified and explained. With proper diagnosis there are effective treatments for results.