Emotion

by Richard H. Hall, 1998

Characteristics of Emotions

Although there are clearly many different types of emotions, they all have some common characteristics. First, emotions are largely non-purposeful and instinctive. The basic emotions that human's express are shared with most mammals. Anyone who has a pet is aware that it's not too difficult to tell when the pet is experiencing emotions like anger, anxiety, and happiness. Second, on the physiological level, as you might expect, emotional behaviors are closely tied to subcortical structures and the autonomic nervous system. This shouldn't be surprising to you in that one of the basic characteristics of the autonomic nervous system is the control of non-purposeful behaviors such as heart rate and respiration. A third basic characteristic of emotions is that, to a large degree, they appear to be innate. For example, sociologists have found that facial expressions associated with the basic emotions such as fear, anger, and happiness are the same across cultures. Even with cultures that have had very little contact with the "outside world". Another piece of indirect evidence for the innate nature of emotions is illustrated by a muscle located above the eyes called **Duchenne's muscle.** In the last century it was proposed that one could tell if another person's smile was sincere based on whether or not this muscle contracts. If it does, the smile is sincere, and if it doesn't the smile is not, and, further, this cannot be controlled consciously. Research since this time has supported the existence of this "emotional lie detector" we all carry around like a light bulb on our forehead.

Our focus in this module will be on fear and anxiety. It is not that more positive emotions, like happiness, are not just as important. It is simply that these other emotions have not been studied in depth. Further, the behavioral characteristics of emotions such as happiness and love are more difficult to define empirically than are fear and aggression.

The Role of the Amygdala in Fear and Anxiety

The brain structure that has received the most attention with respect to its role in fear and anxiety is the **amygdala**. There is a great deal of evidence from animal experiments, and brain damage in humans, which indicates that the amygdala plays a central role in these emotions. For example, humans with localized damage to the amygdala exhibit decreased fear and anxiety responses, even when such responses would be normal and appropriate. Second, PET scan experiments indicate that during difficult and frustrating tasks (e.g., trying to solve a puzzle with no right answer) blood flow to the amygdala increases. In addition, the most popular anti-anxiety drugs are **benzodiazepine** agonists. One area of the amygdala, the **basolateral nucleus**, is rich in benzodiazepine receptors. And some researchers suggest that this area, thus, plays an important role in anxiety disorders. In particular the **central nucleus**, which is adjacent, and connected to, the basolateral nucleus mentioned above, has been implicated as playing an important role in fear and anxiety. Stimulation of the basolateral nucleus in animals increases fear and anxiety. Long term stimulation can even result in ulcers. Lesioning the central nucleus, on the other hand, decreases these emotions, and can, in fact, make a previously hostile animal docile and tame. In particular, it appears that the more specific role of the central nucleus is in emotional integration. The lateral nucleus of the amygdala receives sensory input from various sources and passes this signal to the central nucleus by way of the basolateral nucleus. The central nucleus forms connections with many areas that play a role in the expression of emotion, two examples of which are illustrated in Figure 1. The l**ateral hypothalamus** leads to sympathetic activation and the **locus coeruleus**, the nucleus in the brain stem rich in norepinephrine cell bodies, leads to increased vigilance. The amygdala not only plays an important role in instinctive/innate fear responses, but also appears to play an important role in **conditioned fear**. Conditioned fear is a very basic, and very important type of classical conditioning in which an organism "learns" to exhibit a fear response to some neutral stimulus. It is important in an adaptive sense, in that it allows the organism to be "forewarned" in a situation in which a potential aversive event may occur. You may recall from your general psychology class that **classical conditioning** is a type of learning (often contrasted with operant conditioning) in which a controlling stimulus (**unconditioned stimulus - UCS**), which naturally elicits a response (**unconditioned response - UCR**) is paired with a neutral stimulus (**conditioned stimulus - CS**), which comes to elicit the same response (**conditioned response — CR**). Classical conditioning accounts for very basic, nonconscious/non-purposeful, types of behaviors.

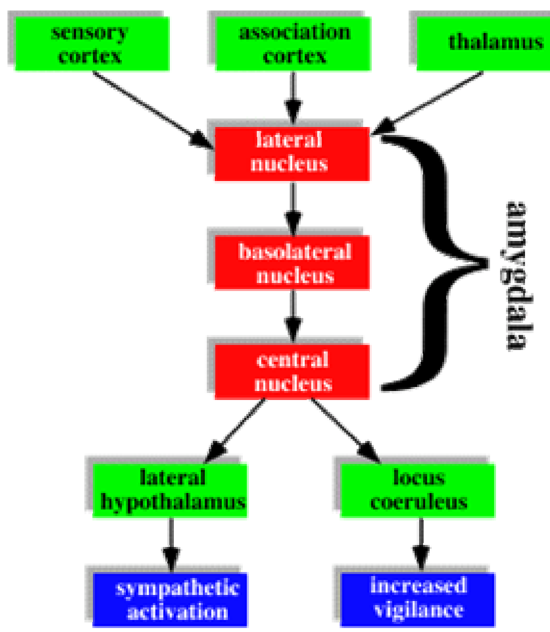

Figure 1. Central Nucleus Connections

An example of the role of the amygdala in such conditioned fear is illustrated by a classic experiment. A rat is classically trained to exhibit a fear response (i.e., increased ANS response and jumping to a tone because the tone has been paired with electric shock). The learning does not occur if the amygdala is lesioned (see Figure 2). The fact that benzodiazepines have been found to disrupt the learning of the conditioned fear response, and that humans with amygdala damage have difficulty learning this response, is further evidence which implicates the amygdala as playing an important role in the learning of the conditioned fear response.

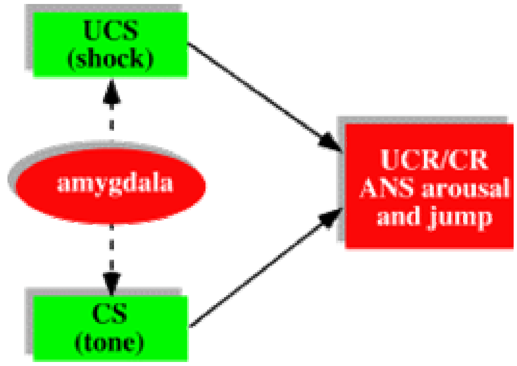

Figure 2. Amygdala/Conditioned Fear Experiment

The Role of the Right Hemisphere in Emotional Expression and Recognition

In most people, the two hemispheres of the brain are specialized to some extent with different roles assigned to the different hemispheres. One such role is the expression of emotion. In most people emotional expression and recognition is carried out primarily in the right hemisphere. Research has consistently found this to be the case. For example, in studies in which a photograph or picture is presented in only one visual field, people are better at identifying the emotion associated with the picture or photograph when it's presented to the left visual field (the left visual field projects to the right hemisphere). Further, people with damage to their right hemisphere have difficulty identifying the emotions associated with facial expressions, and sometimes even have difficulty imagining what a face would look like that was exhibiting some sort of emotion. Further, experiments using PET scans indicate that more blood flows to the right hemisphere than the left when subjects are attempting to identify the emotional tone of a voice.

Not only does the right hemisphere appear to be more important in the recognition of emotions, as supported by the research presented in the previous paragraph, but it is more important in emotional expression as well. In one very clever experiment researchers cut photos of faces in half and made mirror images of one half, creating a face with, in effect, two right sides or two left sides. (Remember that motor nerves from the right hemisphere innervate the left side of the face. Subjects consistently rated the faces with two left sides as expressing more intense emotions than faces with two right sides.) Further, naturalistic observation studies of both humans and monkeys indicate that both species normally show more emotion in the left sides of their faces than their right. The latter finding emphasizes the innate and fundamental nature of emotional expression even across mammalian species.

Emotional Self Perception and the James-Lange Theory

Of course, a very important part of emotion is the feeling of emotion that we all experience. A counterintuitive theory (illustrated in Figure 3) was developed many decades ago to explain this phenomenon. Although the theory is still controversial, experimental evidence indicates that the theory explains our emotional expression a good deal of the time. The basic contention of the James-Lange theory is that we, more-or-less, experience emotion in hindsight. We sense our own autonomic responses, and even overt behaviors that some environmental experience has brought about, and, as a consequence, we feel fear. For example, in the classic prototype of the James-Lange theory, we see a bear, we run, and, **therefore**, we feel scared. Of course, the theory is counterintuitive because it would seem that fear would precede our physical reactions to stimuli, however, as mentioned, there is some evidence that much of the time, it works backwards.

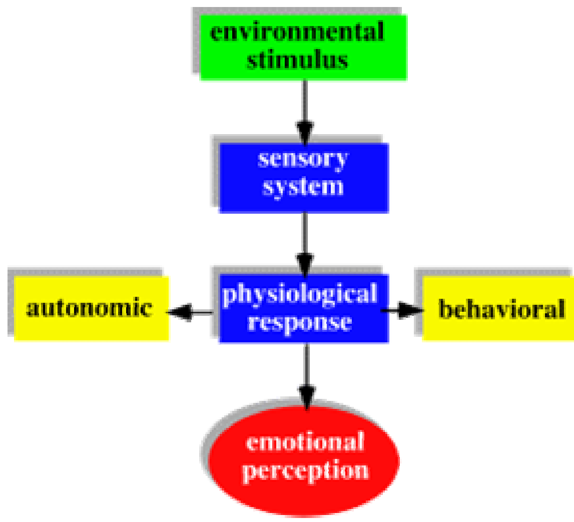

Figure 3. James-Lange Theory

Some of the most interesting evidence that supports this theory comes from experiments in which researchers measured subjects' autonomic responses as they were instructed to move facial muscles in specific ways. So, for example subjects were told to squint their eyes, or move the corners of their mouths in certain directions. These facial movements were intended to match certain emotions that had been catalogued by experimenters based on other observations. In addition, the experimenters had catalogued autonomic responses that were typically associated with given emotions. In one particular experiment subjects' autonomic nervous systems responses were consistent with the emotion that their facial movements represented. For example, when people were told to make facial expressions consistent with anger their heart rates increased as did there skin temperature (typical of anger), while facial muscle movements consistent with fear increased heart rate, but decreased skin temperature (typical of fear). The experiment implied that behavior indeed could **cause** emotional perceptions. Research such as this has powerful implications for us, in that it implies that we can indeed "act ourselves" into feelings, which is something that might really come in handy when we're in need of a mood change. It is also interesting to note that we may even be able to use this trick to affect the emotions of those around us, in that there is evidence that humans, even infants, instinctively imitate the facial expressions of those around them.