Aggression

by Richard H. Hall, 1998

Brain Structures and Neurotransmitters

As I discussed in an earlier module, there are two distinct types of aggression, predatory and affective. Both types of aggression involve one organism attempting to inflict emotional and/or physical harm on another. However, predatory aggression principally involves behaviors associated with food procurement at some level, while affective aggression generally involves some type of defensive behavior. Further, predatory aggression is usually inflicted on an organism of a different species, while affective aggression often involves aggression between two members of the same species and, in fact, usually two members of the same sex. Last, predatory aggression is reinforcing to the aggressor, while affective aggression is aversive. The last difference is illustrated dramatically in self stimulation research in which rats can control an electrode that is sending electrical signals to parts of their brains. When these electrodes are stimulating parts of the brain that elicit predatory aggressive behaviors, the rat will choose purposely to continue or initiate the electrical stimulation. When the electrodes are place in areas that elicit affective aggression, on the other hand, the rats will choose to terminate the electrical stimulation.

When I discussed affective aggression in an earlier module with regard to the amygdala, I pointed out that the amygdala was primarily associated with affective aggression. Although this is the case, as Figure 2 illustrates, the picture is actually more complex. The central nucleus, via the periaqueductal gray area, affects affective aggression, but the medial nucleus of the amygdala indirectly affects predatory aggression via the medial and lateral hypothalamic nuclei, while the medial hypothalamus plays a role in both. Research indicates that these are the brain structures that make up the general brain circuit associated with affective aggression.

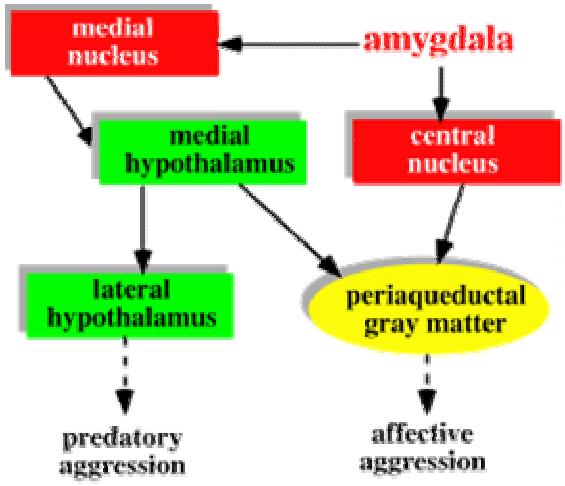

Figure 1. Role of the Amygdala in Predatory and Affective Aggression

The neurotransmitter that has been most consistently and directly implicated in both of these kinds of aggression is serotonin (5-HT). More specifically, 5-HT appears to play a role in the control of aggression. For example, destroying 5-HT neurons in the forebrain increases

aggression in laboratory animals. Further, with free ranging troops of monkeys, those that are observed to exhibit the most aggression, also have the **lowest** levels of 5-HT. In particular, these animals tend to exhibit "risky" behaviors, such as picking a fight with an animal much larger that they have no chance of beating. Indeed, such animals are also less likely to survive. Evidence that indicates that 5-HT has an inhibitory effect on aggression also comes from human studies in which people with a history of antisocial behaviors, especially aggressive behaviors, have been found to have significantly lower levels of 5-HT.

Hormones and the Sex/Aggression Connection

Hormones have been implicated as playing a role in aggression. This is particularly interesting because hormones also play an important role in sexual behavior. Although this might sound surprising on the face of it (not to mention a little disturbing) it's really not so inconsistent with the functions that the two behaviors play, especially with non-human animals. For example, a male who is successful in reproductive behavior must also be successful in defending his territory, and in establishing a level of dominance among the other males. In order for a female to be successful in reproduction, she must also be successful in the very important role of defending her young. At the level of brain structures this sex/aggression connection is illustrated by the fact that the medial preoptic area, an important area in male sexual behavior, has also been implicated as an important area in male aggression. For example, rat males who have been castrated, which, as we'll see below inhibits testosterone from activating aggressive behavior, will exhibit aggression if testosterone is injected directly into the medial preoptic area.

It appears that both organizational and activational effects of hormones are necessary to stimulate aggressive behavior in both male and female laboratory animals (and very possibly in humans). This two stage process is illustrated in Figure 2. Presumably, the organizational effects of androgens act on a neural circuit, which underlies aggressive behavior, and the activational effects of testosterone, later in life, stimulate this circuit in such a way that aggressive behavior will now be exhibited by the organism under the appropriate circumstances. Experiments in which either of these effects of hormones is inhibited support this model. Further, females rats who are closer to males rats in the womb, and consequently receive more organizational androgens, have higher testosterone levels in adulthood and exhibit more aggressive behavior, especially interfemale aggression, in adulthood.

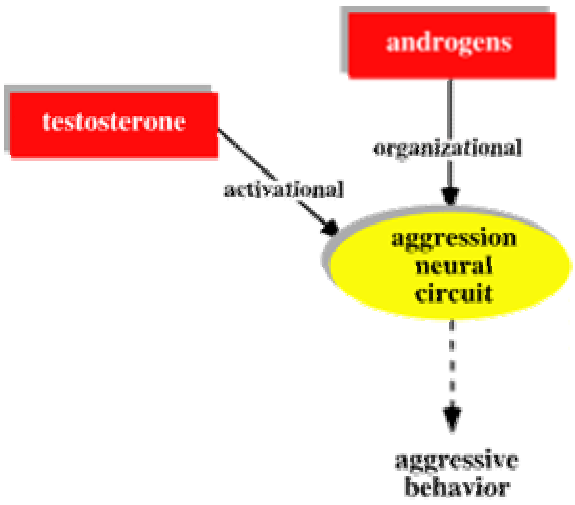

Figure 2. Organizational and Activational Effects of Hormones on Aggression