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UI Health Care News: Week of April 15, 2002

UI researcher receives grant to study connectivity in the brain

A University of Iowa researcher has received a three-year, \$660,000 grant from the National Institute of Mental Health to investigate how an area of the brain known as the amygdala is connected to other brain structures and how those neural links generate emotion and influence behavior.

The amygdala is classically defined as a small area of gray matter about the size and shape of an almond, and it has long been recognized as important in mediating emotion and behavior. However, according to Martin Cassell, Ph.D., UI associate professor of anatomy and cell biology, the classical definitions of both the structure and function of this important brain region need to be revised.

The overall aims of the UI project are to generate a new anatomical framework for understanding how the amygdala influences emotion-related behavior. Current models of the flow of information through the amygdala are linear models. Cassell hopes that data from his studies will help generate a new network-based model of how the amygdala works.

Such a model could help clarify the role the amygdala plays in generating emotion and feelings and may provide a more operational-based understanding of psychiatric illness such as anxiety and depression.

A network model, which links patterns of brain activity in terms of the whole network, could also be useful in interpreting the patterns of activity seen in functional neuroimaging in humans.

Cassell plans to investigate brain connectivity by tracing the contacts made by brain cells in the amygdala with other brain regions in rats. Cassell and his team also will use electron microscopy to closely examine the nature of the amygdala's cellular connections and determine how those connections are made and with which specific cell types.

Scientists now recognize that the amygdala is actually a complex of several brain structures. One of these structures is called the central extended amygdala and is believed to be responsible for sending out information from the amygdala to other parts of the



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[Martin Cassell, Ph.D.](#)

brain.

This output nucleus and its connections resemble the basal ganglia system of connections. The basal ganglia are a mass of gray matter at the base of the cortex that is involved in controlling complex voluntary movement and complex behavior. Parkinson's disease and other movement disorders are caused by disruption of cells in the basal ganglia.

Cassell plans to make use of highly specific antibodies now available to examine the chemical organization of the amygdala's output structure.

"It looks like the major output of the amygdala is to basal ganglia or basal ganglia-like structures and the central extended amygdala is one of three output nuclei of the amygdala," Cassell said. "Although they are not the only structures involved, I think that with the amygdala and its basal ganglia structures, we've got the basic circuitry that will be responsible for the problems of anxiety and depression."

By studying in detail the interconnections between specific cell groups in the amygdala and the cerebral cortex, basal ganglia and brainstem in rats, the UI team hopes to show that the networks centering on the central extended amygdala are organized to directly generate internal emotional states, or how an emotion "feels." The researchers believe that this information is then fed into brain areas, such as the basal ganglia, that control motivation and behavior. This hypothesis is, to some degree, the reverse of other current theories of emotion.

Cassell added that his studies aim to answer very basic questions about the amygdala.

"I am asking what is the structure of the amygdala? What operations are performed by its individual components? How are those components connected up in terms of a network?" he said.

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