# Sample Research Project Description

## Research Goals

We want to understand the development of the human visual system. This knowledge will help in the prevention and treatment of certain vision problems in children. Further, the rules that guide development in the visual system can be applied to other systems within the brain. Our work, therefore, has wide application to other developmental disorders affecting the nervous system.

We do not rely solely on animal experiments. We can obtain answers to some of the questions we pose from computer models designed to simulate various aspects of visual development. In addition, information about some of the mechanisms and molecules that might be operating in development comes from experiments on brain cells cultured in a dish. We utilize this knowledge in planning our experiments to yield the greatest amount of new information. However, our most important goal is to discover new information about the anatomy and physiology of visual pathways in the developing brain. The careful use of living animals in experiments is the only means by which we can obtain this particular information.

A major focus of our work is the pathway that leads from the two eyes to the visual centers of the brain, including the cerebral cortex. Another area of study is the pathway that links visual areas located in the two sides of the brain. In each case, our initial work is performed using normal adult animals, usually rats. Data we obtain from these adult animals are then compared with data from young, developing animals or from older animals that had abnormal visual experience early in life.

Our goal is first to understand the normal arrangement of neural connections and then to assess how genetic and environmental factors guide the formation of these connections during development. The more we learn about development of the visual system, the more we realize the importance of events that occur at the very earliest stages in the formation of the central nervous system. For this reason, much of our work involves studies of animals at, or even before, the time of birth.

## The Value of Our Research

Our experiments result in a better understanding of the biological rules that govern basic aspects of brain development in all mammals, including humans. One of our most important discoveries is that a brief critical period exists shortly after birth when visual experience permanently modifies the properties of the visual system. We could not have predicted this finding from computer models or from experiments on nerve cells cultured in a dish. This discovery helps us to understand some disorders of the human visual system such as amblyopia, also called lazy eye, a currently untreatable severe loss of vision in one eye. Amblyopia occurs when humans are exposed to abnormal visual experience early in life, during the critical period, because of disruption of any one of the delicate systems that control the focus or the movement of our eyes. Conditions that commonly produce these disruptions include an uncorrected refractive error, as in myopia or nearsightedness; a cloudy lens or cataract that is not removed; a misalignment of the eyes, such as a squint or cross-eye, that is not corrected; and irregular eye movements or nystagmus. These clinical disorders are found in over 10 percent of all children. A clearer understanding of normal brain development is a necessary step toward preventing problems like amblyopia and toward rehabilitating children who are already afflicted.

## Animals Used in Experiments

Prior to the use of any animal, all of our proposed procedures are reviewed by a committee of scientists, veterinarians, animal care technicians, and members of the local community to ensure that they conform to all institutional, local, state and federal animal welfare laws, regulations and policies. This committee has the power to ask us to modify our procedures or to halt our work if there are unresolved problems. After our use of animals has been approved, our proposed experiments are reviewed for scientific merit by a national committee of experts in this field, in competition with proposals from other investigators. For

the past 15 years, our experiments have been judged to be excellent and have received funding from various agencies, including the National Institutes of Health.

Our experiments are performed on fully anesthetized animals so that the experiments do not cause pain or distress. Veterinary staff members examine our animals daily to monitor their health and welfare. Staff members have the authority to remove from experimental use any unhealthy animal. The animal care facility in which our animals are housed is fully accredited and subject to inspection by the accrediting agency. All our technical staff and research trainees have received formal instruction in our approved techniques.

In some of our experiments we use rats that we either breed ourselves or obtain from licensed commercial suppliers. We use rats because of their short gestation period, the relatively immature state of their brain at birth and the rapid rate at which they mature after birth. They are ideal studies of mammalian brain development.

In addition, we use various mutant strains of rodents, such as those naturally born without eyes or with abnormal brain pathways, to study the effects of prenatal problems in one part of the visual pathway on the development of visual connections elsewhere. None of these mutants shows any signs of pain or distress as a result of their developmental abnormalities.

We conduct some of our experiments using mixed-breed domestic cats purchased from licensed commercial suppliers. We use cats because, like humans, they have forward-facing eyes and keen visual acuity. Indeed, there are no significant differences between the visual pathways of cats and humans. Thus, our findings on the mechanisms of brain development in cats will also apply to humans.

**Scientists Who Can Offer Assessments of Our Research**

For assessments of our research, please contact the following:

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