Millions of people around the world suffer from brain trauma, due to a stroke or other type of damage. The most common and devastating consequences of brain trauma are impairments in vision, causing patients to be partially or fully blind. These patients have problems recognizing objects and people, leading to a wide variety of severe problems in everyday routines (such as finding the way back home). While acute medical treatments of brain trauma have improved considerably in the last decades, the available procedures around the diagnosis and treatment of the long-term behavioral consequences of brain trauma have remained scarce, time-consuming, and inefficient. The aim of the proposed project is to improve diagnosis and treatment of visual impairments after brain trauma.

For standard diagnostics and treatments to be successful, the patient must be mobile (i.e., not paralyzed), have intact verbal function, and be motivated and highly concentrated. These requirements are often not met in patients with brain trauma. I propose a novel method that does not rely on these functions. We will use the eye's pupil to accurately and quickly determine a patient's visual sensitivity across their visual field, and to diagnose the extent of their visual impairment. Additionally, we will develop a technique that uses the pupil as an objective feedback tool to directly provide the patient with information about their visual capacities during stimulation of their blind fields. The newest neuroimaging procedures will be used to investigate which brain areas account for the visual restoration.

The main advantages of using pupillometry are the circumvention of many challenges that standard, subjective assessments have, and the speed up of recovery rates through biofeedback. These benefits will substantially improve the care of patients with brain trauma and ease scientific investigations into the mechanisms underlying visual impairments and recovery in neurological disorders.

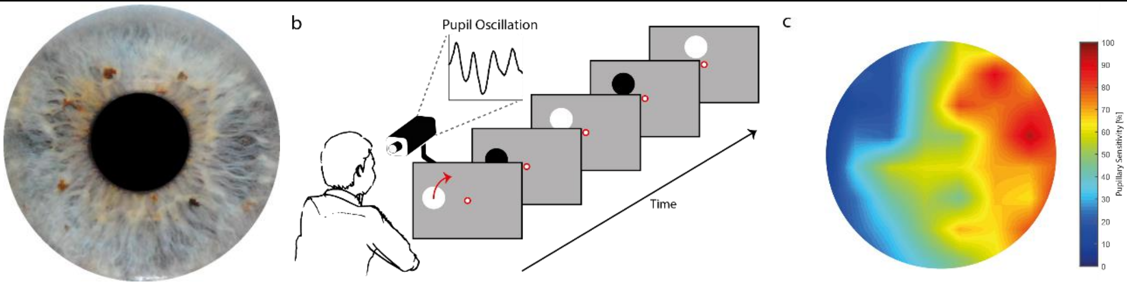

Figure 1. (a) Image of the eye's pupil. (b) Diagnosis of visual neglect and hemianopia with pupil frequency tagging method. The patients' pupil responses is recorded while they look at a moving stimulus that alternates between black and white. Stimulus movement will be slower than depicted in this figure to ensure that enough pupillary responses are collected per visual location. (c) A detailed map of pupillary sensitivity for a variety of stimuli can be created during the diagnostic test. The larger the sensitivity, the redder the color in the figure. Blind fields are thus here indicated with a blueish color (left), indicating left homonymous hemianopia.