Demonstrate the importance of the research project, specify its contribution to the development of knowledge and justify the choice of the research environment.

The project capitalizes on recent advances in the fields of FMRI, electrophysiology, and computational modeling. The project is dedicated to the following aims: 1) development of a comprehensive model to link neuronal population physiology to non-invasive imaging methods, 2) obtaining state of the art multimodal recordings from the same individuals in the service of bridging modalities and feeding the models and 3) validating the models with data from multiple modalities (ECOG, FMRI, EEG and optical recordings) and brain systems (visual, somatosensory, motor). With the envisioned comprehensive model, scientists will be better able to understand the source and nature of non-invasive recordings, dramatically reducing the levels of uncertainty that lead to apparently disparate findings across studies and laboratories.

The proposed research has direct ramifications for interpretation of non-invasive human brain research of sensory systems and functional connectivity. By explicitly modeling neuronal population responses and coupling to hemodynamics, the project will facilitate the interpretation of stimulus and task effects in sensory cortex. More broadly, by integrating multiple types of human brain research into the same models, it will facilitate coordination between researchers who use different instruments.

Specific deliverables of the project include: 1) a unique, publically available dataset of human brain activity spanning multiple measurement modalities and scales, linked by a common set of carefully controlled experimental stimuli and tasks. 2) New computational models of neuronal population activity in the visual and somatosensory cortex, implemented using public, state of the art software infrastructure. 3) Parallel, public datasets in human and rodent, including high resolution FMRI, neuronal, and optical measurements, enabling direct tests of how rodent models of neurovascular coupling translate to human.

The PIs listed on the NIH Brain Initiative grant application each represent a significant body of expertise in their field. The project is currently beginning its 3rd of five years, and significant data collection has already taken place. Therefore, my role will be primarily in data analysis and development of the computation model, which will significantly broaden my skillset. Opportunities for data collection using new modalities will also exist, including optical recordings in rodents and ECOG recordings in humans.