What are your research interests? What about this area of research interests you?

I am interested in doing research in the field of neuroscience; however, I want to do so in the new, more robust divisions known as theoretical/computational neuroscience. I find the previous approach that focused more heavily on qualitative analysis techniques of the anatomy and physiology of the brain to be limited in their ability to explore the brain and learn about its function. Application of mathematical techniques and formalism should allow for more robust arguments to be created on how the brain functions. Since Alan Hodgkin and Andre Huxley received the Nobel Prize in Physiology or Medicine in 1963 for their 1952 model explaining the ionic mechanisms underlying initiation and propagation of action potentials in the squid giant axon, it has been recognized that quantitative methods of analysis in neuroscience are tremendously advantageous. The best analysis is one that utilizes both qualitative and quantitative methods of analysis. In the last decade, researchers such as Christof Koch (formerly of Caltech, currently of the Allen Institute for Brain Science), Steven Quartz (of Caltech), Lucia Jacobs and Darlene Francis (both of Berkeley), Liane Gabora (of the University of British Colombia) have attempted to study the relationship between the brain, consciousness and the automated responses that we develop by using quantitative techniques developed to study the brain. I hope to join these researchers in attempting to study consciousness and the psyche through quantitative techniques that are advanced in theoretical neuroscience.

One of the subjects I am most interested in exploring is the emergence and development of both consciousness and the psyche within the developing brain. Is there a relationship between the structure of the brain and the emergence and development of these two? Is there a relationship between the development of the psyche and the development of what we call "consciousness"? In "Instrinsic Contexuality as the Crux of Consciousness" by D. Aerts, J. Broekaert and L. Gabora, the question of what substances experience consciousness is explored. I, too, both have wondered this and wish to explore this topic. Is consciousness only present in human primates? If not, when else does it manifest, and can it manifest in inorganic substances (if orders of magnitude weaker than it would in organic substances)? In order to study this, it is key that one study intrinsic contexuality, where irreducible and non-predictable specifics of the interaction between the substance's perturbation and the system are taken into account. The paper proposes the use of the quantum machine model to study intrinsic contexuality. While I am not advanced enough to form a conclusion on the merit of this choice, I agree with the idea of using a mathematical model to study this conceptual problem. We just have to do research to find the correct model. Another question that seems natural to ask is, did social complexity emerge and evolve over time along with the brain? "The Emergence of Animal and Social Complexity: theoretical and biobehavioral evidence" by Bradly Alicea argues yes. The argument states that lower-level mechanisms give rise to higher-level mechanisms, ultimately creating "metastable" networks of social relations. To develop his argument, Alicea defines five principles of animal social complexity and three fundamental units of social complexity to create mathematical models that show how lower-level mechanisms may do this.

Mathematical formalism is being used in much of the research concerning the brain and its tie to the conceptual world. The formalism of quantum mechanics seems a natural choice as it involves the collapse of some quantity into reality upon interaction, and consciousness and thought appear to "collapse" into reality upon interaction, that is perturbation by the system we inhibit in the form of our mere existence within it. And indeed there is research towards this as shown by, "Contexting concepts using a mathematical generalization of the quantum formalism" by Liane M. Gabora and Diederik Aerts.

They argue for the use of the state context property (SCOP) formalism to describe "the contextual manner in which concepts are evokes, used and combined to generate meaning". Through research like this we may be able to understand both how consciousness and the psyche emerge, and how the two develop as a substance continues to be "perturbed" through its continuous existence in its world. This research, and similar research, may help us understand how the emergence and interaction of thoughts affect the development of one's psyche, not just directly in the direct "interaction" but also indirectly, in how thoughts effect a substance's interaction with the environment, affecting how the environment interacts with the substance, perhaps further developing the psyche.

I am interested in developing the mathematical formalisms and models that will further our understanding of how the brain functions, and how its physical structure relates to the conceptual world that exists for substances. I hope that in the future, far or near, research advances to the point where with enough computer power it is possible to simulate human interaction. Indeed, artificial intelligence is very alluring to me. My interest stems in its ability to allow psychology, and the social sciences in general, to further study human interaction and learn more about how aspects of humanity may emerge and develop – the psyche, culture, society, etc. It may seem childish, but a "Sims" (the children's video game in which people can create characters and control them and see how they live in the virtual world) like approach to this research is what I dream of and what really excites me. This may not occur during my lifetime, but I want to quantitatively research how the brain physically functions and the implications of this functionality on the conceptual world so that we may understand human development and interaction more concretely in the future.