YOUR MORNING CUP OF NEUROPHARMACOLOGY

By Asha Tamirisa, international studies '10

PETE KARDEL IS A 2003 WAKE FOREST University graduate who is currently working on his PhD at AU in the psychology department's behavior, cognition, and neuroscience program. His current research focuses on the effects of expectancies of caffeine and nicotine use in humans. This research endeavor complements past projects he has worked on that involve the role of environment and context in drug use and research on dopamine receptor subtypes in the reward pathway of the brain.

His inspiration for taking on these projects finds its source in a neuropharmacology class he completed while an undergraduate. He felt that this field of science was much more innovative and progressive than his original interest, general biology. He began working with Professor Terry Blumenthal, studying the effects of caffeine on humans. He hit his stride in this area and decided to look for graduate programs that would accommodate his desire to pursue studies in caffeine and nicotine effects. After finding that his interests closely aligned with those of Professor Laura Juliano, he decided to participate in the psychology program at AU. It was here that he was introduced to "expectancy" phenomena and their effects on the drug experience.

In the lab, Kardel works closely with people. He begins by giving the human subject the drug (either caffeine or nicotine) and then monitors the person for various amounts of time. Kardel says, "We assess the drug's effect on mood, reaction time, attention, sleep, etc., as well as what the participants expect the drug to do or not do to them." He then compares that data to either the same person or others who have gone the same amount of time without their usual drug consumption.

Kardel says that his findings from these studies will help determine what aspect of caffeine and nicotine use is the most influential in the

drug experience. This knowledge can be used in treating drug users by focusing therapy to combat the ideas that are most significant. It is hoped that one day these results could be applied to treat the abuse of illicit drugs.

Kardel's past projects were funded from grants Juliano obtained from the National Institute of Drug Abuse. His current work is being funded by Mellon Grants.

ENTANGLED IN QUANTUM INFO THEORY

By Anneke Mulder, literature '09

GREG HUTTON (CAP MATH '07) POSSESSES a rare ability to converse affectionately about proofs and Gaussian functions. Currently, he devotes much time and many pencils to researching quantum information theory with physics professor Nathan Harshman. Asked to describe his research, Hutton pulled several pages of integrals and other equations from a thick folder. After a few aborted attempts to express the meaning of his innumerable calculations, he interrupted himself triumphantly with, "Dynamic entanglement—that sounds fancy!" In his elaboration, his genuine enthusiasm became more and more apparent.

Hutton examines the interaction of two subatomic particles. To determine the purity of the system, he puts wave functions, the representations of the particles' state, into a density operator and measures the resulting entanglement of the particles. Entanglement is a term that refers to the extent that the particles influence one another's state. This measurement is referred to as the system's purity. Purity, measured on a scale from zero to one, is the focus of Hutton's research so far.

Hutton's calculations deal largely with matrices, rectangular arrays of numbers representing systems of linear equations. In this case, the equations represent information about the motion of the particles. He works with a very important calculation in matrix mathematics called the determinant, from which can be ascertained information about the behavior of the system. The set of real matrices that have determinants equal to one is the focus of his attention. To understand the "general form of their purity," as Hutton says, he thinks of them as linear transformations. He listed the names of these two-by-two matrices—"the flipper, the squasher, the rotator, and the quasher"—with a grin and a light dose of drollery. These linear transformations change the coordinate system in which the equations are mapped, which in layperson's terms is essentially to express the equations in different terms, which allows Hutton to explore their behavior still further.

The "main interest" of the project, Hutton explained, is in describing center of mass and relative coordinates. The research is currently "completely theoretical." But the goal, he went on, is to create a "mathematical framework to pave the way for further research."

A conversation with Hutton about his research reveals a candid fervor for both math and physics. His eyes take on the distinctive polish of those who willingly immerse themselves in calculations, but he is careful not to leave his listener wandering lost in the fog of variables and hypothetical wave functions. He demanded that his listener explain his own research back to him, just to be sure his lesson was comprehensible.

After he graduates, Hutton, this self-proclaimed "advocate of TI-89," aims to get his PhD in either physics or math. As for what comes after graduate school, Hutton willingly admits that he "really [has] no idea," but that he is interested in extensive further research and that he is "really excited about fusion."