



## Kevin McCabe Virtual World Research Program

Distinguished Scholar Kevin McCabe and his students at the Center for the Study of Neuroeconomics (CSN) are using the virtual world of Second Life™ to establish a research program that uses virtual worlds as a platform for teaching economics and running economics experiments. The teaching goal is to use the immersive nature of virtual worlds to involve students in a collaborative exploration of economics concepts. The research goal is to use the persistent nature of virtual worlds to study the emergence of cultural norms and institutional formation in the infinite space of natural language messages. In McCabe's view virtual worlds are a bridge from the classroom, or laboratory, to the natural world.

The research program began with the financial assistance of IFREE and the Mercatus Center at GMU and the purchase of Terraeconomicus -- a virtual region inside the computer network of Second Life. Many skills had to be learned. For example, how to control your avatar inside the virtual world; how to manage your island, including environmental settings, user permissions, and finite computer resource issues; how to terraform your region to give it the look and feel of a geographic space; how to mold, texture, and combine prims into in-world objects; how to program scripts to give objects different behaviors; and finally, how to modify the open-source user interface to improve better experimenter control.

In 2006, Steve Saletta, a Ph.D. student at CSN, programmed the first demonstration experiment, a monopoly pricing experiment, on Terraeconomicus, and in the Fall of 2007, we began running virtual lab meetings on Terraeconomicus where we were joined by GMU Ph.D. students David Chavanne, Gavin Eakins, and Heather Leahy. It was then that we began designing and building an undergraduate course to be taught entirely on Terraeconomicus. In the Summer of 2008, we brought in four CSN summer interns, Hank Reynolds from Clemson University, Timothy Leahy from the University of Chicago, Ben Kuebrich from Wesleyan University and Justus Myers from Beloit College, to help build the course on Terraeconomicus. The course, called Economics of the Metaverse was first taught in the Spring of 2009, and undergoing continuous improvement has been taught a total of three times.

In 2008, Ph.D. students Peter Twieg and Jaap Weel (now at Facebook) joined the group, and we began to design and build our first virtual world experiments. This has resulted in the building of two research islands. On Hurricane Island we have been studying Elinor Ostrom's principles for the effective management of a commons. On Trade Island we have implemented the long distance trading experiment designed by Bart Wilson, Erik O. Kimbrough and Vernon Smith (AER 2008) to further study the effect of property rights on exchange. In 2009 we were joined by CSN intern Michael Huddelson from Georgia State who helped run the experiments in the CSN laboratory..

Many lessons are being learned from these early experiments including the need to develop expertise in natural language processing. With this in mind we invited Ph.D. student Stephan Kunath to join the group and add his expertise in natural language processing. We are now using Amazon Mechanical Turk to enlist human intelligence in classifying the conversations between subjects before, during, and after their decision making in Second Life.

A second lesson was the importance of developing the ability to teach and employ undergraduates how to program in Second Life. In this last summer (2010) we brought in two summer interns, Benjin Dunbar from Rensselaer Polytechnic Institute, and Lawrence Diao from Princeton University, who worked with Peter Twieg to first learn the Linden Scripting Language and then build scripted objects for use on Terraeconomicus. They were able to build a number of objects on Terraeconomicus including a Double Auction which was used in the Economics of the Metaverse course and taught by Peter in the Fall of 2010.

A third lesson was the need to develop a more robust virtual world platform for experimentation. In 2010 we began development of an OpenSim (an open source virtual world package) server on ReactionGrid (a virtual world hosting company) that gives us full control over the server including the ability to remote desktop into the server and save and restore virtual islands with a single OpenSim command. This together with the ability to modify the code in open source client viewers, such as the Hippo virtual world viewer, will eventually allow us to recruit subjects on Mechanical Turk, monitor them during their participation in a reaction grid experiment, and pay them using PayPal or Amazon. This new technology will allow us to collaborate with universities around the world in designing, running, and analyzing virtual world experiments.