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Inductive Metanomics:
Economic Experiments in Virtual Worlds

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Abstract

This research investigates the viability of gaining insights about the real world through conducting economic experiments in virtual worlds. This paper reviews the relevant metanomics literature, discusses the challenges and benefits of establishing a virtual experimental economics lab, and outlines the major issues associated with applying data collected in virtual worlds to answer questions about real-world behavior. Virtual experimental infrastructure enables a dramatically larger and more diverse sample than typical lab-based experiments studying college students, which can enable a more robust analysis within a given budget. However, while anonymity, variance in perceived social norms, and a low prevailing wage make virtual worlds a compelling place to study social and behavioral research, these features simultaneously limit induction of virtual data to provide insight into similar phenomena outside virtual worlds.

Keywords: virtual worlds, metanomics, immersionist, augmentationist, experimentalist.

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Introduction to Inductive Metanomics

Virtual worlds provide a wealth of opportunities for economists and other researchers who seek to generalize insight into individual behavior and decision-making. Enabled by the rise of the Internet, widespread adoption of powerful personal computers, and continuously increasing bandwidth speeds, a number of virtual worlds have emerged over the past decade. Today, a number of immersive online environments exist, ranging from middle-earth fantasy (World of Warcraft, Everquest), intergalactic combat (Entropia, Eve Online) or postmodern daily life (The Sims, Second Life, There) (Bloomfield 2007). Every day, millions of individuals make very real decisions about their virtual selves, known as avatars, and apply judgment about whether to cooperate with the individuals they encounter.

As virtual worlds become increasingly mainstream, researchers have begun to document the economic forces at work in virtual worlds as the field of "metanomics," the study of the economics of the metaverse. Accounting Professor Robert Bloomfield, of Cornell University Johnson School of Management divides the field of metanomics into three areas. Immersionist research refers to research within virtual worlds from the residents' perspective. Augmentationist research explores how real-world enterprises and individuals use virtual worlds to achieve their strategic goals. Finally, experimentalist research, which encompasses this thesis project, includes carefully controlled tests conducted within virtual worlds ranging from subtle language adjustments that induce framing effects to the tantalizing prospect of exogeneously adjusting macroeconomic variables at reduced risk (Bloomfield 2008).

The classic example of immersionist metanomics research is Indiana Telecommunications Professor Edward Castronova's 1999 article "Virtual Worlds: A First-Hand

Account of Market and Society on the Cyberian Frontier." Wisconsin-trained economist Castronova's article applies the exchange of virtual goods for real money to calculate the value of Norrath's economy despite its existence only as bytes on a server farm in San Diego, CA. Consequently, he was able to determine that in Norrath, the nominal hourly wage is $3.43/hr, the unit of currency is valued at $0.0107 and the GNP per capita lies somewhere between that of Russia and Bulgaria. As the first example of rigorous analysis of virtual economies, this article paved the way for economic analysis of virtual worlds. As virtual economies are storehouses of billions of dollars of value, analyzing the economic forces within these worlds is itself a relevant subject in its own right. However, aside from analysis of real-money-transfer (RMT), economists have been heavily underrepresented in contributing research about this space.

In contrast with immersionist research, augmentationist metanomics studies how individuals and organizations leverage virtual worlds to meet their real-world objectives. One example of this type of research is Robert Bloomfield's weekly virtual talk show, Metanomics, which explores the business and policy issues of virtual worlds such as the fallout from Linden Labs' abrupt change in banking regulations made in January 2008. Industry research includes a recent Gartner publication that concluded that 90 percent of corporate virtual world projects fail within 18 months due to lack of clear objectives and poorly defined user requirements, but over time virtual worlds could have as large an impact on organizations as the Internet (Gartner 2008). Arguably all individuals active in virtual worlds, even the most diehard role-players, are there for some augmentationist reason. Indeed, though individuals flock to virtual worlds for a variety of psychological reasons, all such motivations still reflect a conscious decision to log on and an ongoing choice to continue to spend time and effort to participate in virtual worlds.

Bloomfield's final category of metanomic research is experimentalist, which includes measuring the effects of the deliberate exogenous changes on agents' decisions. However, as experimentation is really a method rather than an approach, one could further divide such research as either immersionist experimentation or augmentationist experimentation. Immersionist experimental research is descriptive of behaviors within a specific virtual world and augmentationist experimental research seeks to leverage the benefits of virtual world experimentation to provide insight about real-world behavior. Though immersionist experimental research is valuable in its own right to explore how individuals behave in virtual settings, greater scientific significance results when virtual worlds can contribute to the dialogue about real-world behavior by replicating known experiments in the new setting with a more diverse population, or designing experiments that leverage the unique properties of virtual worlds to study questions difficult to measure in physical labs.

While several notable academics such as Robert Bloomfield and Ted Castronova have called for experimentation through virtual worlds, few true economic experiments have been conducted. One notable exception is a 2007 article by Chesney, Chuah, and Hoffman, who chronicle their experience replicating classic economic experiments including the ultimatum, dictator, public goods, minimum effort, and guessing game. Using sample sizes between 4 and 30 pairs, their experiments are more concerned with replicating classic experiments rather than leveraging the technology to drastically increase the amount of data collected. Their results are generally consistent with findings from physical labs, attributing discrepancies to demographic differences of virtual and undergraduate populations.

Additionally, David Abrams and John List of the University of Chicago are reportedly currently conducting research quantifying the differences between experiments conducted virtually and in labs. According to the July 6, 2007 Chronicle of Higher Education,

> List, who often runs field experiments in microeconomics, says that if he sees people in some tests behaving the same in real-world and virtual environments, he will consider doing more studies in virtual worlds, because they are more cost-effective. "For certain types of games, like bidding and auctions, I think that will generalize quite easily across the virtual world to the lab," he says. Other studies, though, may work only in face-to-face laboratories. "Behaviors are influenced by whether people can link your identity to your behavior," says Mr. List. "In the virtual world, I think, you're virtually free of these reputational concerns, so you might get people acting in a more self-interested way."

A phone conversation with Abrams confirmed that their work involves 1) experiments such as testing the same set of subjects both in Second Life (SL) and in a lab to see if their choices differ, 2) testing changes in the physical environment, such as the color of walls or wording of instructions, to see how this influences agents' choices, and 3) manipulating the subject pool within the virtual worlds to determine how that affects the outcome. Abrams reports that he is interested in creating contracts that offer proper incentives for completing transactions in virtual worlds in the absence of an effective authority to mediate disputes (Personal Interview, 2008).

While Bloomfield provides a useful framework in order to interpret recent economics research, some research appears to fall outside the boundaries of these three categories. Simple demographic studies of virtual world residents or more subjective psychographics used by marketing researchers do not fit in Bloomfield's paradigm. Additionally, virtual worlds could provide insight into a host of social science research questions through econometric analysis of the terabytes of related data automatically collected by their servers. However, all of these research areas appear to fall outside his metanomics framework unless we expand experimentalist metanomics to include non-experimental metanomics research studying real-world issues. Perhaps a concept such as "inductive metanomics" would suffice to refer to the application of data obtained from virtual worlds to provide insight about the real world. In this context, experimental metanomics is but one method to provide such intuition.

In the process of conducting inductive metanomic research in the form of virtual experimentation, it is worth emphasizing the abundance of unanswered questions limiting the insights carried from the virtual world to the real world. While internal validity issues are paramount in developing meaningful research methods for both immersive and augmentationist inductive metanomics, ecological validity is particularly important in assessing whether observations from virtual worlds are appropriate to provide any insight to reality.

Motivating a Virtual Experimental Economics Lab

Experimental economics poses the significant obstacle that researchers must develop their own data sets in order to explore individual economic behavior. One constraint is the high cost of providing test subjects with sufficient payment that not only compensates them for their time but also offers additional incentives to drive their decisions in the experiment. This has impaired the pace at which economic theory has adapted the neoclassical economic assumptions

driving many models with observations from other social science fields. Recruiting and compensating participants from virtual worlds at a lower cost presents an opportunity to leverage experimental funding for a more robust analysis, made possible through a larger data set drawn from a more diverse pool as compared to the typically sampled college student population.

Using traditional lab based methods, even a short experiment is expensive to finance. At $15 per subject, a $1,000 budget can be expected to finance at most 66 participants that produce 33 observations. It is worth noting that many previous studies suffer from a small sample size due, in part, to cost constraints. In contrast, this study creates a 'virtual lab' infrastructure to collect data from nearly 1,500 participants. The methodological key element is the use of a novel recruitment and compensation strategy that exploits the fact that a large number of users in the virtual online platform, Second Life, are willing to participate in return for the virtual currency, called Lindens, which is exchanged with the US dollar at an exchange rate of 265 to one.

Acting in virtual worlds defined by player created content, online 'gamers' explore a virtual environment embodied as an avatar, their in-game 'self.' As network technology evolves, online games can connect more users simultaneously while faster Internet transfer speeds allow more robust fantasy worlds. This provides an increasingly engrossing environment for gamers, who often work for hours to acquire money that exists outside the virtual world only as bytes in a computer server. Meanwhile, through established virtual-to-real currency exchange vendors, it is possible to buy a large amount of in-game currency. By stimulating participants using this inexpensive in-game currency, a research budget can be applied to answer behavioral questions by motivating gamers to react to experimental incentives as if they were in a lab setting, but at a fraction of the cost.

Constructing the Virtual Lab

Developing a virtual lab for conducting economic experiments presented a number of practical considerations not typicalfactors in an experiment's design, including the selection of an appropriate virtual world, selecting a site, and developing the experimental apparatus. Once these issues were addressed, the study could turn to the more common methodological specifications such as recruiting participants, compensating them, and executing the substance of the experiment.

Virtual World Selection

A variety of available virtual worlds presented an important strategic decision in conducting this study. Virtual worlds vary widely by demographics, culture, structure, and economic integration. While demographic and cultural considerations were not important factors in the selection of the world, structure and economic integration were crucial factors in meeting IRB - Institutional Review Board's ethics requirements as well as developing lab infrastructure fully integrated with the virtual world.

"Structured" worlds, such as Blizzard Entertainment's World of Warcraft (WoW) are driven by content created by developer. Conducting an automated experiment in a structured world required either the development company to create content specifically for the purpose of the experiment or for interactions to occur strictly outside the virtual world in a website. As the

World of Warcraft economy is officially closed, subjects' payments would be delivered through informal currency vendors operating against the wishes of Blizzard Entertainment. The IRB required that the research plan could not violate the Terms of Service (ToS) of the virtual world provider, which in effect prevented the use of World of Warcraft because it lacked a sanctioned real-money trading (RMT) mechanism. Consequently, if the experiment had been implemented in this space, it could have subjected participants to significant unnecessary risks such as account termination. Thus, World of Warcraft presented a unsatisfactory environment for conducting experiments through a virtual lab.

Alternatively, the "unstructured" world of Linden Labs' Second Life is defined by the content created by the users themselves. This allowed for the creation of a virtual lab with all subject-facing content existing inside the virtual world without the necessity of involving the game developers themselves. Additionally, the ethical concern present in WoW was eliminated by the fact that the Second Life economy was "open" through sanctioned RMT transfers of the virtual currency, Lindens (L$). In fact, the scripting language used in Second Life allowed for the automatic payment of subjects. The combination of these factors presented a much more promising environment for developing a virtual lab infrastructure. Therefore, Second Life was selected as the site of the Tufts University Virtual Experimental Economics Lab.

Selecting and Constructing a Site

The diversity of environments available in Second Life provides an abundance of choices for the selection of a virtual lab site. Spanning over 65,000 acres and constantly expanding, the environment of Second Life is limited only by the imagination of its residents, including private beachfront residences, shopping malls of an urban metropolis, zombie-infested streets of a twisted future, or the hallowed lecture halls of academia (Linden Labs, 2008).

The ideal environment of a lab would be a dedicated island in which the terrain is built from the ground up and the entire space can be defined according to the needs of the researcher. However, such a construction would not be possible without a larger budget: after a 50% discount given to real-world academic institutions, islands are priced at $840 for 16 acres, plus $150 monthly land fees (Linden Labs, 2008). In the absence of access to such great resources for what amounts to an exploratory study, we are left with the option of renting space within the established islands of Second Life.

For the purposes of conducting exploratory research in a foreign space, one of the most critical elements of conducting research was the availability of a local community who could assist with the practical tasks associated with constructing the lab. Etopia Island emerged as a suitable location with an appropriately sized office space in which to construct the lab. The owner of Etopia Island, Williamthewise Goodman, describes Etopia as "Second Life's premier environmental eco-village showcasing real-life examples of sustainable development, renewable energy, organic living and authentic community." The particular draw to Etopia was the members of the community, most notably Jojogirl Bailey, who willingly answered the experimenter's "noob" questions about navigating Second Life's notoriously painful user interface. Additionally, Etopia was home to a labor force of talented "builders" such as Prim Chemistry, who helped convert the office space to include the décor of a virtual lab, complete with fluorescent lighting. Meanwhile, for the island's managers, the lab presented an important

revenue stream and a way of drawing traffic to their community which they continually aspire to grow.

For the purposes of an exploratory study, the objective was to develop a functioning lab. It is certainly not the case that Etopia Island was the only available option. One could rent a kiosk at a virtual shopping mall, but that comes with a greater loss of control over the stimuli exposed to subjects. Additionally, researchers could rent a variety of other spaces according to their needs; most would probably find a more isolated location to be more appropriate to their needs once they become comfortable with Second Life development tools. Below, images of the Tufts Experimental Economics Lab.

Developing the Experimental Apparatus

Figure 1

In order to interact with Second Life residents and automatically collect data, a script was developed through the expertise of Stefan Bornhofen, a computer science doctoral student at the University of Paris. Using Linden Script Language (LSL), a C/Java-style language, we developed a "chair" (see figure 1) with an internal script that automatically 1) confirms that participants are at least 18, 2) displays and captures consent to participate, 3) ensure avatars participate only once, 4) administers different versions of the instructions to comprise several treatments, 5) asks a series of follow-up demographic questions, 6) automatically compensates participants, and 7) sends the data to a centrally managed SQL -Structured Query Language - database.

The ability of our apparatus to communicate with users was limited to either text at the bottom of the screen or a blue box at the upper right. While both options could be fashioned to collect the desired data, the blue box seemed to be a better choice. In contrast with the standard chat text used to communicate with other players, the blue box conveyed greater anonymity of players' selections and had user-friendly buttons instead of requiring a more complex syntax to "whisper" with the device. The picture below shows the typical appearance of this interaction method with users.

In the figure 2, above, we see a screenshot of the apparatus interacting with the user through the blue box in the upper right corner.

Recruiting and Compensating Subjects

Subjects were recruited through the placement of classified advertisements in Second Life. Classified ads are browsed by users looking for new areas to explore in Second Life. The full announcement read:

> Earn L$100-400 in Academic Study
>
> Interested in earning some quick Lindens? Come to our economic research lab to participate in a 15-minute academic research study on virtual decisionmaking. If you are over 18, you can earn L$100-400. This project is sponsored by Tufts University and is part of a master's thesis - your responses will not be used for marketing purposes. Places are limited, so come now to ensure you do not miss this opportunity!
>
> (Some keywords: test subject, test subjects, experiments, free lindens, research, linden, earn, job, work, participate, win, clothes, clothing, furniture, skins, skin, pay, buy, sell, event, newbies, newbie, events, shop, new year, cheap, deal, sale, easy job)

These keywords are included in the recruitment ad to help increase the frequency it is viewed. SL residents search the classifieds by keyword and the results are sorted by the amount of money paid by the advertiser. Bidding around L$5, 000 per week (around $18) ensured a prominent placement. Once subjects read the announcement, they followed a link that teleported their avatar directly to the lab.

Compensation occurred automatically based on decisions made by the subjects and their counterpart. Participants were exclusively paid in Second Life's virtual currency, which carried

an exchange rate of roughly 280 Lindens per USD. It is worth emphasizing that the offer of L$100-400 has an explicit value between 35 cents and $1.40 for 15 minutes of time. Nevertheless, this is a relatively well-paying job in Second Life. Consequently, demand to participate in the experiment was exceptionally strong; a test of the apparatus with only one available chair exhibited such an abundance of willing participants fights broke out between avatars over who could participate in the experiment next, with subjects ejecting each other from the apparatus.

To keep up with demand, three chairs were included in the full implementation of the virtual lab. This raised a host of additional questions, most notably how to ensure that participants do not participate more than once. Solving this problem required communication between the scripts and a central SQL database. The final version of the script confirmed that the avatar had not participated on another chair previously.

Discussion

Limitations

This experiment was rife with potential sources of experimenter bias because of its automated construction and lack of a present administrator. On many occasions test subjects spoke to each other or reported that they thought they knew who their partners were. While it was soon corrected by adding additional chairs, some data could have been compromised due to conflict over who was next to use a single available apparatus. In one known instance, a male subject was propositioned for sex while participating in the experiment, with ambiguous consequences. Further experiments could benefit greatly from starting with a more established virtual lab, by hiring a monitor (or simply chat logging) to better document such incidents, and by running experiments in a larger space that allows participants greater privacy.

One major methodological concern with collecting online data is the impact of truth-telling. Theoretically, users are induced to be honest about their preferences regarding their economic decisions with actual fiduciary consequences, as was the case with the main experimental question. However, it is unclear how users valued the virtual currency relative to its real world value, which could distort their choices. Additionally, in contrast with the main experiment question, whether participants accurately provided their demographic information remains a mystery. As David Garman commented while reviewing such data, "I think there is information in the first life answers, but I don't know that it corresponds to the truth." This could conceivably be investigated, in part, by providing a list of avatar names as well as their birth dates and gender to contacts at Linden Labs, the producer of Second Life, who may be willing to report aggregate levels of accuracy of these responses. However, this verification would require modification of the consent form, which is not possible after the fact.

Another method is to infuse demographic questions to include extremely unlikely options to help flag users who may be providing inaccurate demographic data. While the data has not been cleaned for such unreliable demographic data, it would be important to remove the "junk data" before conducting a more rigorous analysis of the provided demographic data.

Additionally, there may be some selection bias present due to users who did not complete the experiment or completed it multiple times. The fact that over 80% of users who started the

15-minute experiment continued to participate through the end is a promising sign about the former concern. As for the latter, users were prevented from participating more than once with the same avatar, but as their identity was not verified, they could not be prevented from participating again under the guise of another avatar. However, while the large sample size most likely corrects for internal validity issues, overrepresentation in the group who did not complete the experiment could limit its external validity in generalizing to the broader Second Life population.

In sum, there is a lot more research that can be completed by establishing best practices in virtual experimentation and stimulating truth-telling, and this study attempts to help build that foundation.

Answering the Critics

Prior to this research being presented, published, or discussed openly, debate had emerged over the use of this methodology. Most notably, John Duffy of the University of Pittsburgh Economics Department has written a working paper criticizing the reliability of data collected from experiments in virtual worlds, citing heavily the lab developed for this research as his case study (Duffy, 2008). Certainly, there are some unresolved methodological concerns with gathering data in online settings. However, it is important to weigh these costs against the benefits of online research.These methods allow us to test the external validity of general principles by experimenting on a different subject pool than the usual undergraduates; additionally, the combination of automated data gathering scripts and a population who are willing to participate at a fraction of the normal cost allows samples to be dramatically larger. The end result was that online methods allowed the collection of over 1,200 data points over two months on a graduate student budget, realizing a 95% cost savings compared with more traditional laboratory methods. This allowed evaluation of five treatments on this subject pool and the teasing out of more subtle factors that influence behavior that might not be detected in a smaller sample.

Duffy's objections to the virtual experimental methods used in this study appear to be:

1. Data accuracy. Subjects can be dishonest about their demographic information and are more likely to do so compared with real life.

2. Selection Bias. There is little control over people who show up to participate and their knowledge of economics, and the low stakes nature of the experiment may result in some subjects dropping out prematurely.

3. Identity Mapping. "There is little control over whether the same individual is logged in on multiple machines, under different identities, perhaps playing a two-person game with himself."

It is important to note that even if the demographic data may not be perfectly accurate, the substance of the experiment was about subject's behavior during the trust game. On this issue subjects were making decisions with real (in virtual terms) stakes about which they would be truthful. For example, while Duffy did not feel compelled to be accurate about his age and gender, he indeed answered the core experiment question on trust with what he truly believed to

be the "best" course of action. Other participants' selections provided results that were consistent with the trust and reciprocity effects observed in the 1995 Berg, Dickhaut, and McCabe experiment, in contrast with the subgame-perfect equilibrium expected by neoclassical economic assumptions.

What remains of questionable data integrity, however, are the 28 demographic and background questions that followed the experiment. Indeed some (17%) of participants did not choose to complete the experiment and followup questions. These "partial" data points were dropped from the resulting analysis. Whether patterns in peoples' decisions to drop out prematurely does indeed affect the outcome is a matter that could be tested by further experiments and data analysis.

While the followup questions were indeed not for "extra payment," it is not accurate to say that there was no incentive to complete the survey aspect of the experiment because subjects were required to complete the questions in order to receive any earnings from the prior question. Nevertheless, Duffy's concerns about the accuracy of subjects' responses is noted and is a real practical consideration in the design of experiments in any setting. In online experiments (both in virtual worlds and in web-based experiments), the absence of an authority could result in users providing inaccurate information on their demographics. One possible way to assess the accuracy of the demographic data would be to verify aspects of the data with previous data provided to Linden Labs (though this was not possible in this study due to the limitations of the confidentiality agreement provided to subjects. Hence I suggest that future experimenters insert a clause into such agreements that would allow them to share the data with the virtual world management company for validation purposes). However, this does beg for further research into mechanisms to elicit truth-telling in anonymous online settings.

Duffy's final concern is that "there is little control over whether the same individual is logged in on multiple machines, under different identities, perhaps playing a two-person game with himself." In anticipation of this, our script prevented individual avatars from participating in the experiment more than once. We also used a delay mechanism between matched players so subjects would not know the identity of their counterpart. These two features made a two-player game with oneself practically impossible.

Underlying this concern, however, there is a legitimate issue about players' use of alternate characters, known as "alts," to participate in the experiment multiple times using different avatars, a practice described earlier as *experiment farming*. This can sometimes be manually cleaned by noticing obviously duplicated avatars with names such as "Po Potez," "Po1 Potez," etc. My experience is that such experiment farming is most prevalent when participants are offered a large reward for participating in a relatively short experiment.

In closing, Duffy has identified some very real concerns to be addressed in designing effective virtual experiments. In truth, I think he is just scratching the surface about the issues that virtual experimentation needs to overcome. However, to invalidate these methods while in such a nascent state would be an overreaction. I believe the solution is to expand academic inquiry into experimentation in virtual worlds and develop better tools for collecting online data. In the meantime such confounding issues should certainly be addressed by researchers, and the field is wide open for the design of experiments to demonstrate the dimensions along which subjects behave differently in virtual worlds and the real world.

Opportunities for Further Research

Based on the experience gained during this thesis project, a number of open research threads are currently available. These can be broadly categorized into 1) improving small-scale virtual lab infrastructure to eliminate confounds and reduce bias, 2) determine the dimensions by which virtual decision-making departs from decisions in physical labs by replicating established experiments in virtual settings and comparing outcomes, and in this context, 3) applying new technology to answer questions impossible or unethical to investigate in physical labs.

The first area of open research in virtual worlds is in improving the virtual lab infrastructure to support higher quality experiment design. It is suggested that data collected through virtual lab infrastructure embody the following improvements in the design executed in this research project:

1. Randomize between treatments on each chair, or at least cycle between them in a manner to increase consistency.
2. Hire "Observer" / "Monitor" to greet participants and document potential incidents. However, I note that including a monitor introduces a new variability that cannot be scripted practically nor documented fully. My future experiments will likely have a chat logger in use to catch the most egregious incidents.
3. Explicitly assure users of the anonymity and confidentiality of responses. Ask separate questions for "Second Life" and "Real Life" demographic info.
4. Provide full assurance that participants are not partnered with anyone currently in the lab. Also, when dealing with a large group, be extremely clear as to exactly when subjects will be paid.
5. Repeat their answers at the end of the experiment for subjects to confirm their answers.
6. To the extent possible, it is advantageous to have cubicles to seclude subjects' avatars from others in the lab. While they could still conceivably communicate with each other or send instant messages, this more clearly communicates our expectations for silence and prevents unwanted intrusions during the experiment.

Additionally, further virtual experiments could draw on the best practices of the marketing community. Market Truths Ltd. Managing Director, Dr. Mary Gordon, mitigates the effects of those who provide inaccurate answers online through a variety of methods, with the most applicable practices including:

1. Require that people had been in Second Life for at least 30 days.
2. Require respondents to have a verified account.
3. Apply quality control checks, such as consistency checks across multiple small samples and algorithms to identify and remove points of likely "junk" data, as the majority of inaccurate data is provided by a small portion of survey participants.

While developing more consistent methods of conducting virtual experiments in the context of inductive metanomics, one topic that deserves special mention is the virtual behavior bias. This includes the fact that there is a different population in virtual worlds than the real world, as well as the possibility that individuals behave differently online. Consequently, it is yet unclear how an individual's judgment and decision-making processes differ when mediated through technology. For example, there is some initial evidence that social distance is negatively

associated with reciprocity (Charness, Haruvy, and Sonsino 2006) but there remain other aspects of virtual association that are yet unexplored. Better understanding of the dimensions of these differences have immediate payoffs in modeling consumer behavior, and also provide enhanced context for additional research to address the heavy external validity issues when engaging in inductive metanomics.

The final area of open inquiry, applied inductive metanomics, is the most intriguing and unbounded. This includes the development and application of new technology to answer questions impossible or unethical to investigate in physical labs. Nick Yee's research on the Proteus Effect is an excellent example of research leveraging the unique properties of virtual worlds to provide insight into real-world questions. He showed an association between perceived body size and aggressiveness after controlling for actual body size by disconnecting subjects' perception of their avatar's height and its actual height (Yee 2007). Another example is that while ethical considerations preclude a trust game experimental design with partners known and present in physical labs due to the threat of fights, virtual worlds could help investigate this effect while mitigating the risk to participants. The above examples would utilize the avatar as the key technological enabler, but other elements of virtual worlds could be similarly utilized for scientific inquiry. Perhaps the most exciting applications will arise from the array of political, economic, and macroeconomic questions that could be explored through the abundance of willing test participants motivated cost-effectively through the virtual currency premium.

It is too early to determine whether virtual world experiments emerge as a revolutionary tool or an interesting diversion. Certainly, there are benefits to be gained from the fact that virtual worlds reduce barriers to conducting experiments. At the very least, virtual labs can provide a pre-test to investigate novel theories without a large expense. Similarly, with the proper guidance, students could design and execute experiments of their own as a class exercise, through the use of virtual world methods. However, the key issue of establishing data collected in virtual worlds as a valid laboratory for testing real-world theories will take a significant amount more research into developing virtual research methods, understanding virtual behavior, and crafting novel research questions to best utilize virtual experiments.

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Bibliography

Abrams, D. (2007). A Primer on the Economics of Virtual Worlds. *Working paper, University of Chicago Law School*..

Bloomfield, R. (2008). Blast from the Past: Metanomics 101, Revisited. *Metanomics 2008 – Business and Policy in the Metaverse.* Jan 29 2008.

< http://www.metanomics.net/29-jan-2008/blast-past-metanomics-101-revisited >

Bloomfield, R. (2008). Worlds for Study: Invitation; Virtual Worlds for Studying Real-World Business (and Law, and Politics, and Sociology, and…). *Working paper, Johnson Graduate School of Management, Cornell University.*

Castronova, E. (2001). Virtual Worlds: A First-Hand Account of Market and Society on the Cyberian Frontier. *Working paper, Department of Telecommunications, Indiana University Bloomington.*

Castronova, E. et. al. (2008). Synthetic Worlds as Experimental Instruments. *Video Game Theory Reader II*. Routledge. Spring.

Charness, G.; Haruvy, E. & Sonsino, D. (2007, May). Social Distance and Reciprocity: An Internet Experiment. *Journal of Economic Behavior & Organization.* 63.1 : 88-103.

Chesney, T.; Chuah, S. & Hoffmann, R. (2007). Virtual World Experimentation: An Exploratory Study. *Working paper, Nottingham University Business School*.

Duffy, J. (2008). Trust in Second Life. *Working paper, Department of Economics, University of Pittsburgh.*

Gartner Inc. (2008). Gartner Says 90 Per Cent of Corporate Virtual World Projects Fail Within 18 Months. *Press Release*. May 15, 2008.

< http://www.gartner.com/it/page.jsp?id=670507&format=print >.

Gordon, M. (2008). Follow Up Comments. *Griefers in Virtual Research and the Truth Serum.* Metanomics. March 2008.

< http://metanomics.net/25-mar-2008/griefers-virtual-research-and-truth-serum#comments >.

Linden Labs. (2008, Feb.). Land: islands. *Second Life I Land: Islands*.

< http://secondlife.com/community/land-islands.php >.

Linden Labs. (2008, Feb.). The World. *Second Life | The World.*

< http://secondlife.com/whatis/world.php >.

Linden Labs. (2008, Jun.) Private Region Pricing. *Second Life | The World.*

< http://secondlife.com/land/privatepricing.php >

Yee, N. & Bailenson, J. (2007). The Proteus Effect: The Effect of Transformed Self-Representation on Behavior. *Human Communication Research*, 33, 271-290.

< http://www.nickyee.com/pubs/Yee%20&%20Bailenson%20-%20Proteus%20Effect%20(in%20press).pdf >.

Recommended Resources

1. Virtual-Economy.org carries an extensive bibliography on academic papers on virtual economics, with a focus on real-money trade and virtual property.

http://virtual-economy.org/bibliography

2. Rob Bloomfield's *Metanomics* is a weekly broadcast about business and policy issues affecting the metaverse. http://metanomics.net/

3. Terra Nova often carries articles and discussions of interest to virtual economic researchers. http://terranova.blogs.com/

4. Second Life Research Listserv (SLRL) and Virtual Worlds Research Listserv (VWRL) are mailing lists of virtual world researchers. These links are

http://list.academ-x.com/listinfo.cgi/slrl-academ-x.com and
https://utlists.utexas.edu/sympa/info/vw-research