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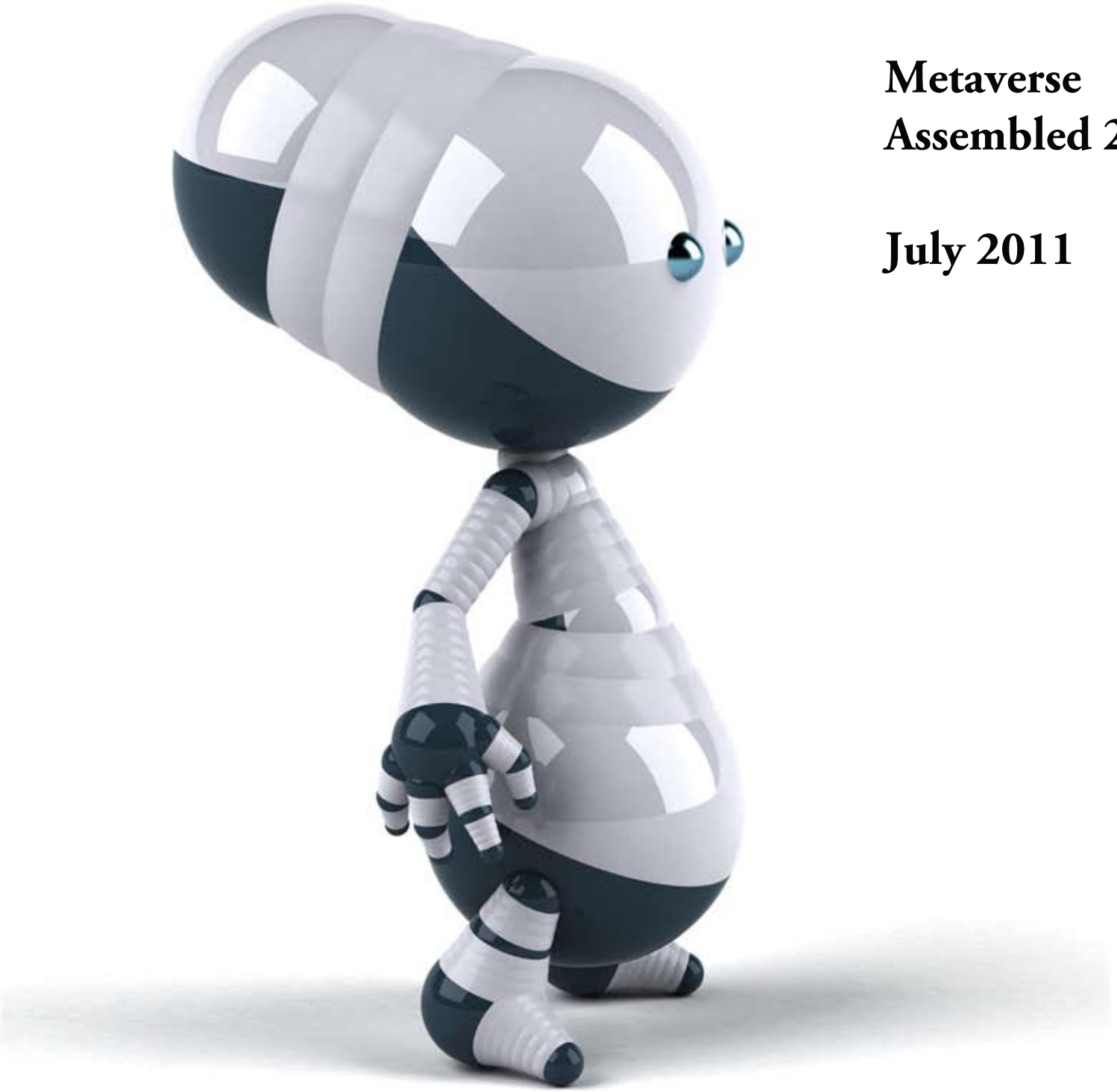

Metaverse Assembled 2.0

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The P.R.O.S.E. (Psychological Research on Synthetic Environments) Project: Conducting In-World Psychological Research on 3D Virtual Worlds[1]

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Abstract

The P.R.O.S.E. (Psychological Research on Synthetic Environments) Project was established to investigate the psychology of 3D virtual worlds. Under the auspices of the project, a systematic program of in-world behavioral research is being conducted that addresses three core questions related to the psychology of 3D immersive environments: What are the characteristics of active participants in virtual worlds? Do the principles of psychology that operate in the real world also apply to the virtual world? Do experiences in the virtual world have the capacity to influence behavior and subjective experience in the real world? The current paper describes a series of studies that examine each of these questions and outlines future directions for the project. If projections for a highly populated, ubiquitously accessible (web-based), and seamlessly integrated (interoperable) network of virtual worlds are borne out, a new realm of psychological reality and interaction will have been created that will be increasingly important for behavioral scientists to investigate and understand.

Keywords: Psychology, Internet, Virtual Worlds, Second Life

[1]An earlier version of this paper was presented at the 2010 SLACTIONS Conference in Second Life and received one of four "outstanding paper" awards for the conference.

The P.R.O.S.E. (Psychological Research on Synthetic Environments) Project: Conducting In-World Psychological Research on 3D Virtual Worlds

Richard L. Gilbert
Loyola Marymount University

The Historical Context of P.R.O.S.E.

In recent years a new phase or "iteration" of the Internet and World Wide Web - the Immersive Internet and Web 3.0/3D - has been emerging. In this latest phase of cyberspace, individuals go beyond accessing information via static web pages (The Informational Internet and Web 1.0) or interacting via chat rooms, blogs, wikis, and social networking sites (The Interactive Internet and Web 2.0) and construct avatars (i.e., 3-dimensional digital representations of the self) that operate within intricate, increasingly vivid, online environments, a number of which involve global communities or "virtual worlds" comprised of tens of millions of resident avatars. Collectively, this network of 3D virtual environments is referred to as the "Metaverse" – the digital equivalent of the physical universe. Extending this analogy further, the rapid proliferation of these 3D communities and the explosive growth in the worldwide population of avatars (now over 1 billion, see http://www.betterverse.org/2010/10/kzero-over-1-billion-virtual-world-users-half-under-age-16.html**)** has led me in several presentations to refer to the formation and growth of the Metaverse as "The Second Big Bang." Simply stated, the expansion of 3D virtual worlds and the Metaverse is creating a parallel, competing context for human interaction.

Considerations of virtual worlds and the Metaverse most often focus on the *computer science* that underlies the creation and operation of 3D virtual platforms, the *graphical interface* that determines its aesthetic qualities and sense of realism, and the social, educational, artistic, and commercial *applications* that structure the activities of its users. However, the advent of interactive, 3D graphical environments, like other radical innovations in media and communications such as radio, telephony, television, and personal computing, is a technical advance with major *implications for human psychology and culture*, particularly in the areas of social interaction, personality, and identity (Gilbert, 2009).

In response to these techno-historical changes, the P.R.O.S.E. Project was designed to serve as a leading research center investigating the psychology and culture of 3D virtual worlds and the Metaverse. Moreover, the P.R.O.S.E. Project is not only conducting a systematic program of behavioral research on the Metaverse, it is taking the step of executing this research in a fully-functioning laboratory housed *inside* the virtual world, within the "natural" ecology of avatars.

The P.R.O.S.E. Project: Mission and Goals

In recognition of the psychological significance of interactive 3D graphical environments, The P.R.O.S.E. (Psychological Research on Synthetic Environments) Project was formed in 2008 to conduct a systematic program of empirical studies on the psychology of virtual worlds. While the definition of what constitutes a virtual world is a subject of controversy, a virtual world can be defined as a digital environment that:

- Has a *3-D Graphical Interface* (an environment with a text interface alone does not constitute a full virtual world.)
- Supports *Massively Multi-User Remote Interactivity* (simultaneous interactivity between large numbers of users in remote physical locations.)
- Is *Persistent* (the virtual environment continues to operate even when a particular user is not connected.)
- Is *Immersive* (the environment's level of graphical realism creates an experience of psychological presence. Users have a sense of "being inside," "inhabiting," or "residing within" the digital environment rather than being outside of it, thus intensifying their psychological experience.)
- Emphasizes *User-Generated Activities and Goals*. (In contrast to immersive games, where goals -- such as amassing points, overcoming an enemy, or reaching a destination – are built into the program, virtual worlds provide a more open-ended setting where, similar to real life, users can define their own activities and goals. However, there are some immersive games such as World of WarCraft that include specific goals for the users but are still psychologically and socially complex. These intricate immersive environments stand at the border of virtual games and virtual worlds.)

In investigating the psychology of virtual worlds, three broad areas of research have been defined within The P.R.O.S.E. Project:

1. *What are the characteristics of active participants in virtual worlds* (i.e., their demographic, social, personality, behavioral, and mental health characteristics)?
2. *Is there cross-realm generality or specificity*? Do the principles of psychology (i.e., of behavior and subjective experience) that operate in the physical world also operate in the virtual world?
3. *Is there a capacity for psychological influence*? Do experiences in virtual worlds have the capacity to influence behavior and subjective experience in the physical world?

P.R.O.S.E. Labs in Both the Physical and Virtual World

The P.R.O.S.E. Project has a presence in both the physical and the virtual world. The *physical lab* is housed within a university psychology department and contains a set of workspaces with computers equipped to efficiently run the graphically intensive programs that operate 3D virtual worlds. The *virtual* P.R.O.S.E. lab is located in the virtual world of Second Life. It is specifically housed within the Institute of Virtual Studies, one of the major structures

within the Psychology Island region of Second Life that was designed and constructed by the P.R.O.S.E. Project. While the P.R.O.S.E. Project is interested in studying the psychology of virtual worlds across the full range of platforms, a decision was made to base it within Second Life because this setting currently offers the most psychologically and culturally rich immersive environment within the Metaverse. Hopefully, in the future there will be interoperability between platforms and it will be possible for a lab based in one platform to use avatars from other immersive worlds without having to fund and operate multiple virtual labs.

Figure 1 The Institute of Virtual Studies, LMU Psychology Island, Second Life (http://slurl.com/secondlife/LMU%20Psychology%20Island/98/113/22)

The P.R.O.S.E. lab in Second Life is equipped with 30 computer stations consisting of a virtual computer, desk and chair. Avatars who come to Psychology Island to participate in a research study are prompted (either by an avatar research assistant or a digital notecard) to sit at one of these stations and click on the virtual computer screen. When they do so, a numbered menu of research study topics appears (e.g. addiction, personality, sexuality, relationships, etc.) and they are asked to select the number that corresponds to the study they are currently participating in. A link is then activated that takes them to an online survey site (www.qualtrics.com) that contains an IRB approved informed consent followed by a set of measures for them to complete. When the measures are completed, the data can be automatically downloaded from the Qualtrics site to an excel spreadsheet and then transferred to SPSS for statistical analyses. In addition, the Institute of Virtual Studies contains a set of individual interview rooms and group rooms for focus groups in case a particular study calls for obtaining qualitative as well as quantitative data.

Figure 2 A computer lab within the virtual P.R.O.S.E. lab
http://slurl.com/secondlife/LMU%20Psychology%20Island/65/75/25

Research Methodology Employed by P.R.O.S.E.

The P.R.O.S.E. Project uses a multi-method approach with financial incentives to recruit research participants. Participants are recruited via posted announcements in the Second Life Events Calendar, notices sent out by heads of large groups representing major constituencies in Second Life (e.g. social, business, educational, and artist networks), a CNN IReport (www.ireport.com, a website where citizen journalists can post stories), and word-of-mouth communication. Each method of recruitment offers potential participants the opportunity to come to a virtual research lab located within Second Life and earn 1000 Lindens (virtual currency equivalent to slightly less than four U.S. dollars) for completing approximately 30-60 minutes of measures on a topic related to the psychology of Second Life. The decision to pay participants 1000 Lindens per study was based upon pilot data that indicated that this level of reimbursement would constitute a robust inducement in the micro-economy of the virtual environment. Consistent with this finding, acquiring data for a study involving several hundred participants was generally accomplished in a matter of a few days, a length of time that represents a considerable increase in efficiency over the typical process of data collection in a real world setting.

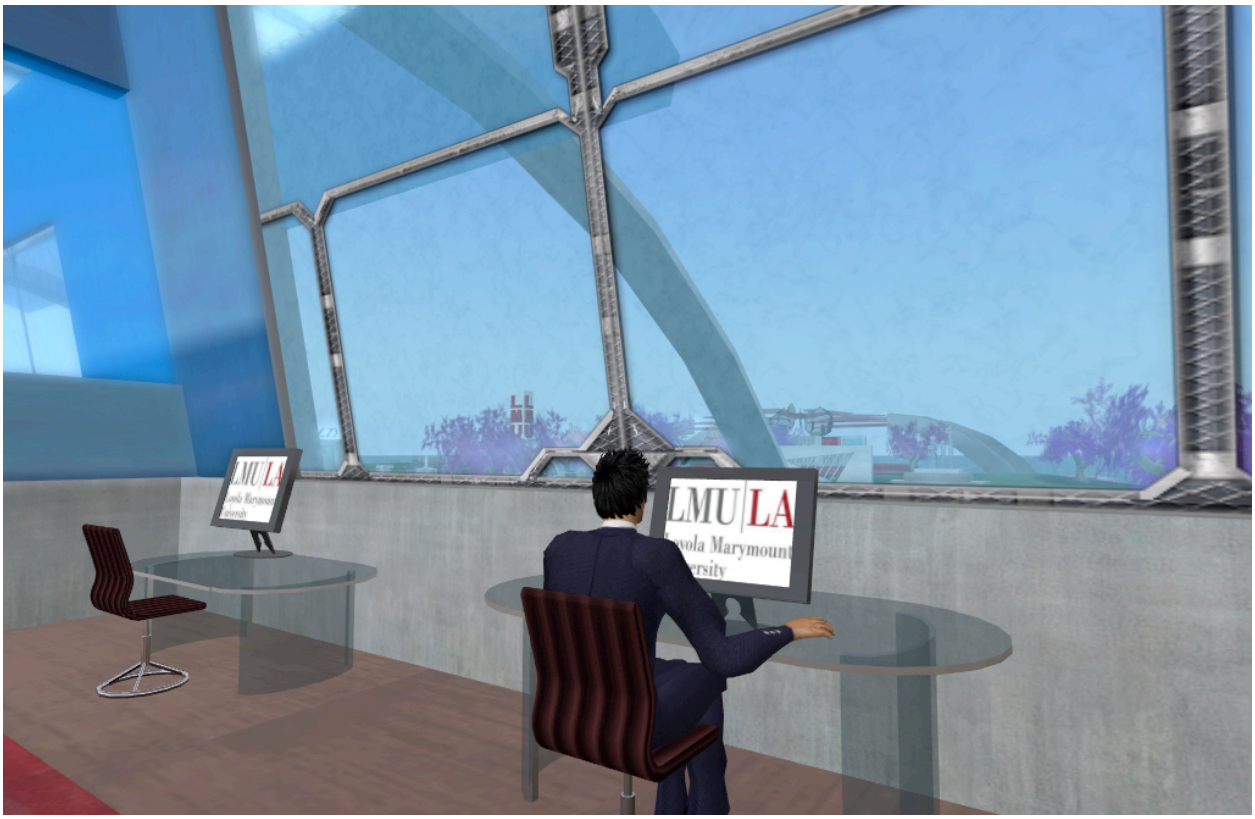

Figure 3 Completing a Research Study In-World

Figure 4 Collecting Qualitative Data Via a Focus Group on Psychology Island

The recruitment notices also specify that the participant's avatar must have had at least six months residency in Second Life. This "minimal residency requirement" ensured that all data were derived from at least moderately experienced users as opposed to newcomers with unstable patterns of behavior and use of the virtual environment. This reasoning parallels that of Young (1998), who advised that measures of Internet behavior should be used cautiously with novice users in their first 6 months of exposure to the medium. Essentially, the six-month minimum duration requirement used in the current studies extends Young's methodological guideline from Internet research conducted within Internet/Web 1.0 to the emerging 3-Dimensional Internet and Web.

Across multiple studies, employing these recruitment methods tended to produce samples that had more females (percentages in the mid-50's) than males (percentages in the mid to low 40's). A large majority of participants, approximately 90%, were in the age range of 18 - 49 and resided in North America or Europe. Most participants had completed at least a high school diploma or equivalent (about 90%), while approximately 40% had either a 2-year or a 4-year college degree, and about 10% held a graduate degree. With regard to the length and extent of their participation in Second Life, the samples were usually divided in thirds according to whether they had been in Second Life for 6 months to a year, one to two years, or two to three years. Only a few participants had been in-world residents for over 3 years. Finally, almost all of the participants were active users of the virtual environment, with approximately 90% reporting that they logged on to Second Life on a consistent basis (i.e., daily, almost everyday, or several times a week.)

These sample characteristics match previous research regarding the demographics of Second Life users. An internal report by Linden Labs conducted in 2008 found that 60% of Second Life users were between 18 and 34 years of age and a survey by Market Truths in 2009 (http://sl.markettruths.com/) found that over one half of Second Life users were female, Thus, while the current sampling methods for behavioral research in virtual world settings are subject to the selection biases that affect all forms of on-line studies, there is some support that the current samples are representative and thus generalizable to the larger population of Second Life users.

Current Research Studies

The information below summarizes the subject matter, basic methodology, major findings (if available), and current publication status of a series of studies conducted under the auspices of the P.R.O.S.E Project in the last two years, arranged according to which major research area they primarily address. Collectively, they provide an overview of the work being done within the P.R.O.S.E. lab.

Major Question 1: What are the Characteristics of Active Participants in Virtual Worlds?

Psychological and Social Adjustment of Active Users of Second Life. *(Richard Gilbert, PhD, Nora A. Murphy, PhD, and Jessica Foss).* The introduction of new forms of media and communications is often accompanied by concerns about its negative impact on society and the emotional makeup of its early adopters. This process was evident with the rise of popular novels, radio, television, and later digital technologies such as social networking. Currently, a similar process appears to be occurring with respect to emerging 3D virtual worlds, where media accounts of the Metaverse generally focus on the more prurient and sensational aspects of immersive digital worlds and raise questions about the emotional makeup of participants in these

settings. In order to empirically evaluate the later issue, this study administered an extensive battery of mental health and social adjustment measures to 225 active users of Second Life. Scores on these measures will be compared to normative data for these measures obtained on real life samples and data from a sample of active users of 2D online applications (such as social networking) that are not also involved in immersive digital environments. Data collection for the 3D sample has been collected along with the normative data for the real life sample; data from a matched 2D sample still needs to be collected. The data will be used to evaluate the prediction that no significant differences in mental health or social adjustment will be found between active users of 3D virtual worlds and groups of non-participants in immersive digital environments.

Major Question 2: Do the Principles of Behavior and Subjective Experience found in the Physical World also apply to the Virtual World?

Addiction to the 3-Dimensional Internet: Estimated Prevalence and Relationship to Real World Addictions *(Richard Gilbert, PhD, Nora A. Murphy, PhD, & Talisa McNally*). Multiple studies using diverse samples indicate that, on average, 3.6% of adolescents and young adults and 1% of older adults demonstrate severe levels of problematic involvement with non-immersive Internet activities (i.e., web surfing, social networking), with problematic involvement defined as usage that cannot be controlled and causes feelings of distress and impairment of daily activities. These studies also indicate that 19.1% of adolescents and young adults and 5% of older adults have moderate or at-risk levels of usage for non-immersive Internet applications. Moreover, many individuals who exhibit problematic levels of Internet usage show evidence of "cross-addictions" with various real life addictions (e.g., drug and/or alcohol abuse, compulsive gambling, eating, or shopping, etc.) Some have suggested that because of the assumed power of the immersive experience, the rates of severe and moderate levels of problematic Internet usage would be higher for participants in 3D virtual environments. To test this prediction, 213 participants, all of whom had been residents of Second Life for at least 6 months, were administered the Internet Addiction Test, the most widely used measure of compulsive Internet use (Young, 1998). The results indicated that 4.2% and 29.1% of adults, the vast majority of whom were between 18 and 49 years of age, scored in the severe and moderate/at risk range of the measure, respectively. In addition to providing the first estimates of prevalence for problematic usage of 3D virtual settings, the results indicated that the finding of co-morbidity or cross-addiction between Internet addiction and various forms of real world addictions/compulsions also applies to the 3-Dimensional Internet. This research has been published in the journal *Addiction Research and Theory*.

Sexuality in the 3-Dimensional Internet and Its Relationship to Real World Sexuality *(Richard Gilbert, PhD, Monique Gonzalez, and Nora A. Murphy, PhD)*. Two hundred and seventeen participants completed the Second Life Sexuality Survey (Gonzalez & Gilbert, 2009) to obtain descriptive information about sexuality within the virtual world. They also completed a measure of their current and historical real life sexuality in order to assess the relationship between 3D and real life sexual satisfaction ("Is your Second Life sexuality more satisfying than your Real Life sexuality?") and sexual feelings ("I feel sexually confident more in Second Life, more in Real Life, or about the same in both realms?) The results indicate a wide range of common and experimental sexual practices in Second Life, with sexual involvement occurring at faster pace and with a larger number of partners than in real life, and in a variety of relationship contexts from casual dating to cohabitation and virtual marriage. Participants were evenly split on which realm was more sexually satisfying, had similar sexual feelings across the real and

virtual environments, and tended to view the two domains of sexual experience as largely independent, This research has been presented at the 2010 meeting of the American Psychological Association and is currently in press in *Psychology and Sexuality*.

Communication Patterns and Satisfaction Levels in 3D versus Real Life Relationships *(Richard Gilbert, PhD, Nora A. Murphy, PhD, and Maria Avalos).* This study compared communication patterns and satisfaction levels between 3D and real life intimate relationships using a sample of 71 participants who were concurrently involved in an intimate relationship within Second Life and a separate real life relationship. Participants indicated that the quality of their communication was significantly better in their Second Life relationship and that they experienced higher levels of satisfaction with their virtual partners. The more positive or idealized view of the 3D relationships may have been due to higher levels of focused interaction and reduced stressors in the virtual world and the greater length, and associated problems, in participant's real life relationships. In addition, the presence of a concurrent relationship within Second Life could have negatively affected participant's judgments of their real life relationships. These data offer the first detailed assessment of communication patterns and satisfaction levels in intimate relationships across the real and 3D virtual realms as the number of users and romantic partners in immersive virtual environments continue to grow. This research has been presented at the 2010 meeting of the American Psychological Association and is currently in press in *Cyberpsychology, Behavior, and Social Networking.*

Realism, Idealization, and Real World Impact of 3D Virtual Relationships *(Richard Gilbert, PhD, Nora A. Murphy, PhD, and Maria Avalos).* The emerging 3-dimensional Internet provides a new medium for social relationships and a context for conducting empirical research on intimate relationships in digital environments. In the current study, 199 participants, each of whom was currently involved in an intimate relationship within the 3D virtual world of Second Life, completed measures assessing whether they 1) viewed their 3D virtual relationship as an exercise in fantasy or one that had a quality of emotional realism and 2) perceived the personality characteristics of their 3D partner in more positive terms than their real life partner on an adapted version of the Big Five Personality Inventory (BFI; John, Donahue, & Kentle, 1991). In addition, a subset of 71 participants who were concurrently involved in a Second Life and a real world romantic relationship indicated whether they experienced any negative impacts in their real life relationship due to their 3D intimate relationship. The results indicated that the majority of participants viewed their Second Life relationships as real (analogous to a long-distance relationship in real life) rather than as a form of game-playing, but opinions were sharply divided regarding whether there is an exact correspondence between emotional experiences such as falling and being in love across the two realms. In addition, participants generally reported more positive or idealized personality traits with their Second Life partners (i.e., significantly higher levels of extraversion, openness, and conscientiousness, lower levels of perceived neuroticism, and comparable levels of agreeableness.) Finally, given the sense of realism and positive qualities participants ascribed to their virtual relationships, it was not surprising that they indicated that their virtual relationships sometimes served as emotional competitors to their real life relationships. Participants reported positive feelings toward their Second Life partners (i.e., degree of love, amount of openness, strength of connection, ease of relating) that rivaled or exceeded those for their real life partner in a quarter to half of the cases. Moreover, in approximately 25% of the cases participants indicated that they experienced problems or considered leaving a real life partner due to competing feelings toward their virtual relationships. In sum, the current study provides data on intimate relationships in the emerging 3-dimensional

Internet and contributes to greater understanding of these next generation online relationships. This research will be presented at the 2011 meeting of the Western Psychological Association and is in preparation for submission to Computers in Human Behavior.

Multiple Personality Order: Physical and Personality Characteristics across Multiple Identities of Self, Primary Avatar, and Alt(s) *(Richard Gilbert, Jessica Foss, & Nora A. Murphy).* Throughout history, human beings have demonstrated an interest in modifying aspects of their identity and experimenting with alternative personas. Early expressions of this tendency generally involved brief alterations of identity such as: participating in ceremonial rituals in which participants concealed their true selves behind elaborate masks and costumes, performing roles that were discrepant with one's daily persona following the rise of the formal theater, and attending masquerade balls that were popularized during the renaissance. In more recent times, examples can be found of elaborate and lengthier efforts to modify core aspects of identity such as gender (De Pauw, 1981; Royster, 2006), race (Griffin, 1961), and social class (Camigliano, 1983; Ehrenreich, 2001). Now, with the coming of the digital age it has become far easier to experiment with alternative personas and different components of identity. This is especially true in the context of the emerging Immersive Internet and the rise of 3D virtual worlds where individuals can create an avatar or multiple avatars (alts) depicting almost any form of imagined self, including those that have physical and/or psychological traits that depart from their real life self.

In the current study, 104 participants, all of whom had multiple avatars in the 3D virtual world of Second Life, completed a set of measures to asses how physical characteristics, activity preferences, personality features, and social-emotional processes are similar or different across various combinations of the real self, the primary avatar, and the sole or most frequently used alt. Data was also obtained on the frequency of alt use, motivations for constructing alts, and the main forms of identity experimentation engaged in with alts. The combined results were then used to construct a model of how personality systems composed of multiple offline and online identities operate and form a "multiple personality order." As 3D virtual worlds and the global population of avatars continue to grow, creating and coordinating a system of multiple offline and online identities will increasingly become a normative feature of human development and, like a choreographer managing a company of dancers or a conductor leading an orchestra, the operation of personality will take on a quality of performance art. A chapter describing this research is currently in press in an edited volume entitled *"Reinventing Ourselves: Contemporary Concepts of Identity in Online Virtual Worlds"* to be published in 2011 by Springer Publishing.

Major Question 3: Do Experiences in the Virtual World have the Capacity to Influence Behavior and Subjective Experience in the Physical World?

Psychological Effects of Using a Fully Enabled Avatar on Individuals with Real Life Disabilities *(Richard Gilbert, PhD, Nora A. Murphy, PhD, Alice Krueger, Ann Ludwig, & Torri Efron).* This study, conducted in conjunction with Virtual Ability, Inc. (a Colorado-based non-profit serving the needs of disabled persons) and Virtual Ability Island in Second Life (the 3D presence of VAI, Inc.) investigated the psychological and social impact of constructing and operating a fully enabled avatar on individuals with significant real life physical or medical disabilities. One hundred and ninety-seven participants with significant real life disabilities (e.g., multiple sclerosis, cerebral palsy, etc.) were administered an extensive battery of psychological measures (including a depression inventory, a measure of self-esteem, a social connectedness

scale, etc.) within days of joining Second Life and again after they had experienced the virtual environment for over 3 months. The prediction of this pre-post study is that the experience of operating a fully enabled and healthy avatar, and not being viewed by others through the lens of their disability, would lead to higher participant scores on the various measures of well being and social adjustment. An additional measure examined whether changes in post-test ratings were related to the nature of participant's experiences in the immersive environments such as the amount of time they spent in-world, the types of activities they engaged in, the number of groups they joined, and the number of friendships they formed. Currently, all 197 pretest assessments have been completed and the last post-tests are slated for completion in early 2011. At that time, the process of data analysis and drafting a manuscript for publication will begin.

Future Directions

Some general conclusions can be gleaned from the studies conducted to date. The graphical sophistication of advanced virtual settings such as Second Life appear sufficient to psychologically engage the user and create a sense of psychological realism that goes beyond a game or idle fantasy. As seen in the studies on addiction to immersive environments and 3D sexuality and virtual relationships, this sense of realism occasionally rises to a level where the immersive environment serves as a rival for the user's involvement and emotional investment in his or her physical existence. At the same time, while the experience and impact of immersive virtual worlds have a realistic quality, there are also strong elements of idealization present in the virtual setting such as seen in the physical and psychological characteristics of avatars and in the communication and satisfaction levels found in virtual relationships.

In addition to completing the data collection, analyses, and manuscript preparation for several of the studies described above, researchers affiliated with the P.R.O.S.E. Project are currently working on a new set of studies that will be conducted and disseminated in 2011-2012. As with the Phase I studies reported earlier, these studies are presented according to which major research question they address.

Studies in development related to Question 2 on the Cross-Realm Generality or Cross-Realm Specificity of Psychological Processes.

The Accuracy of Avatar-Mediated Person Perception. Real world studies such as "Room with a Cue" (Gosling, Ko, Mannarelli, & Morris, 2002) have shown that individuals (to varying degrees) can make accurate judgments of some personality traits from observations of environmental cues (e.g., the degree of orderliness of a person's living space, etc.) In addition, studies have obtained similar findings based upon inferences from 2D digital contexts such as Facebook profiles (Back, Stopfer, Vazire, Gaddis, Schmukle, Egloff, & Gosling, 2010). With regard to the 3D Internet, there is a belief that individuals can hide aspects of their identity behind their avatar. This study would test that notion. Specifically, it would see if participants are able to make accurate judgments about the personality traits and socio-cultural characteristics (i.e., race, gender, ethnicity, age, SES, etc.) of the human driver of an avatar following a period of brief interaction in the 3D environment. Results from this study would help determine the extent to which accurate person-perception is possible in a 3D virtual environment.

Qualitative Study and Theoretical Paper on Proposed Model of Multiple Personality Order. This study involves an extension of the previously described empirical study on "Multiple Personality Order." It involves conducting standardized interview with 40-50 individuals who have multiple avatars in Second Life (i.e., a primary avatar and one or more

secondary avatars or "alts) to obtain a more in-depth, qualitative assessment of the dynamics of personality systems composed of multiple offline and online identities. Concurrent with this study a theoretical paper is being written that explores the possibility that the rise of 3D digital environments and avatar-mediated behavior may bring about a new era in the history of human identity. A summary of this theoretical paper is currently under review for possible inclusion in an edited, multidisciplinary volume on the Metaverse slated for publication in late 2011.

Studies in development related to Question 3 on the Capacity for Cross-Realm Psychological Influence

Diversity Simulation I: The Impact of Operating a Wheelchair-Based Avatar on Real-life Attitudes and Policy Issues Toward Individuals with Disabilities. The basic hypothesis of this study is that having individuals who do not have a physical disability operate a wheelchair-based avatar will impact their real life attitudes and policy positions toward individuals with disabilities.

Diversity Simulation II: The Impact of Operating a Race-Discrepant Avatar on Real-life Racial Attitudes and Policy Issues. The basic hypothesis of this study is that having individuals operate an avatar whose racial features are discrepant with their physical race will impact their real life racial attitudes and policy positions.

Avatar Mediated Therapy for Eating Disorders. This study will explore whether individuals who struggle with issues related to anorexia (self-starvation) can grow more comfortable with a physical body that is not overly thin by operating an avatar whose form reflects a more normative body-type.

Factors that Influence Psychological Connection with one's Avatar. The capacity for virtual environments to have a psychological influence on the physical self rests on 1) user's degree of psychological immersion or presence in the 3D environment and 2) their level of emotional or psychological connection to their avatar. To date, however, there is no reliable and valid measure to assess the later variable. This project would undertake to the development of a psychometrically sound measure of a human-driver's connection to his or her avatar(s) and, using this measure, seek to identify the factors that influence this level of connection across realms.

Collaboration with Other Organizations and Disciplines

Psychologically-beneficial Applications of 3D Virtual Environments

The Director of the P.R.O.S.E. Project also serves as the co-chair and charter author of the Psychology of Immersive Environments (PIE) Working Group, one of the core groups within the Immersive Education Initiative (http://MediaGrid.org/groups/technology/PIE.TWG.). Currently, researchers affiliated with P.R.O.S.E. are collaborating with the PIE working group to collect examples of psychologically-beneficial applications of immersive environments in preparation for creating 2D and 3D searchable, expandable repositories of beneficial applications. Both the 2D database and the 3D exhibits that will be made available to the public in the summer of 2011 and will be reported in the newly established *Journal of Immersive Education*.

In addition to working with the Immersive Education Initiative, three projects are underway or in-development that involve interdisciplinary collaborations with computer scientists.

3D Virtual Worlds and The Emerging Metaverse: Current Status and Future Directions.

This paper, co-authored with John Dionisio, an Associate Professor of Computer Science at Loyola Marymount University, and William Burns of The Andromeda Media Group, seeks to 1) describe the current state of the emerging Metaverse (i.e., a massively distributed network of increasingly realistic, seamlessly integrated, ubiquitously available, and scalable immersive environments that potentially comprise the next generation of the Web) and 2) outline a progression of steps that would contribute to a fully-realized Metaverse. The paper is currently in preparation for submission to ACM Computing Surveys sometime in the summer or fall of 2011.

Can Programmed Avatars (Bots) Pass the Turing Test?

The Turing Test, an essential concept in the field of artificial intelligence, was introduced by Alan Turing in a 1950 paper entitled *Computing Machinery and Intelligence* (Turing, 1950). It is a test of a machine's ability to demonstrate intelligence. Procedurally, a human judge engages in a conversation with one human and one machine, each of which tries to appear human. All participants are separated from one another. If the judge cannot reliably tell the machine from the human, the machine is said to have passed the test. In order to test the machine's intelligence rather than its ability to render words into audio, the conversation is limited to a text-only channel such as a computer keyboard and screen. The current study in development would investigate 1) whether the most advanced programmed avatars or "bots" operating in 3D virtual worlds can pass an adapted Turing Test (i.e. Can avatars operated by human beings determine that they are interacting with an avatar driven by artificial intelligence?) and, if so, 2) how long can bots pass the Turing Test (30 seconds, 1 minute, 2 minutes? etc.)

The Uncanny Valley Revisited.

The term "uncanny valley" was coined by the Japanese roboticist Masahiro Mori in 1970 (Mori, 1970). Mori's hypothesized that as a robot is made more humanlike in its appearance and motion, the emotional response from a human being to the robot will become increasingly positive and empathic, until a point is reached beyond which the response quickly becomes that of strong revulsion. However, as the appearance and motion continue to become less distinguishable from a human being, the emotional response becomes positive once more and approaches human-to-human empathy levels. The area of repulsive response aroused by a robot with appearance and motion between a "barely human" and "fully human" entity is called the uncanny valley. The name captures the idea that a robot that is "almost human" will seem overly "strange" to a human being and thus will fail to evoke the empathic response required for productive human-robot interaction. More recently the concept of the uncanny valley has been applied to emotional responses to 3D computer animated figures on a continuum of realism. The current study in development investigates whether this effect applies in a contemporary context in which many young people have grown up interacting with highly realistic 3D computer generated characters in video-games and virtual worlds. Thus, this new cohort may demonstrate a linear vs. undulating curve of emotional response to 3D figures in which the greater the realism of the 3D figure, the more positive the observer's emotional reaction with no repulsive reaction at mid-levels of realism.

Conclusion

In-world behavioral research on 3D virtual worlds and the Metaverse is important to social scientists for several reasons. First, a variety of metrics support the view that the rise of 3D virtual platforms represents a new phase in the history of the Internet rather than something ephemeral or faddish. In the past year the number of registered avatars in Second Life has increased to well over 20 million, with proportionate growth in the size of the virtual world and its number of active participants. This reflects dramatic growth from a registration base of approximately one million avatars less than five years ago (Terdiman, 2006). In addition, while Second Life is the most prominent 3D virtual world, there are other immersive worlds currently in existence or in the later stages of development that are, or will be, contributing to further acceleration in the global population of avatars. Consistent with this view, a number of forecasts from major research organizations have predicted that rapid growth of 3D virtual environments will occur in the near future. These include predictions from Gartner Research that, by the end of 2011, 80% of Internet users -- 1.6 billion of out of 2 billion users worldwide – will have experimented with a presence in a virtual world such as Second Life (Gartner Research, 2007). If even a fraction of this predicted growth takes place, it is inevitable that the amount of social interaction occurring in 3D virtual environments will significantly expand, and engaging in avatar-mediated social relationships may become as commonplace as having a Facebook page and participating in other Web 2.0 modes of social interaction.

However, it not just the raw number of worldwide avatars that make studying the psychology of virtual worlds important to behavioral scientists. With anticipated improvements in browser capabilities, virtual worlds may soon navigate to the web making them almost ubiquitously available. In addition, with the establishment of standardized file formats, interoperability between platforms will be possible. If all of these projections are borne out, the vision of a highly populated, ubiquitously available, and seamlessly integrated network of virtual worlds (i.e., a fully-realized Metaverse) will have been achieved and a new realm of psychological reality and interaction will have been created. At the same time, while avatars are digital entities, their interactions and relationships are ultimately dictated by the thoughts and feelings of a physical person. Thus, the study of avatar-mediated interaction has the potential not only to illuminate the dynamics of a new kind of digital reality but to address aspects of human psychology that are relevant across multiple realms of identity.

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