When Real-Life Choices Predict Virtual Ones:
***Virtual Validity* and Why It Matters**

Abstract

Communication research must enhance understanding of everyday life. Virtual environments (VE), not only afford sophisticated lab situations for systematically analyzing behavior, they can be used to bolster our claims that behaviors in the lab help us to better understand similar real world phenomena. This assumes however that virtual behaviors in the lab, will predict to similar everyday real-life behaviors. To examine whether this is true, 267 men who had sex with men (MSM) filled out initial and post measures of their sexual risk-taking and went on a "virtual date" that allowed them to make the same contextually driven choices just as in everyday life (e.g., use of alcohol, drugs, sexual acts). These electronically recorded virtual choices were significantly related to similar past and subsequent real-life choices confirming their *virtual validity*.

Introduction

Virtual environments (VE), in which humans interact with virtual characters (e.g., agents, avatars) using interactive technology, are increasingly being used to advance basic (Loomis, Blascovich, & Beal, 1999) and applied psychological science (Bailenson, Blascovich,, & Guadagno, 2008). Although commercial VE can address some research questions (Griebel, 2006), increasingly researchers are designing their own VE for greater control and to meet specific research needs (Vandelanotte, et al., 2005). Virtual environments provide exceptional opportunities to create experimental laboratories that help to enhance the generalizability of research findings (Krämer, Bente, Troitzsch, & Eschenburg, 2009). The work by Slater, et. al., 2006 and Blascovich, et al., 2002, on designed VE, for example, nicely illustrates that VE with social interactions using virtual characters can replicate findings of earlier interpersonal laboratory experiments (Blascovich, & Ginsburg, 1974;Milgram, 1963). These prior studies clearly support the external validity of virtual environments where external validity is defined as the extent

to which the results of a study can be generalized or extended to others (Campbell, & Stanley, 1966). What is less clear is the important question of whether individual responses in a virtual environment are *related to* those *same individual responses* to similar situations in their *everyday lives*. This type of validity, which we call *virtual validity*, tends to be more the focus when the research goals are assessment, training, or clinical intervention.

Simulators have long been designed to capture experiences in virtual settings that are very similar to real-life situations. These include simulations of pilot's first real-life control of a specific aircraft (Kennedy, R.S., 1989); triggers to Post-traumatic Stress Disorder (PTSD) symptoms for military personnel (Rizzo, A.A., .et .al, 2009), and challenges in risky sexual decision making sequences (Miller, .et, .al, 2009). These virtual simulations and games aim to place the user in a context and scenario similar to one they have or will experience in real life. Then, the researchers' goals are to (1) assess how the user responds to given challenges in that environment and (2) provide an intervention in the environment, and assess whether it changes the individual's behavior later on, under similar real-life contexts. Especially for those interested in using virtual environments to understand, predict, and change individuals' decisions in specific real-life situations (e.g., pilot's first real-life control of a specific aircraft; reducing triggers to PTSD symptoms; reducing sexually risky decisions), the extent to which a VE has *virtual validity* is typically an unaddressed question. Yet, it's an important one!

If virtual situations and challenges that are more psychologically similar to participants' real life challenging situations help explain, predict, and change individuals' behavior, then this would suggest how we might improve our science: Namely, identify

these real-life situational challenges, adequately sample from them, and satisfactorily represent these in the VE.

A first step then is to demonstrate, at least in a rough way, that VE can be designed such that individuals' virtual choices can "map onto" their past and future real life choices. In the current work, we focus on introducing the concept of *virtual validity* (the relationship between individuals' virtual and non-virtual decisions), a method for assessing it, and why virtual validity matters not only in these clinical and training settings, but more broadly for social science aimed at understanding, predicting, and changing behavior.

Real-Life Challenges and Virtual Validity

> "*Ultimately, what makes research findings of interest is that they help us understand everyday life*" (Mook, 1983, p. 386)

Internal validity has been the *sin qua non* of experimental research, especially when one is primarily interested in testing explanatory theory (Brewer, 2000). But, there is also a large chorus of scientists (e.g., Lillenfield, 2011, Reis et al., 2012) noting that external validity matters too. Findings with greater external validity provide the "convergence of results" (e.g., from lab and field studies) that "greatly enhances our confidence in the findings from both sets of operations" (Brewer, 2000, p. 14). Moreover, the generalizability of our work across contexts is critically important if communication scholars wish to be useful, have their work valued by, and perceived as relevant to other research communities and by policy makers, funding panels, and the public at-large (see for example, Lillenfield, 2011).

Why Relevance Matters and Why It is Difficult to Test and Thus Often Ignored

Although these concerns are especially clear in other social science fields (e.g., psychology), this is precisely where communication researchers are positioned to excel. We often conduct research in field and applied settings. And, many of us have extensive experience in virtual environments. We simply haven't directly linked the two. As Brewer (2000, p. 12) notes "research is motivated ultimately by a desire to understand real and meaningful social behavior." The problem is that many scholars do not have the tools to connect their basic research findings with behaviors outside of the lab. As communication scholars working in VR we have a particular advantage.

As Brewer (2000,p. 12) notes, "the connections between basic research findings and application are often indirect and cumulative rather than immediate. Relevance is a matter of social process, that is, the process of how research results are transmitted and used rather than what the research results are (Brewer, 1997)." Often, however, this may mean that there is a large disconnect between lab and field, what is studied by whom, and how the pieces are supposed to connect to one another.

It is not enough to rely on the work of others to show that our lab-based insights have important real-world implications. First, others will not necessarily ensure translation of experimental work into useful applications. Second, and more importantly, the quality of the pipeline from raw product (basic research findings) to refined final product (e.g., application adapted to prevent or change risky behavior for a specific target population in the field) is more uncertain if this pipeline, typically involving extensive additional scientific research, is left unsupervised. Third, as Lewin once noted, applications in the "real world" often tell us what we do not know and provide the circuit

back to cumulative advances in laboratory research more apt to be relevant and useful in everyday life (Lewin, 1951). That is, understanding, predicting, and changing real-world behavior outside of the lab is essential to a vibrant and relevant science.

The goal of the current work is to suggest how virtual environments (VE) can provide one accessible pipeline, under our control, for more readily linking decision-making and behavior in our experimental work to decisions in everyday life. In the current work, we focus on introducing the concept of *virtual validity* (the relationship between individuals' virtual and non-virtual decisions), a method for assessing it, and why virtual validity matters not only in these clinical and training settings, but more broadly for communication research aimed at understanding, predicting, and changing behavior.

The Current Work

In the current work we tested the hypothesis that real-life choices in the past 3 months regarding specific risk-taking behaviors (e.g., UAI with non-primary partners, alcohol use, methamphetamine use (MA)) will correlate with virtual choices in a VE. In a randomized controlled trial testing an HIV-prevention intervention funded by the NIAID, men who have sex with men (MSM) filled out specific measures of their behaviors at baseline and then made a series of choices in a VE that used interactive video with human actors (where users assumed the role of one of the characters and made choices for him with a casual non-primary partner that subsequently affected how the narrative proceeded). The participants' virtual choices were automatically recorded and then correlated with their past behavior. This allowed a method to assess the virtual validity of this VE. Namely, did the virtual environment simulate risk challenges (e.g., regarding

UAI, alcohol, MA) where MSM made virtual choices (that were recorded) and where corresponding data was available regarding those same MSM's real-life choices in the preceding 3 months.

Because the VE experience also involved an intervention, which might have reduced the range of MSM's risky choices, or affected some MSM but not others, it was less clear if MSM's risky virtual choices would predict their subsequent risky real life choices. We also examined this possibility as a research question.

We also wished to assess whether MSM's sexual position choice in the virtual environment was correlated with their real-life choices when those choices were measured but not subject to the intervention. To do so, we afforded MSM the choice to be either the receptive or insertive partner in the IAV. We hypothesized that for this preference, there would be a significant positive relationship between the virtual sexual position choice and both past 3 month and subsequent real-life similar 3 month sexual behavior.

Method

Participants and Eligibility

Participants were 276 men who had sex with men (MSM) that had been randomly assigned in a larger randomized controlled trial, to an interactive video arm (see Miller et al., 2009 for details). Eligible MSM had engaged in receptive or insertive unprotected anal intercourse (UAI) with another man in the past 90 days, were 18 to 30 years old, were available for 3 months (for a 3-month follow-up), were HIV-negative, had never used injection drugs and were either African American, Latino, or Caucasian. Of these

MSM, 111 were Latino (40.2%), 54 were African American (19.6%), and 111 were Caucasian (40.2%). Their mean age was 24.5 years and the mean income was 30,000. The average level of education was 'some college'.

Procedure

The development and nature of the interactive video (IAV) used in the current work are described elsewhere (Appleby, .et, .al, 2007; Read, .et., .al, 2006; Godoy, .et, .al, 2005). Following informed consent, participants filled out baseline measures (e.g., past drug, alcohol, and sexual behavior), and viewed the interactive video (IAV). After providing brief instructions, guides encourage the user to assumed the role of the main character within the IAV and become immersed in the virtual environment, interacting with other characters and making decisions as the story progresses. As the narrative unfolds, the user can chose to get advice but must ultimately make various choices that affect how the narrative unfolds. The IAV was programmed such that participant's choices could be logged. Three months after the intervention, participants returned and filled out the same behavioral measures (as in the baseline) again.

Measures

Virtual choices. The user could make a series of choices in the IAV that were automatically recorded and then binary coded. Those of interest in the current work involving risky choices included: (1) methamphetamine use or not; (2) alcohol use or not; and (3) unprotected anal sex at some point or not. Those that involved preferences not subject to intervention attempts included position preference: insertive or receptive partner.

Self-reported past behavior. Participants reported at baseline on their methamphetamine, alcohol, and sexual behavior in the past 90 days and answered these questions again at the 3-month follow-up. Regarding sexual behavior, participants were asked to indicate the total number of times that they had, separately, receptive and insertive unprotected anal intercourse (UAI) with a non-primary partner in the past 90 days.

All of these virtual and real-life choices were then coded to numerical measures. Pearson product-moment correlations were used to determine the relationship between real-life and virtual behavior at Time 1 and Time 2 (90 days out). [1]

Results

The first research question, is that VE choices will be related to past real-life behavior. To assess this, a series of Pearson product-moment correlations were performed. As indicated in Table 1, there was a statistically significant relationship between subjects' past behavior and their subsequent virtual behaviors. Those who drank alcohol in the past 90 days were likely to choose to drink alcohol in the VE, *Alcohol (Time 1)* $p(274)=.31$, $P=.001$. Similarly, those who took methamphetamine in the last 90 days, were also likely to choose to take methamphetamine in the VE, *Methamphetamine (Time 1)* $p(274)=.48$, $P=.001$. Of those who chose to have anal sex in the VE, position preference was consistent with their real world preferences. Those who were more a top (at least 60% of the time the insertive partner, in the past 90 days) chose to be a top in the IAV, and those who preferred to be a bottom (at least 60% of the time the receptive partner in the past 90 days) chose to be a bottom in the IAV, *Anal Sex Receptive (Time 1)* $p(274)=.45$, $P=.001$, *Anal Sex Insertive (Time 1)*

[1] Pearson's correlation coefficient is **a** measure of the strength of the association between the two variables.

p(274)=.45, *P*=.001. Lastly, those who chose to have unprotected anal intercourse (UAI) in the VE, were more likely to have engaged in risky anal sex in the last 90 days, *UAI (Time 1)* *p*(274)=.20, *P*=.002 (*see Table 1)*.

Exploratory question: Interactive Video Choices will predict to future risk-taking behavior

The second exploratory question examined whether VE choices can predict future risk-taking behavior. As indicated in Table 1, a series of Pearson-product moment correlations demonstrated a significant relationship between subjects' virtual behaviors and the behaviors they were likely to engage in 90 days into the future. Those who drank alcohol in the VE were likely to drink alcohol in the next 90 days, *Alcohol (Time 2) p*(274)=.20, *P*=.002. Similarly, those who took methamphetamine in the last 90 days, were also likely to choose to take methamphetamine in the VE, *Methamphetamine (Time 2) p*(184)=.24, *P*=.001. Of those who chose to have anal sex in the VE, position preference was consistent with their real world preferences. Those who chose to be the insertive partner in the VE, were also more often the insertive partner over the next 90 days and vice versa for t hose who were the receptive partner, *Anal Sex Receptive (Time 2) p*(184)=.35, *P*=.001, *Anal Sex Insertive (Time 2) p*(184)=.32, *P*=.001. Those who chose to have UAI in the virtual environment were more likely to have UAI over the next 90 days, *UAI (Time 2) p*(184)=.21, *P*=.002.

Discussion

We had several research questions. The first was whether virtual risk taking behavior (based on scenarios similar to what they might encounter in their real-life) was related to past real life risk taking. In the current work, MSM were significantly more likely to make virtual behavioral choices (i.e., having unsafe sex, using drugs, using alcohol) in the IAV consistent with their respective past real life behavior. For example,

MSM who had unsafe sex as a receptive partner in the past 90 days, were significantly more likely to also do so when given the opportunity, within the VE. Those who used alcohol or methamphetamine in the past 90 days were more likely to want to use alcohol and use methamphetamine respectively in the IAV.

The second question went a step further by also asking whether risky choices made in a virtual environment predict behavior 3 months into the future. In this longitudinal study, we found that risk-taking behavior in a virtual environment was indeed related to real-life risk-taking into the future (e.g., those who engaged in unsafe sex or drank alcohol in the IAV were significantly more likely to do so in the future).

Why is virtual validity methodologically advantageous and how can we refine the concept further?

If you consider the number of variables involved in attempting to replicate studies, you can easily see how virtual validity can help to improve the science of predicting behavior. In typical studies, there are a host of issues that can confound results. These involve questions of internal validity, external validity, and ecological validity. Usually accurate measurement and generalizability of findings both within and among samples of populations are paramount for a study to be deemed useful. However, problems can occur when the individuals who are conducting an experiment unconsciously or unknowingly exhibit biases towards different members of control and experimental groups. With virtual validity researchers are able to automatically predetermine and record unobtrusively the desired behaviors/outcomes elicited within a VR environment thereby eliminating a real threat to research replicability (e.g., history,

instrumentality, selection bias, selection interaction, and differential attrition). At the same time, participants are not tipped as to what condition they might be in, thereby eliminating compensatory rivalry between conditions.

Currently, under traditional experimental conditions outside of VR, researchers must take a variety of precautions to decrease the risks to internal validity. These include: random selection, random assignment to conditions, reliable instruments, reliable manipulations, safeguards against confounding factors, etc… However, these same strategies may also serve to limit the generalizability or external validity of the study findings.

Determining virtual validity through the use of VR can sever the liability to *generalizability* imposed upon researchers who desire having high *internal validity*. It does so by creating a series of standardized levels that researchers can look to, to correctly gauge the degree to which virtual realism in the experimental setting (i.e., ecological validity) translates to predictable and reproducible real life behavior among different samples of persons over various situations. So for example, by using VE, researchers can start to map out risk profiles over varying levels of complexity and start to understand the contexts and situations under which different degrees of virtual validity may exist. These include questions of exact replication (How strong is the design realism between real life and in-lab simulations?), cross-situational consistency (same individuals across different situations [How do decision-making variables map across situations?]), stability (How consistent are similar situations across multiple time-spans? –e.g., longitudinal stability), and strength of external validity [How do different individuals

respond to generalizable research findings across highly dissimilar situations in a VE environment?]

Having high virtual validity means that by using a VE environment, you can eliminate many of the issues with regard to internal and external validity. For one, because in a VE environment context can be designed to be similar to real life situations, you no longer have to reason by analogy. Your research results are entirely falsifiable or reproducible. Context matters, using a VE environment you can simulate the critical (e.g., psychological, sensory) aspects of real-life situations and critically evaluate how individuals' responses map on to predicted outcomes based on theoretical manipulations (that remain constant for each designed situation).

The technology is not new, flight simulators allow for speed training (Kennedy, et., al. 1989), medical haptic sensory simulators enhance recovery outcomes with real patients (Johnson & Guediri, 2011), and military training VE scenarios can facilitate cultural and language skills acquisition (Johnson, & Valente, 2008). For sufferers of PTSD, VE affords clinicians the tools to recreate and gradually desensitize clients to threats. Rizzo et al., 2009 & McLay et al., 2011 found significant drops in PTSD symptom reporting in real-life contexts following treatment when compared to a control). Using VE to assess the level of virtual validity that exists however is new. VE allows us to use virtual environments in a manner that can help us to understand and change otherwise difficult to observe decision-making (e.g., risky sexual choices in intimate contexts). For example, Read et al. (2007) found in a randomized controlled trial (RCT) that sexually risky young MSM exposed to a VE (interactive video) involving similar to real life risk challenges, reduced UAI over time compared to the control.

Implicit or explicit in the use of VE for specific training and behavior change interventions is the assumption that they have *virtual validity*: That is, that individuals' responses to designed challenge situations in the VE will be correlated with their responses in similar real-life contexts. Yet, this has, to our knowledge, not been tested up until now. This is a significant milestone for researchers and practitioners to build upon.

Our findings are consistent with past research that has shown a link between individual difference variables and virtual behaviors within interactive environments (Bailenson, 2007; Yee, 2007; Griebel, 2006; Whang & Geunyoung, 2004) but prior to this current study, the literature has *only* been able to effectively link individual difference variables with virtual behavior, not virtual behavior with either prior or subsequent *actual behavior* (for virtual rehabilitation lab based training exceptions *see* Rizzo, 2009*).* Thus, this is one of the first studies to demonstrate a relationship between people's decisions in realistic VE and their past or future real-life decisions.

Conclusion

Establishing this link between virtual and real life behavior has three major implications. First, it confirms the external validity of using VE to represent challenges psychologically similar to those MSM encounter in their everyday life. *External validity* is usually examined by noting that the patterns found in the lab generalize to those found in comparable samples in comparable real-world phenomena (Yee, 2007; Bailenson, 2007; Blascovich, 2002; Rizzo, 2004). But, that work rarely is able to *directly link* an individual's *chosen* behavior in the experimental setting to an individuals' *chosen* behavior in similar contexts in the real world. The ability to examine generalization of

effects from the lab to the real world – at the level of individual participants -- is a major methodological advance of this approach.

Second, the current work suggests the potential value of VE for unobtrusively diagnosing, predicting, and understanding the circumstances under which real-life risk-taking might take place. Furthermore, if we knew the link between the virtual and the real was generalizable, then we could attempt to assess behavior across multiple contexts at different points in time, in order to determine with finer granularity, the factors that predict individual patterns of risk-taking.

Lastly, if virtual validity exists, than this should mean that the virtual environment created contains enough seamless realism and salience such that the subjects are immersed in the experience, and therefore not responding as if they are solely in an experimental setting. An important question then, for further research is: How can we, as researchers, continue to maximize this link between the virtual and the real?

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Tables

Table 1:
Contingency Coefficients for virtual and corresponding behavior at Time 1 and Time 2 (past 90 days)

Virtual and Past 90 day Behavior	Time 1 [a]	Time 2[b]
Methamphetamine	.48***	.24***
Alcohol	.31***	.20**
UAI(only MSM with NPP)	.20**	.21**
Anal sex, receptive	.45***	.35***
Anal sex, insertive	.45***	.32***

NOTE: MSM= men who have sex with men, UAI= unprotected anal intercourse
NPP= non-primary partner
$n = 276_a$ $n = 184_b$
***p<.001