

# The Potential Societal Impact of Virtual Reality

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## Abstract

Virtual reality (VR) is a powerful technology with a potential for far-ranging social and psychological impact. Disciplinary psychology and other social sciences should take a proactive stance in relation to VR, and conduct research to help determine the outlines of this potential impact, with the hope of affecting its direction. This article describes some potential psychosocial effects of a “seamless VR” such as might exist in the year 2025, in relation to several societal domains: private experience, home and family, and religion and spirituality. Research questions are described, as are several approaches to research in this area. Engineering and social science professionals should cooperate in research regarding the potential societal effects of VR.

## 1 Introduction

As a discipline of research and study, psychology typically has been reactive; that is, a phenomenon occurs (e.g., a social trend is noted), and then psychologists study this phenomenon. However, we live in a time of multiple powerful demographic, technological, and cultural changes—a psychosocial perfect storm, as it were. Under these conditions, it behooves all disciplines, psychology included, to be more proactive in considering the potential effects created by various present and foreseeable trends (Koltko-Rivera, 2005a; see L. F. Thompson, quoted in Michaels, 2003). So it is that we come to consider the potential societal impact of virtual reality.

The term “virtual reality” (VR) refers to an immersive simulation that involves relatively high verisimilitude. “In general ... the term *virtual reality* refers to an immersive, interactive experience based on real-time 3-D graphic images generated by a computer” (Pimental & Teixeira, 1995, p. 15, italics in original). “Our preferred definition is an immersive experience in which participants ... view stereoscopic or biocular images, listen to 3-D sounds, and are free to explore and interact within a 3-D world” (Pimental & Teixeira, 1995, p. 91).

Oddly, although much has been written about the potential social impact of other emerging technologies, such as genetic engineering and cyborgization, relatively little has been written about the societal impact of VR (an exception: Calvert, 2002). In passing, one wonders why this would be so. I would speculate that this is because people may think they already have experienced VR, through depictions of VR in television and movies; the worlds of genetic engineering and cyborgization are less familiar, and yet seem capable of transforming the very meaning of “human being.” If this is why future-oriented scholars have paid less attention to VR, this situation has resulted from misguided thinking. Virtual reality has the potential to profoundly alter human society, not by altering our physical bodies (as genetic engineering or cyborgization might), but by altering our perceptions and interactions. There is a great deal of attention being paid to the psychology of those who use the Internet (e.g., Wallace, 1999), and to the Internet’s larger social implications (e.g., Lévy, 1997). Certainly VR and its potential social and psychological consequences deserve this type of attention, and much more.

What will VR do to society, and to individual psychological experience? I will consider conjectural answers to this question in relation to several societal domains. In addition, I will outline some specific research questions, and potential research approaches with which to address these questions.

## 2 Parameters of the Current Investigation

In order to consider the potential societal impact of VR, we must first define the temporal, technological, and experiential contexts and parameters of VR as we will consider it here.

## 2.1 Temporal Context

For the sake of this discussion, let us consider what VR will be like, not in the year 2005, but in 2025. Given accelerating rates of technological innovation, I suspect that the period 2005-2025 will witness a change in VR capabilities much like the progress seen in computing capabilities during the period 1965-2005.

## 2.2 Technological Parameters

A VR system may be defined in terms of four types of components (Pimental & Teixeira, 1995, pp. 91-92): effectors (input and output devices), a reality simulator (the computer and sensory synthesis hardware), an application (i.e., software), and geometry (information within the application that describes physical attributes of objects). The technologies involved in each of these components will undergo major development over the next twenty years.

Ongoing efforts in miniaturization and nanotechnology should make effectors ultralightweight and wireless by the end of this period. In addition, the application of nanotechnology to materials science should make it possible to simulate textures on skin with a much higher degree of verisimilitude than is currently available. Responsible scientists are researching how to control prostheses and robots directly through the activity of the human brain (Zimmer, 2004). It will not be long before the same is possible with the control of the virtual world.

Reality simulators should become much smaller and more powerful over this period. Current hardware deficits (e.g., the current lack of graphic processing power in the Quantum 3D Thermite wearable computer; Knerr, Garrity, & Lampton, 2004) should be overcome in the course of normal technological development, making only reasonable and conservative extrapolations from present capabilities and development efforts.

VR software should see major development during this period. Efforts are underway to improve many aspects of verisimilitude in VR simulations, including such details as small-group discussions in virtual crowds (Patel, Parker, & Traum, 2004) and the simulation of emotion in virtual characters (Gratch & Marsella, 2004). We may reasonably expect improvement in geometry over this period, as well. Currently, the development of AI character personalities seems to be focused on behavioral expressions of affect and personality traits (e.g., see Plantec, 2004); however, during the period contemplated, I would expect to see more focus on incorporating behavioral expressions of belief systems and worldviews (Koltko-Rivera, 2004b) into AI characters.

As a net result, by 2025, I expect that the technological interface between user and virtual environment will be much more subtle than it is today, in terms of requiring less mass and power. At the same time, all sensory modalities will be engaged. In terms of user-interface technology, I envision a very light body suit/visor arrangement, incorporating computer technology and nanotechnology into the clothing worn by the VR system user. Alternatively, simulation by direct neural induction of sensations may be possible. Whatever the technology used, it will be much cheaper than it is today; in constant dollars, the personal income that can afford a wide-screen television in 2005 will be able to afford a fully functional personal VR system in 2025. Some technology experts have predicted this level of technological sophistication to be available even sooner than 2025 (e.g., Kurzweil, 1999, pp. 202-218).

## 2.3 Experiential Context

I expect that the user experience of VR in 2025 will be something close to seamless; that is, the person will experience little if anything that intrusively indicates that 'this experience is a simulation and not reality.' Thus, the VR experience will be something akin to what has been depicted as science fictional in television series and motion pictures over the last generation of our era (without, presumably, either the "3-D TV" or the "die virtually/die really" conventions that are a part of some depictions). Seamless VR was depicted frequently in the "holodeck" of the television series *Star Trek: The Next Generation* (Roddenberry, 1987), and was integral to *Wild Palms* (Stone & Wagner, 1992), *VR5* (Cherry, Hemwall, Kattleman, Renshaw, & St. John, 1995), *Harsh Realm* (Carter, 1999/2004), *eXistenZ* (Cronenberg, 1999), *The Thirteenth Floor* (Rusnak & Centeno-Rodriguez, 1999), *The Matrix* (Wachowski Brothers, 1999), and memorable episodes of such disparate television series as *The X-Files* (Gibson, Maddox, & Carter, 2000) and *Family Guy* (Adler & Povenmire, 2002); seamless VR also provided an interesting scene in *Minority Report* (Spielberg, Frank, & Cohen, 2002). These fictional depictions of seamless VR may be valuable for providing hypotheses for future-oriented researchers into the societal impact of VR.

### 3 The Potential Impact of Virtual Reality in Various Psychosocial Domains

Although much might be said concerning the impact of VR on such domains as education (e.g., Murray, 1997; Wertheim, 2004) and health care (Nagourney, 2004; Wiederhold & Wiederhold, 2005), I prefer to focus here on three important domains that are often slighted in discussions of this type. The domains I focus on are private experience, home and family, and religion and spirituality.

#### 3.1 Private Experience

I will begin with a domain that I label “private experience.” By this term, I mean a large category of human life, that which occurs outside of the contexts of work, social service, one’s worship community, and the family. Basically, private experience is what one does and experiences when no one else is watching. Perhaps ironically, a consideration of the societal impact of VR must include a consideration of private experience.

In considering the potential impact of VR on private experience, I wish to apply an interpretive framework that is controversial in its own right: Freudian psychoanalytic theory. In doing this, I am aware that in many circles Freud is considered problematic, inaccurate, or passé. However, it is also true that, in some sense, “we all speak Freud” (Gay, 1989, p. xiii); many of Freud’s ideas are well known in American society and form a basis for common discussion. It is fair to say that many of Freud’s concepts have at least an heuristic value. From this angle, several Freudian notions cast VR in a very interesting light. In particular, these involve the notion of primary instincts, and the role of delayed gratification in the development of both individual personality and social structure.

Freud postulated the existence of two primary instincts, Eros and Thanatos, or, crudely put, sex and death (Freud, 1923/1961b). For our purposes, it may be useful to recast these as primal impulses for sexuality and aggression. (These hypothetical impulses are, at the least, compatible with contemporary conceptions of evolutionary psychology; see Buss, 1995, 1996.) On the one hand, Freud considered these urges to be primary, primal, and powerful. On the other hand, for Freud, the very pillars of society involve the suppression, repression, and sublimation of these primal urges. As Freud put it, “a progressive renunciation of constitutional instincts, whose activation might afford the ego primary pleasure, appears to be one of the foundations of the development of human civilization” (Freud, 1907/1995a, p. 435).

For Freud, the whole process of socialization involves redirecting the child’s energy away from immediate gratification, and towards delayed gratification. This is necessary in order to move the child away from operating on the basis of the *pleasure principle* (basically, a combination of ‘if it feels good, do it,’ and ‘I want it all, and I want it now’) and towards operating on the basis of the *reality principle* (the idea that behavior should address external or real world constraints, demands, and opportunities). Without delay of gratification to strengthen the adherence to the reality principle, in Freud’s scheme, there would be little work, certainly no art, no science, no social organization above that of the family (if that), actually no civilization at all. (See: Freud, 1911/1995b, 1930/1961a.)

In the future world that I have described, VR will place many impulses within reach of instant virtual gratification, with no immediate social or legal consequences. By doing this, VR will radically change some of the fundamental rules on which the game of life has been played throughout the entire length of human history. Surely this may have momentous social consequences. What will these be?

The issue of impulse gratification is worth consideration by itself. Will the immediate gratification of impulses available on VR make people less capable of delaying gratification in the real world? Or, will the release of tension provided by gratification in the virtual world make people more capable of focusing on work and life in the real world? Or, as is so often the case today, will we see one outcome with certain personality configurations, and the other with different personality configurations? Beyond the matter of impulse gratification generally are the issues of aggressive and sexual impulses specifically. Let us consider these separately.

##### 3.1.1 Aggressive Impulses

Will the acting out of violent or aggressive scenarios in the virtual world make us more likely to act violently or aggressively in the real world? Or, will the release of violent impulses make us more peaceful in the real world? Or,

here again, will it be one way for some sorts of people, and a different way for others? The first two of these points of view are well expressed in the episode of *The X-Files* to which I made reference earlier. In the episode, the protagonists are discussing an immersive first-person-shooter-type seamless VR game.

SCULLY: Mulder, what - what purpose does this game serve except to add to a culture of violence in a country that's already out of control?

MULDER: Who says it adds to it?

SCULLY: You think that taking up weapons and creating gratuitous virtual mayhem has any redeeming value whatsoever? I mean, that the testosterone frenzy that it creates stops when the game does?

MULDER: That's rather sexist, isn't it? (Beat. Scully won't go there, so Mulder takes a different tack.) I mean, maybe the game provides an outlet for certain impulses, that it fills a void in our genetic makeup that the more civilizing effects of society failed to provide for.

SCULLY: Well, that must be why men feel the great need to blast the crap out of stuff.  
(Gibson, Maddox, & Carter, 2000; unofficial transcript)

Social science research raises strong warnings in this regard. A great mass of research demonstrates that exposure to violence in entertainment media (including television, movies, video games, and music) is associated with an increase in aggression and violent behavior, both immediately and in the long-term (see literature comprehensively reviewed in Anderson, et al., 2003). For example, participating in a violent VR game produced more aggressive thoughts than either watching this game or acting out the physical movements (Calvert & Tan, 1994); indeed, playing violent video games seems to lead people to *think* of themselves as more aggressive people overall (Uhlmann & Swanson, 2004). Pop folklore is also discouraging; as one T-shirt slogan puts it, among the pearls of wisdom that one learns from video games is the lesson that "there is no problem that cannot be overcome by violence" ("Everything," n.d.). Humor like this is often a vehicle for conveying widespread but socially unacceptable attitudes. The issue of violence and VR deserves careful thought by designers and policy makers.

### 3.1.2 *Sexual Impulses*

It appears to be the case that many people use the Internet to fulfill sexual needs, sometimes in ways that strongly suggest the need for professional therapeutic intervention (Cooper, 2002). How much more likely will it be the case that people will use VR to fulfill sexual needs, especially when haptic sensing and haptic feedback mechanisms become more highly developed?

Calvert (2002) has pointed out several issues involving the acting out of sexual impulses via VR. On the positive front, this author suggested the possibility that people will be able to learn social skills through virtual environments (VE) that are transferable to real world contexts. Calvert used the analogous experience of current Internet users interacting via multiuser domains (MUDs):

In text-based Internet MUD applications, many characters meet online and engage in virtual sex. Some even get married in virtual ceremonies. These fantasy relationships provide an opportunity for safe sex because there is no danger of contracting or spreading a sexually transmitted disease. Users also are engaged in an experience with another person, allowing them to participate within the boundaries of a shared sexual fantasy rather than an individual one. By knowing how a partner feels and what a partner enjoys, a player may become better able to interact with real partners by understanding their needs. (Calvert, 2002, p. 674, citation omitted)

As interesting as Calvert's perspective is, there are problems with extrapolating from the MUD experience of the present to the VR experience of the future. If the entity with whom one interacts intimately in a VR simulation is an avatar of another human, then the potentially positive effects that Calvert has described might possibly occur. However, I would point out that much sexuality in the VR realm is likely to include interactions with AI characters, not human ones; in particular, I anticipate that the AI characters involved will be programmed specifically to satisfy

the human user's expressed desire, acting essentially as a VR sex slave. The availability of a compliant sexual slave seems to be a popular fantasy; the concept of "Stepford wife" has been a part of American mainstream popular consciousness for over three decades (Goldman, 1974; Levin, 1972; Rudnick, 2004). However popular this fantasy is, its attainment is not the way in which one should expect to gain the skills at interpersonal communication that are a foundational element of mature adult sexual relationships (see, e.g., Hyde & DeLamater, 2003). How will the widespread availability of seamless (some would say zipless) VR sexuality affect the development of interpersonal skills and interactions between humans in the real world? (Regarding the term "zipless": see Jong, 1973.)

Calvert also noted areas in which VR sexual experiences might have negative social effects.

The anonymity afforded by cyberspace currently allows sexual deviants to act out with impunity. Issues of imitation, disinhibition, and desensitization may become serious issues as sexual activity becomes an immersive, online option.

Ethical issues, such as marital fidelity, will also be experienced in virtual spaces. How will a person feel if their [*sic*] partner has virtual sex with an imaginary character, or with a character who is a real person in another location? Will betrayal and infidelity be experienced? (Calvert, 2002, pp. 674-675, citation omitted)

These issues should be considered at greater length. Research cited earlier (Anderson et al., 2003; see also Funk, et al., 2003) suggests that, as people are exposed to violence in video games, they become desensitized to aggression in real life, and disinhibited in regard to acting out aggressive impulses in real life. We have no reason to believe that it will be any different in regard to VR sexuality. That is, repeated immersion in VR sexual scenarios may strengthen the expectation that, in the real world, as well, one's partner should be expected to do anything one wishes, without regard to one's partner's preferences. Beyond this, experiences in the virtual world may create the expectation that the acting out of violent or sadistic impulses during sexual behavior is normal and should be met with by compliance from one's partner. Such would be suggested by research conducted regarding exposure to violent pornographic films (Malamuth & Check, 1981). In a country that is already awash in sexual violence (Laumann, Gagnon, Michael, & Michaels, 1994; Schafran, 1995), these are not expectations that we should reinforce.

Even without the issue of violence involved, the availability of VR sexuality might lead to deterioration of sexual relationships in the real world. Such would be the extrapolation we might make from studies of the effect of printed or filmed pornographic images; exposure to such images in the laboratory seemed to make men rate "average" women, or their own partners, as less attractive (Kenrick, Gutterres, & Goldberg, 1989; Zillman, 1989). Thus, one possible consequence of widespread seamless VR might be a weakening of marital and familial bonds, resulting in an increase in the divorce rate. This would be a highly negative consequence, given what we know about the long-term effects of divorce on the children of such marriages (e.g., Wallerstein, Lewis, & Blakeslee, 2000). In addition, although the broader societal effects of large-scale divorce rates are only dimly known, one cannot imagine that increasing the divorce rate would add to social stability. Certainly it would be ironic for VR technology, which is intended to help individuals better adapt to the demands of the real world, to cause instead the deterioration of relationships in the real world. This is a good point at which to consider specifically the domain of home and family.

### **3.2 Home and Family**

Most people marry and have children; the resulting family groups have been the basic units of essentially all human cultures. What will happen when a VR simulation of this experience is available? The popularity of *The Sims*—"the best-selling computer game ever" (Hamilton, 2004, p. 78)—suggests that people want to try out alternative simulated lives and relationships. How will the availability of virtual family life affect people's desire or intention to pursue family life in the real world?

Consider this scenario. A single person, Jane or John Smith, ends work for the day and is at home. "Home," in a real-world sense, consists of a chair or two, a bed, a closet, a refrigerator, a table that serves as both dining and work space, a food preparation area, and a personal hygiene area, all of which fits into a studio apartment. However, this home also includes a personal VR system. Through this system, Smith lives in a mansion, with marble staircases, sauna, an Olympic-sized pool, private helipad, and other accoutrements. In this mansion lives, not only Smith, but also an attractive, caring partner, who may exist as an AI construct. Perhaps there are children as well, an entire family or extended family unit. Family and friends come by and visit, perhaps based in distributed VR networks that

enable Smith's real-world friends to interact in real time, or perhaps based on AI constructs. Family life, recreation, and adventure—almost every aspect of human life, short of the intake of nutrition and the elimination of waste products—can be simulated through VR. But how will this affect the individual or society?

One can imagine different possible outcomes here. One that seems plausible is that fewer people will marry and form family units. Although marriage and family life have their benefits, they also pose inevitable challenges and frustrations. VR, on the other hand, can provide a virtual simulation of a stress-free life. One's virtual partner can be programmed to be continually and unfailingly attentive, considerate, forever youthful, and eternally compliant with the wishes of the user of the VR system. One's virtual children can be programmed to be consistently polite and deferent; some other virtual character will change the diapers. In the short run, the opportunity to visit such a virtual world might be an enticing prospect for many people. However, in the long run, continual exposure to such a virtual world might raise unrealistic expectations concerning people in the real world. Frequent immersion in such a virtual world might allow one to escape from the tasks of adult life rather than attend to them. Ultimately, such immersion might make people less willing, or even less capable, of dealing with the frustrations involved in participating in real-world marriages and family units. (Consider my earlier comments on instant gratification, of which the flip side is intolerance for frustration.)

A decrease in the rate at which marriages and family units are formed and maintained should be considered a major negative consequence. As it is, the current rates of birth in developed countries are so low as to instigate major negative consequences in society in coming years (Kotlikoff & Burns, 2004; Longman, 2004; e.g., Faiola, 2005). A development that would retard the formation of stable family units in which children would enter the world would exacerbate what already will be a difficult situation. (An exception to this might involve areas where longstanding sexist, infanticidal practices involving the selective murder of female infants has left a surplus male population; because a male surplus is associated with increased crime and even warfare [Hudson & den Boer, 2004], it may be advisable to encourage virtual families in such areas.)

Of course, it may be argued that the availability of an escape from reality, judiciously applied, would 'let off steam' and allow the person to deal with the frustrations of the real world more effectively (cf. C. Pearce, quoted in Heins & Bertin, 2002). It is difficult to see how this perspective would apply to this issue; it seems counterintuitive to think that avoidance of the family might solve family problems. However, this difference in perspectives underlines the importance of settling this question with empirical research, rather than a priori arguments.

### **3.3 Religion and Spirituality**

We come finally to the realm of religion and spirituality. Casual investigation of the Internet suggests that many people like to involve themselves with their faith communities in a virtual way. There is even a Roman Catholic pseudo-“diocese” that exists only in virtual space (Gaillot, n.d.).

However, as can be seen with other comparisons between the Internet and virtual environments, VR has the potential to take things in a very different direction than the Internet. It is one thing to interact with others in a virtual space, and engage in the act of worshipping a god or goddess. It is another thing altogether to react in this virtual space with the gods themselves—something that VR can emulate. To go farther, it is yet another thing for one to become the embodiment of a god or goddess (the original meaning of “avatar”)—another experience that VR can emulate. What might be the societal consequences of such circumstances?

One framework used in the academic psychology of religion frames religion and spirituality as having five dimensions: knowledge, ideology, ritual, emotion, and behavior (adapted from Glock, 1962). VR has the potential to heavily influence at least two of these. In terms of knowledge, all the educational potential of VR is apparent here; for example, VR makes it possible to achieve total immersion in the holy languages of one's tradition, whether that language be Sanskrit, Latin, or Sindarin. In terms of ritual, VR would give one the opportunity to conduct almost any ritual, regardless of time, place, or one's hierarchical status (e.g., not being officially consecrated as clergy).

What will it mean when spiritual rituals can be enacted virtually by anyone? At any time, or place? Will something be lost by divorcing rituals from their traditional context in time or space? Or, will the potentially greater amount of participation add to the spiritual lives of the people who enact these rituals? Will the process of being involved with

an in-person worship community become passé? Or, will the experience of private spirituality change independently of the evolution of communal spirituality?

One aspect of spirituality that may be transformed thoroughly is the matter of spiritual experimentation. Such experimentation in the real world sometimes carries social consequences that are uncomfortable (e.g., being around strangers) or downright aversive (e.g., conflict with or even excommunication from one's 'home' tradition). No such consequences exist in the virtual world. In American consumer culture, some people already practice a form of what some sociologists call "supermarket religion," picking what they want from this or that tradition. In the VR world of 2025, however, these opportunities will be considerably expanded. One may pick any tradition, of any time, existing in the real world or in the imagination, and try it on for size. For that matter, one may create one's own tradition, and populate it with ritual, symbol, and virtual co-worshippers (either avatars of real world humans, or AI constructs).

No doubt this will come with social consequences, as well. Will real world spiritual communities decline as virtual private spiritual pseudo-communities flourish? Or, will people try on the virtual experience and find that they now want to engage the real world counterpart? Will people reconfigure worship communities in a distributed VR environment? Will people more easily change (i.e., convert) from the religious communities of their heritage? If so, what will that do to traditions that have added some stability to their communities for millennia?

## 4 Research Questions and Approach

I have indicated some broad research questions above. The Delphi method (Linstone & Turoff, 1975) may be helpful to generate other questions.

The simplest form of the research question facing us is, how will VR affect individual and group psychological variables and behavior? There are more and less sophisticated ways in which to address this question. In a schematic sense, this is a question involving how variable  $x$  affects variable  $y$ . However, it would probably be more worthwhile to consider, not a simple  $x$  and  $y$  pair of variables, but a collection or set of super-variables,  $X$  and  $Y$ , each of which would represent a host of variables involving VR and human psychology, respectively.

This approach recognizes a distinction that was long ago set out as a guiding vision for research in psychotherapy and counseling. It is not a simple matter of whether treatment affects a person. Rather:

The question towards which all outcome research should ultimately be directed is the following:  
*What treatment, by whom, is most effective for this individual with that specific problem, and under which set of circumstances.* (Paul, 1967, p. 111; italics in original)

This approach has been called the "matrix paradigm" of counseling and psychotherapy research, because it specifies a 5-dimensional matrix within which to lay out the parameters of practice research (i.e., treatment x practitioner x client x problem x context, or circumstances; Stiles, Shapiro, & Elliott, 1986, p. 168). A similar type of matrix approach might be taken regarding research into the psychosocial effects of VR. **The question is, what types of VR exposure, with what type of individual or group, under which set of circumstances, create what effects, in which areas of psychological, interpersonal, or social function?**

As a very tentative list of types of VR exposure ( $X$ ), I might include the following variables: type and degree of *aggressive content* (either pre-programmed or potential), type and degree of *sexual content* (either pre-programmed or potential), type of *interacting others* (i.e., avatar of human in the real world, versus AI agent), degree of *user control over the scenario* (i.e., on a continuum from no control at all through omnipotence), and degree of *user control over the actions of others* (i.e., on a continuum from no control at all through total control).

Psychosocial research has often been hampered by taking too narrow a view of the psychological variables that might influence behavior (Koltko-Rivera, 2005b). A minimum list of psychological user variables ( $Y$ ) to consider in VR-related research would include the following: *mental aptitude*, *mental conditioning* (i.e., training and experience), *personality* (Koltko-Rivera, 2004a), *affect* (Ganey, Murphy, Dalton, Koltko-Rivera, & Hancock, 2004), *motivation*, *worldview* (Koltko-Rivera, 2004b; Koltko-Rivera, Ganey, Dalton, & Hancock, 2004), and *acculturation* (Chun, Ball Organista, & Marín, 2003; Koltko-Rivera, Ganey, Dalton, & Hancock, 2004; Ryder, Alden, & Paulhus, 2000). (For a more detailed description of this approach to research, see Koltko-Rivera, 2005b.) Of course, one of

the most important types of variables involving a user or group of users is not a psychological one, per se, but rather the *behavior* that the user or users engage in; many real-world behaviors may be of interest in relation to VR.

Research might take the form of either experimental or quasi-experimental approaches. Experimental approaches might include: (1) ‘Simulation of simulation,’ wherein researchers simulate currently unobtainable seamless VR effects (perhaps using actors); (2) analogue studies involving, for example, exposure to aggressive or sexual or other video stimuli; and, (3) responses to “what if” scenarios presented to research participants. Quasi-experimental approaches might include in-the-field studies of the effects of immersive environments using current technology. Multivariate data from these efforts might be analyzed using multiple regression (Licht, 1995; Pedhazur, 1997) and structural equation modeling (Klem, 2000; Kline, 1998).

## 5 Conclusion

What would be the outcome of such research? Certainly the discovery of potential negative effects of VR technology, if any, would be sufficient motivation for engineers, social scientists, and perhaps legislative experts to consider and implement countermeasures. These might involve any number of options, from the VR equivalent of the television “V” chip to guidelines for user licenses for this technology, not to mention many software solutions. The point of this would be to minimize negative effects and maximize benefits from VR technology.

VR has the potential for massive psychosocial impact. It would be wise to take a proactive approach to the matter of VR’s psychosocial impact. One way to do this is for professionals both in VR engineering and in social science to cooperate in conducting research into the possible effects of this powerful, transformative technology.

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