TRANSFORMATIVE INTERACTIONS USING EMBODIED AVATARS IN COLLABORATIVE VIRTUAL ENVIRONMENTS: TOWARDS TRANSDISCIPLINARITY

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by
Barbara E. Truman
B.A. University of Central Florida, 1994
M.A. University of Central Florida, 1996

Colorado Technical University

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Committee

Cynthia Calongne, D. CS, Chair

Andrew Stricker, Ph.D., Committee Member

Patsy Moskal, Ed. D., Committee Member

December 19, 2013

Abstract

My research explored the relationship dynamics of personal identity and intersubjective, group dialogue using avatars in collaborative virtual environments (CVEs). Two proposed constructs, *virtual-physioception* and *virtual intersubjective presencing* formed the basis of an online survey exploring group, avatar, and individual experiences. Measures were adapted from Andrew Stricker of The Air University (United States Air Force) and the US National Cancer Institute's Team Science Toolkit. The constructs were framed around an inferred discipline of *presencing* built upon research performed by Peter Senge and Otto Scharmer of MIT. Correlations were found between avatar embodiment and interdisciplinary professional/personal development practices suggesting the collaborative potential of CVEs to support both constructs. Resultant qualitative themes included levels of avatar embodiment culminating in a state of transdisciplinarity based upon self-leadership practices. Heuristics for collaboration using embodied avatars were created based on findings of mixed, quantitative and qualitative analysis and literature review. Future research is proposed into *virtual learning organization communities* as blended, virtual-physical lifestyles reliant upon strengths-based practices. Future collaborative research was recommended connecting CVE use with simulators and experimentation with open virtual conferences as platforms for community engagement in support of collective intelligence for mass collaboration and crowdsourced, citizen science.

Dedication

For Grace
My mother and ambition

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Epigraph

Carpe Vitam

Keywords: embodied avatar, collaborative virtual environments, dialogue, collaboration, transdisciplinarity, virtual self, presencing, team science, somatic awareness, human computer interaction, human systems integration, embodied computing, anthropomorphism, embodied interaction

Table of Contents

List of Figures

List of Tables

Nomenclature

Abbreviations and Acronyms

AI- Appreciative Inquiry
ARG- Alternate Reality Game
CoP- Communities of Practice
CIRET- International Center for Transdisciplinary Research and Studies
CI- Collective Intelligence
CVE- Collaborative Virtual Environment
GLF- Global Learning Forum
IDR- Interdisciplinary Research
IEEE- Institute of Electrical and Electronics Engineers
ISTE- International Society for Technology in Education
LARP- Live-Action Role-Playing Games
MMO- Massively Multiplayer Online environment
MMOG- Massively Multiplayer Online Game
MMORPG- Massive Multiplayer Online Role Playing Game
MOOC- Massively Open Online Course
MOSES- Military Open Simulation Enterprise Strategy
MUVE- Multiuser Virtual Environment
NCI- National Cancer Institutes
NIH- National Institutes of Health
NMC- New Media Consortium (United States)
NSF- National Science Foundation
OpenSim- Open Simulator
SAVI- Science Across Virtual Institutes (US National Science Foundation)
SciTS- Science of Team Science
SL- Second Life
STEM- Science, Technology, Engineering & Mathematics
SPSS- Statistical Analysis in Social Science
TD- Transdisciplinary
TDC Transdisciplinary Collaboration
TDS- Transdisciplinary Science
TI- Transdisciplinary Inquiry
TR- Transdisciplinary Research
TREC- Transdisciplinary Research on Energetics and Cancer
TSI- Transformed Social Interaction
TTURC- Transdisciplinarity Tobacco Use Research Centers
Ubicomp- Ubiquitous computing
UNESCO- United National Educational and Scientific Organization
VLOC- Virtual Learning Organization Community
VW- Virtual World
VWBPE- Virtual Worlds Best Practices in Education
VWER- Virtual Worlds Education Roundtable
WoW- World of Warcraft

Nomenclature Review

The following section elaborates on definitions useful to understand concepts broadly framed in this study. Where practical, terms are presented if common knowledge is lacking or overused. Consistency of usage and consensus among scholars for terminology varies. It is recommended to become familiar with these terms before reading the chapters that follow. The document has been structured for multiple entry points to accommodate multiple domains of inquiry. Sections are minimally duplicative in most cases. The nomenclature section and chapters compliment and complement each other.

The term discipline is frequently used and refers to either an academic field of study or a personal habit or practice.

Appreciative Inquiry

Appreciative Inquiry (AI) is one of four theoretical frameworks used as a basis for this study. AI originated in the Weatherhead School of Management at Case Western Reserve University in the 1980s and helped launch the strengths-based movement used in organizational development. AI is taught in business schools and used in organizational development. Dr. David Cooperrider is considered responsible for originating and championing AI. The late Suresh Srviastva was Cooperrider's mentor and the pair first wrote about AI in 1987.

According to Cooperrider and his collaborator Diane Whitney:

> Appreciative Inquiry is about the coevolutionary search for the best in people, their organizations, and the relevant world around them. In its broadest focus, it involves systematic discovery of what gives "life" to a living system when it is most alive, most effective, and most constructively capable in economic, ecological, and human terms. AI involves, in a central way, the art and practice of

> asking questions that strengthen a system's capacity to apprehend, anticipate, and heighten positive potential. It centrally involves the mobilization of inquiry through the crafting of the "unconditional positive question" often-involving hundreds or sometimes thousands of people. In AI the arduous task of intervention gives way to the speed of imagination and innovation; instead of negation, criticism, and spiraling diagnosis, there is discovery, dream, and design. AI seeks, fundamentally, to build a constructive union between a whole people and the massive entirety of what people talk about as past and present capacities: achievements, assets, unexplored potentials, innovations, strengths, elevated thoughts, opportunities, benchmarks, high point moments, lived values, traditions, strategic competencies, stories, expressions of wisdom, insights into the deeper corporate spirit or soul-- and visions of valued and possible futures (Cooperrider & Whitney, 2001, p.1).

Transdisciplinarity

The origins of transdisciplinarity are traced to Jean Piaget, the Swiss psychologist and philosopher who was credited in coining the term around 1969 in France. Three types of transdisciplinarity are described in the literature and they are: theoretical, phenomenological, and experimental.

Basarab Nicolescu, a physicist from Romania, is widely considered the father of transdisciplinarity and holds several international honorary titles. Nicolescu is the founder of the International Center for Transdisciplinary Research and Studies (CIRET), a non-profit organization founded in 1987 located in Paris, France. CIRET was formed after a World Congress was held in 1985 on transdisciplinarity in Portugal. The quantum revolution and a need to speak for nature spurred Nicolescu's *Manifesto of Transdisciplinarity*: ". . .transdisciplinarity concerns that which is at once between the disciplines, across the different disciplines, and beyond all discipline. Its goal is the *understanding* of the present world, of which one of the imperatives is the unity of knowledge" (Nicolescu, 2002, p. 44). Transdisciplinarity is not a discipline itself, but it benefits from disciplinary research; likewise disciplinary research benefits from

transdisciplinarity as a complementary provider of clarity. Transdisciplinarity has three pillars: multiple levels of Reality, the logic of the included middle, and complexity.

Nicolescu (2002) stated that adherence to one level of Reality eliminates the sacred (p.54). He cited how the word 'Nature' has disappeared from science vocabulary (p. 57) and stated that Nature can only be conceived in terms of being human such that as if the book of Nature were being written, it is not to be read, rather to be experienced as if we participate in the writing of the book of Nature (Nicolescu, 2002, p. 65).

Can new forms of collaboration serve as bridges to disciplines? Nicolescu said, "Transdisciplinarity can be understood as being both the science and the art of discovering these bridges. It is there that we find the framework for an authentic revolution in intelligence (2002, p. 89).

After other publications appeared with pragmatic perspectives aimed at using transdisciplinarity to solve wicked problems, Nicolescu (2003) elaborated on his view of the definition of transdisciplinarity:

> … transdisciplinarity is the new 'in vivo' knowledge, founded on the following three postulates: 1. There are, in Nature and in our knowledge of Nature, different levels of Reality and, correspondingly, different levels of perception; 2. The passage from one level of Reality to another is insured by the logic of the included middle; 3. The structure of the totality of levels of Reality and perception is a complex structure: every level is what it is because all the levels exist at the same time (p. 2).

Dr. Alfonso Montuori, Professor of Transformative Leadership at the California Institute of Integral Studies has written extensively on transdisciplinarity in the United States. Montuori stated that the three traditional pillars of transdisciplinarity should have a fourth added to include *being*. Montuori restates the pillars as:

One: Inquiry Based rather than Discipline Based

Two: Must know how different kinds of knowledge is constructed

Three: Complex thinking that connects and contextualizes

Fourth: Integrate the observer into the observed (Volckmann, 2009, p. 280)

Finally, transdisciplinarity should be meta-paradigmatic as it involves moving across disciplines and their theories. The fundamental assumptions underlying disciplines, theories, and paradigms must be understood (Montuori, 2013a, para.2).

On a more pragmatic, phenomenological level, the following definition came out of an international meeting hosted by the Swiss National Science Foundation held in Zurich, Switzerland in February 2000:

> Transdisciplinarity is a new form of learning and problem solving involving cooperation among different parts of society and academia in order to meet complex challenges of society. Transdisciplinarity research starts from tangible, real-world problems. Solutions are devised in cooperation with multiple stakeholders. A practice oriented approach, transdisciplinarity is not confined to a close circle of scientific experts, professional journals and academic departments where knowledge is produced. Ideally, everyone who has something to say about a particular problem and is willing to participate can play a role. Through mutual learning, the knowledge of all participants is enhanced, including local knowledge, scientific knowledge, and the knowledges of concerned industries, businesses, and nongovernmental organizations (NGO's). The sum of this knowledge will be greater than the knowledge of any single partner. In the process, the bias of each perspective will also be minimized (Hurni; Pohl) as seen in (Klein, et al., 2001, p. 7).

Multidisciplinary

The terms cross-, multi-, inter- and trans-disciplinary are often interchanged. In terms of research, more than one discipline makes a complementary contribution separately on distinct parts of research. Approaches and facilities may be shared while working separately (National Academies, Committee on Facilitating Interdisciplinary Research, 2004, p. 3). Nicolescu (2007) wrote that multidisciplinary goals remain limited to the framework of the disciplinary research while overflowing disciplinary boundaries

in approach (p.4). Emerging technologies shape thought as well as manifestations of collaboration inherit in the technology.

> When a particular science, for instance high-energy physics or astrophysics, uses, in an essential, endogenous way, sophisticated technologies, without which its development would not be possible, then, that science–technology is, for internal epistemological reasons, a multidisciplinary activity (Alvargonzález, 2011, p. 392)

Interdisciplinary

Interdisciplinarity signified a new metalevel of discourse involving the synthesis of two or more disciplines (Klein, 1990, p. 66). One indicator of interdisciplinarity is whether research can be published in either field(s) for which collaboration occurred. Nicolescu (2007) said interdisciplinarity concerned the transfer of methods between disciplines including new knowledge that could create new disciplines (p.18). An example of interdisciplinarity includes how biomimicry has shaped architectural design (Davies, Fidler & Gorbis, 2011, p. 11). Choi & Pak (2006) recommended that interdisciplinarity results in a coordinated and coherent whole as disciplines are linked, synthesized, and harmonized (p. 359).

National Academies, Committee on Facilitating Interdisciplinary Research (2004) defined Interdisciplinary Research (IDR) as:

> a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice (p. 29).

An example of the integration and synthesis of methods yielding new insights is found in string theory that serves both mathematicians and theoretical

physicists (National Academies, Committee on Facilitating Interdisciplinary Research, 2004, p. 54).

Transdisciplinary

According to Nicolescu (2002) “In the transdisciplinary vision, reality is not only multidimensional, it is multi-referential" (p. 55). Transcendence across disciplines is possible as transdisciplinary collaborations occur (Contractor, Amaral, Uzzi & Monge, 2009, p. 9). The creative potential for cross-disciplinary research increases through the passage of multidisciplinary to transdisciplinary, conceptually integrated practices. More dialogue and collaboration are required among scholars from different fields, especially when sharing a conceptual framework (Rosenfield, 1992 as seen in Stokols et al., 2003, p. S24). One of the distinctions of transdisciplinary research is the involvement in stakeholders in decision making at many levels of activity from conception to completion.

Additional terms not elaborated upon here include transdisciplinary collaboration (TDC) and transdisciplinary science (TDS). They often differ in their intellectual aspirations (Stokols et al., 2003, p. S22) and should not be confused with transdisciplinary research (TR). A comprehensive site for international transdisciplinary research can be found at the Swiss web site: td-net http://www.transdisciplinarity.ch/e

Mass participatory culture using social media and mobile devices contribute to the socio-technical and socio-cultural factors fueling transdisciplinary thinking. Rasmussen, Andersen & Borch (2010) suggest a participatory strategy is required to support transdisciplinary:

> The transdisciplinary approach calls for bringing new actors and stakeholders into knowledge production as well as debates. A lack of common language and traditions can be a barrier to communication across professions, and the facilitator has to be familiar with the fields involved. The facilitator also has to bridge, couple and integrate concepts and theories from various groups of stakeholders, both scientific and non-scientific, to identify interfaces and crossroads between disciplines, paradigms and stakeholders, and to support the formation of joint visions and ownership of strategies (p. 43).

Fernheimer, Litterio & Hendler (2011) described researchers' calls for concerted inquiry to address high-stakes societal, real-life problems where knowledge is uncertain and the nature of problems are disputed (Hirsch Hadorn et al., 2008, p.34).

In the United States, a major program contributing to the programmatic assessment of transdisciplinary work stemmed from the Transdisciplinary Tobacco Use Research Centers (TTURCs) created and funded in 1999 from a combination of agencies. These funders required evaluation and involved the National Cancer Institute (NCI), the National Institute on Drug Abuse, and the Robert Wood Johnson Foundation (National Academies, Committee on Facilitating Interdisciplinary Research, 2004, p. 167). An outcome from the TTURC initiative was to create coordinating centers responsible to assist in the collaboration among faculty and researchers within large-scale, transdisciplinary grant projects. The Science of Team Science arose as a result of lessons learned from the TTURC initiative (Patterson, et al., 2013, p. 8).

The Transdisciplinary Research on Energetics and Cancer (TREC) Initiative was initiated after the TTURC Initiative and was architected based on the premise that the exchange of ideas and resources across disciplines increase the potential and acceleration for achieving scientific breakthroughs. Harvard University, University of California San Diego, University of Pennsylvania, and Washington University in St. Louis were the four institutions that received funding in 2011 as part of the TREC Initiative. The Fred

Hutchinson Cancer Research Center in Seattle, Washington is the Coordination Center for the TREC (Patterson et al., 2013, p. 1). One of TREC's key challenges is assessing outcomes for broader impacts. Representative experts of the Science of Team Science will assist along with the Coordinating Center. Outreach, educational programs, peer-reviewed publications, and the effectiveness of collaborative research will be evaluated (Patterson et al., 2013,
p. 8).

Collaboration

For the purpose of this dissertation, collaboration surrounds the notion of shared goals. The terms cooperation and collaboration are often used interchangeably, but collaboration involves a metacapability often necessary for use in research and development among industries. Such capabilities cannot be easily learned or transferred. Merely serving as a member on a team does not necessarily result in attaining such metacapabilities (Montoya, Massey & Lockwood, 2011, p. 451). Collaboration frequently requires significant investment in relationship and trust building activities. Devouard, (2008) distinguishes well between cooperation and collaboration stating, cooperation aims at "getting mutual benefits by sharing or generally partitioning the work to be done (thus saving on time and costs)" while "collaboration is meant to enable the emergence of understanding and realization of shared visions in complex environments or systems" (p. 39).

Collaboration is used to attain results not achievable by working independently. Collaborative research among diverse scientists and universities requires coordination and support. On an organizational level commitment to collaboration is also required

especially, “to a definition of mutual relationships and goals; a jointly developed structure and shared responsibility; mutual authority and accountability for success; and sharing of resources and rewards" (Mattessich & Monsey, 1992, p.4).

Collaboration does not necessarily require harmony. Bennett, Gadlin, & Levine-Finley (2010) described how Daniel Kahneman, Nobel Prize-winning behavioral scientist, used a methodology of adversarial collaboration elevating science above personal rivalry for people with competing perspectives to help them, "work toward the solution of shared problems and puzzles" (p. 42). Among collaborative endeavors, there are cases of participants who demonstrate leadership formally and informally. "Collaborative leaders in preventive medicine can, and should, emerge to help structure the foundations for mass collaboration needed to solve problems of unprecedented complexity in an increasingly connected global environment" (Hesse, 2008, p. S238). Mostly, collaboration requires commitment in addition to shared goals, trust and respect (Devouard, 2008, p.39).

Team Science and Science of Team Science

Team Science may be confused with the emerging field of the Science of Team Science. Team Science has been described as an often cross-disciplinary approach to scientific inquiry attracting researchers who work as co-investigators on smaller-scale projects within collaborative groups and institutional centers (Bennett, Gadlin & Levine-Finley, 2010, p. 1). The Science of Team Science, also referred as ‘SciTS’ encompasses an: “amalgam of conceptual and methodologic strategies aimed at understanding and enhancing the outcomes of large-scale collaborative research and training programs" (Stokols, Hall, Taylor, & Moser, 2008, p. S77).

Some funding agencies endeavor to assess the collaborations funded as part of grants spanning many disciplines and institutions. The (SciTS) field is not involved with the phenomena under study as a result of funding (e.g., cancer, addiction, obesity and eating disorders, environmental concerns), but rather on:

> understanding and enhancing the antecedent conditions, collaborative processes, and outcomes associated with team science initiatives more generally, including their scientific discoveries, educational outcomes, and translations of research findings into new clinical practices and public policies (Stokols, Hall, Taylor, & Moser, 2008, p. S78).

Some of the theories surrounding Team Science include the theory of contagion, homophily, proximity, and the function theory of leadership (p. S78).

Communities of Practice

Etienne Wenger (1998) originated the Communities of Practice term that encompassed four dimensions: negotiation of meaning, preservation and creation of knowledge, spreading of information and as a home for identities (p. 252). Michael Schratz (2009) described challenges related to an international project that involved seeking cultural understanding. Schratz' experience showed that communities of practice do not happen automatically: "It frequently involves painful discoveries, difficult transitions, and learning through hard-won experience. … Each stage of community development, like each stage of human development, confronts the community with a central challenge" (p. 291).

Communities are often formed as a result of playing massive online games. Some communities formalize into guilds losing casual members. Or guilds expel members as more serious play is sought through game mechanics (Williams, Ducheneaut, Xiong,

Zhang, Yee & Nickell, 2006, p. 343). "Aside from in-game communities, players may also join online communities outside the game to discuss particular games or genres, including game strategies, game designs, genre characteristics, etc." (Moncarz, 2012, p. 46). These groups may form into communities of practice operating outside of the game focusing on other goals. "Communities of practice, inside and outside the game, will encourage reflection and discussion of the game and meta-game, respectively" (p. 46).

Collective Intelligence

The term collective intelligence was originally coined in 1994 by Pierre Levy, a philosopher and cultural theorist researching media in cyberspace at the University of Ottawa in Canada. Levy (2011) frames what drives his research as: "How can the ubiquitous resources of communication and computing offered by the digital medium by fully exploited in modeling and augmenting human collective intelligence" (p. 165).

Collective intelligence is an enabler of collaboration and a by-product of socially-shared cognition. Conklin (2005) states there are natural forces challenging collective intelligence, "forces that doomed projects that making collaboration difficult or impossible. These are *forces of fragmentation"*(p. 3). Fragmentation of knowledge is a focus transdisciplinary approaches seek to unify. Conklin added, "The antidote to fragmentation is shared understanding and shared commitment" (p. 4). Time is usually a benefactor of collaboration and collective intelligence. Opportunities to have meaningful communication must be architected or engineered whether members have the ability to meet face-to-face or work virtually across time zones. Holton (2002) is attributed with how time for communication enables overcoming differences, "Particularly important is the need to ensure adequate time is devoted to creating shared meaning and commitment

to a culture of collaboration (as seen in Davis, Murphy, Owens, Khazanchi, & Zigurs, 2009, p. 103).

The Global Learning Forum (GLF), a community within Second Life spanning multiple military and educational organizations in the United States, collaborates and conducts research on prototyping in the Cognition and Instructional Technologies Laboratory (CITL). Areas of research examined include collective intelligence for collaborative problem solving such as augmented by cybernetic feedback systems (Stricker, Holm, Calongne, McCrocklin, 2011, p.2). Members of the Global Learning Forum participate across communities such as with the MOSES OpenSim project and the Virtual Harmony OpenSim and Loire Design Thinking in Virtual Worlds Massively Open Online Course (MOOC).

Collective intelligence is often involved when creating and publishing media as a by-product of participatory culture. Clay Shirky (2008) suggests the practice of ‘publish first then filter’ is common in participatory culture (p.79). Producing media is an expectation of digital citizens who contribute to collective intelligence. Fernheimer, Litterio, & Hendler (2011) illustrated the socio-technical drivers that feed into collective intelligence, "Characterized by user control of data, cost-effective scalability, collective intelligence, and an architecture of participation, Web 2.0 fosters a culture of ‘prosumers’ who both read and create Web content" (p. 324).

Collaborative Virtual Environments

For the purpose of this dissertation, the term collaborative virtual environment (CVE) was selected, which may also be known as virtual worlds (VW), virtual environments (VE), multiuser virtual environments (MUVE) and immersive

environments. The next sections describe some common CVE instantiations. CVEs allow geographically distributed users to interact in real time via screen technology enabling users to share space exchanging verbal and non-verbal communication techniques. "Traditionally, CVEs are roughly defined as ‘geographically separated interactants’ interacting over some kind of a computer-mediated network in a shared environment” (Bailenson, Beall, Loomis, Blascovich & Turk, 2004, p. 437).

Many CVEs share a base of literature with computer-mediated communication that corresponds with the social networking aspects incorporating profiles, chat, contact lists, and enable more private conversations. "Desktop CVEs are technically simple compared with immersive CVEs and can be adapted according to the needs of the users" (Allmendinger, 2010, p. 41)**.** Simulation technologies have evolved dramatically affording home and work use. “Access to CVE is by no means limited to desktop devices, but might well include mobile or wearable devices, public kiosks, etc." (Churchill, Snowdon & Munro, 2001, p. 4).

The prospect of virtual Team Science using CVEs is possible through increased computing power, reduced equipment costs, and ubiquitous computing.

> The use of 3D CVEs as collaboration platforms represents an entirely new way for geographically distributed team members to interact and work. Although virtual work has always been considered to be missing some important aspect of human interaction, 3D CVEs have the potential to change this perspective as they grow more sophisticated and realistic (Montoya, Massey & Lockwood, 2011, p. 452).

MUVEs and Second Life

Second Life (SL), an online 3-D virtual environment, began in 2003 and has a world-wide user base. “The global reach of SL and the opportunities it provides for cross-

cultural exchange using multiple modes of communication in real and virtual worlds make it an ideal venue to examine cross-cultural engagement" (Diehl & Prins, 2008, p. 101).

Unlike massively-multiplayer online role-playing games (MMORPGs), Second Life does not employ rule-sets to structure in-game achievements and goals. The environment affords constructive activities that encourage sharing. “Since user behavior is neither pre-defined nor restricted, scholars have recently turned to Second Life as a research platform to study how people behave in the virtual environment" (Yee, Bailenson, Urbanek, Chang, & Merget, 2007; Friedman et al., 2007; Eastwick & Gardner, 2008) as found in (Harris, Bailenson, Nielsen & Yee, 2009, p.438).

Calongne (2009) described features of MUVEs (multiuser virtual environments) as having 3-D graphics that ‘come to life’ with high quality sounds, streaming audio and video. Second Life, a platform supported by Linden Lab, provides interaction with other players or residents via the public text-based chat, instant messaging and voice chat (p. 131). MUVES offer rich opportunities for interaction, exchanged between participants and content making them useful for education, socialization and entertainment. Calongne added, "The immersive nature of today's virtual environment does not require specialized end-user equipment, such as headmounted display (HMD) device or data glove" (Calongne, 2009, p. 131). Harris, Bailenson, Nielsen, & Yee (2009) stated desktop virtual environments can be used to study social phenomena. “Even through desktop interfaces, individuals react to the mere presence of human representations sharing the same virtual space, just as they would immersive virtual environments or real life" (p. 437).

Second Life allows content to be created within the program or uploaded by users, called residents. All objects in Second Life are scriptable to perform various behaviors and many objects can be easily purchased through a robust online community of artists, builders, and scripters. As a CVE platform, Second Life has improved as a technology and reduced its appeal among some users for a variety of reasons including intellectual property rights. Second Life's mature, adult uses restrict underage users and make it more difficult to obtain funding support. Some educators prefer Second Life's affordances stating "Second Life easily lends itself to researchers as a data collection environment" (Dean, Murphy & Cook, 2009, p. 2).

The United States Army's Simulation & Training Technology Center (STTC) within the Army's Research lab created the Military Open Simulation Enterprise Strategy Project (MOSES) to investigate virtual worlds. Second Life was explored for social interactivity and its objects that allowed computational steering representing a major departure from traditional virtual training environment creation process (Maxwell & McLennan, 2012, p. 1). MOSES' community leaders participate in Second Life regularly, but OpenSim was selected for the Army's CVE needs.

OpenSimulator – MOSES' Platform of Choice

The OpenSimulator website describes the software as open source, multi-platform, multi-user 3D application server useful to set up and create a virtual environment accessible through a variety of clients via multiple protocols. The software can be configured to allow users to hypergrid (visit) to other OpenSimulator installations across the web from an account on a 'home' OpenSimulator installation (OpenSimulator, 2013).

The Military Open Simulation Enterprise Strategy (MOSES) is a unique, cross domain collaborative project created by the United States Army's Simulation & Training Technology Center (STTC) as a program to replace the investments made into Second Life Enterprise, a program discontinued by Second Life's maker Linden Lab. In early 2011, about a dozen Open Simulator experts obtained access to MOSES shown at the 2011 Defense GameTech Users Conference in Orlando, Florida (Maxwell & McLennan, 2012, p. 2). Users from government, other military services, and educational organizations were offered the ability to request participation in the MOSES community. In-world meetings were held weekly where users shared experiences with the experimental software usually through text chat. Community participation allowed cross pollination of cultural domains between military, education, and industry. Approved organizations were given virtual land for free as part of a transparent, applied research and development agenda. The virtual land has terrain called a "sim" configurable for users' unique needs. "The amount of processing capability and memory dedicated to each sim are variables left to the administrator and is highly dependent on the available hardware resources and user behavior" (Maxwell & McLennan, 2012, p. 3). In 2013, distributed scene graph experiments were conducted to research how the OpenSim environment could be scaled for thousands of simultaneous users (see *Figure 27*. MOSES Distributed Scene Graph Load Test with Intel Labs). Future research is being conducted on combining physical and virtual training using MOSES and OpenSim (see *Figure 28.* MOSES Field Training Experiment).

The Active Lab@UCF (2012) reported simulation users and developers found MOSES to be valuable for facilitating research, testing secure collaborations, and

delivering e-learning experiences (p. 12). Douglas Maxwell, Manager of the Science and Technology Center at the U.S. Army's Research Lab led the MOSES initiative's technical research and facilitated regular community meetings. Maxwell described the collaborative nature of the research, "MOSES is not a product, but intended to be a best practice strategy for other organizations wishing to deploy an Open Simulator based virtual world. (Maxwell & McLennan, 2012, p. 2).

3D immersive virtual world simulations provide a way to simulate complex problems, learn the skills required to solve them, and allow improvisational discovery which builds an understanding of complex processes allowing for solutions to be found (Jenkins, 2009 as seen in Buede, D., DeBlois, B., Maxwell, D., & McCarter, 2013, p.2). A similar initiative to MOSES originating in the Netherlands invited by the European Defense Agency found distributed experimentation with OpenSimulator was cost effective. A recommendation was made to test larger-scale experiments with more users (Gregory & Rulof, 2013, p. 11).

MMOG: World of Warcraft

This dissertation is weighted toward CVES possessing constructive properties for co-constructing the environment, activities, and interactions. MMOGs and more specifically, World of Warcraft are examined as a reflection of the extant literature surrounding gaming communities and guilds engaged in collaboration. This dissertation does not examine the richness found in many MMOGs nor does it discuss the literature surrounding game design and play.

Constance Steinkuehler, associate professor of Digital Media and Curriculum & Instruction at the University of Wisconsin, Madison has been a leading researcher in the

United States on the use of massively multiplayer online games (MMOGs). Steinkuehler coordinates an annual gaming conference held in Madison called Games, Learning, and Society. The event attracts thousands researching the application and development of game-based learning. Steinkuehler has also served in the Whitehouse as a senior policy advisor and was affiliated with the National Science Foundation's Cyberlearning grant initiative. Steinkuehler & Chmiel (2006) defines MMOGs: "Massively multiplayer online games (MMOGs) are 2- or 3-D graphical, simulated worlds played online that allow individuals to interact, through their digital characters or "avatars" not only with the designed environment in which activities take place but also with other individuals' avatars as well" (p. 724).

Michael McCreery (2011), assistant professor at the University of Little Rock, Arkansas described MMOGs as having 1) a mixed goal-orientation with no particular beginning or end. There is also no score. Inhabitants (verses residents in Second Life) "can socialize, build relationships, and develop cultural artifacts central to the play space or take part in a token economy, which reward accomplishments upon the completion of tasks or perhaps overcoming an opponent in battle" (p. 36) McCreery added 2) MMOGs are pseudo-extensible 3) MMOGs are multiplayer and 4) MMOGs are persistent and narratives evolve (p. 36).

Ubiquitous Computing

Ubiquitous (found everywhere) and computing (benefiting from use of a computer) is far different when the terms are combined to denote the term ubiquitous computing. Mark Weiser is considered the father of ubiquitous computing. Weiser refers to calm technology where computing recedes into the background. Ubiquitous computing

is also known as the third wave of computing, which comes after the use of mainframes and personal computers. Unlike virtual reality where the user is inside the computer, ubiquitous computing is everywhere else outside of the computer (Weiser, 2013).

Game designer and author Jane McGonigal thoroughly discussed the evolution of ubiquitous computing in her dissertation (2006) and applied her interpretation of ubiquitous computing's future potential to gaming, collaboration, and culture. McGonigal suggested three distinct pairs of design philosophies and aesthetic practices have emerged as part of the ubiquitous computing and game studies literature. They are ubicomp gaming, pervasive gaming, and ubiquitous gaming (McGonigal, 2006, p. 51).

Virtual-Physioception

Virtual-physioception is one of two proposed constructs created for this study that emerged from the literature review and discernment. *Virtual-physioception* is the phenomenological or subjective-awareness of shared self-representation concurrently across virtual and physical spaces arising from meta sensory information from combinatorial interoceptive, proprioceptive, and exteroceptive processing (A. Sticker, personal communication, August 2, 2013).

Extroceptive describes stimuli received from outside an organism.

Interoception involves processing of sensory input from within the body.

Proprioception describes how the brain knows where its physical limbs are at any given time. When this capability is damaged by stroke or brain injury, proprioception must be remapped in the brain to allow for walking or other actions to be relearned.

> Proprioception and interoception… are processed 'before we know it', pre-cognitive, unconsciously. Interoceptive information, for example, is not identical

> to interoceptive awareness. Some of this information can enter consciousness, and we become aware of it (Mehling et al., 2009, p. 2).

Metacognition

Metacognition represents one of the two domains in this study that required a refinement of construct to associate with behavior and interactions involving avatars in collaborative virtual worlds. The father of the field of metacognition, John Flavell, (1979) implied the influence of the environment on learning when he wrote:

> Perhaps it is stretching the meanings of metacognition and cognitive monitoring too far to include the critical appraisal of message source, quality of appeal, and probable consequences needed to cope with these inputs sensibly, but I do not think so. It is at least conceivable that the ideas currently brewing in this area could someday be parlayed into a method of teaching children (and adults) to make wise and thoughtful life decisions as well as to comprehend and learn better in formal educational settings (p. 910).

Self-regulation is widely considered the second part of metacognition along with thinking about thinking. In the case of this study, metacognition involved the self-regulation of the avatar as self and in relation to self. Lane (2007) described metacognition as:

> … a higher order of thinking that operates on these cognitive activities, such as planning, analyzing, assessing, monitoring, and reflecting on problem solving decisions and performance. Metacognition also enables more effective learning. A learner who is able to accurately gauge his or her own understanding is better equipped [to] monitor his or her own progress (p. 3).

Pina Tarricone performed her dissertation research on metacognition and has made a comprehensive volume on the subject called *The Taxonomy of Metacognition.* In it, Tarricone quotes Alexander (2006) who referred to the potential transdisciplinary nature inherit in metacognition: "Reflection and metacognition research can form stronger connections between psychology and philosophy, especially in the areas of

implicit metacognition, consciousness and introspection" (Alexander, 2006 as found in Tarricone, 2011, p. 214).

Avatar and Virtual Self

This study centers on the actions, perceptions, and relationship to one's avatar(s) or character used in a collaborative virtual environment. In Sanskrit, there are several interpretations, but incarnation is usually the translation for avatar. Research partly funded by the European Commission reported that avatar interactions based on media synchronicity theory increased possibilities for representation creating a capability to improve collaboration effectiveness (van der Land, Schouten, van den Hooff & Feldberg, 2011, p. 6). Prior studies confirmed avatar influence on users' behavior and perception. The research of Jeremy Bailenson, associate professor at Stanford University's Virtual Human Interaction Lab along with his colleagues provides the nexus for Transformed Social Interaction (TSI). TSI studies include research in the following areas: CVEs (Bailenson, Beall, Loomis, Blascovich, Turk, 2004), TSI, augmented gaze, and social influence (Bailenson, Beall, Loomis, Blascovich, & Turk, 2005). TSI and avatar plasticity (Bailenson & Beall, 2006), embodied-perspective-taking (Yee, & Bailenson, 2009), non-verbal social norms (Yee, N., Bailenson, Urbanek, Chang, & Merget, 2007), learning sciences (Bailenson, Yee, Blascovich Beall, Lundblad, & Jin, 2008).

McCreery, (2011) described virtual self as:

> The avatar no longer represents a simple tool or mechanism manipulated in cyberspace. Instead, it has become the individual's bridge between the physical and virtual world, a conduit through which to express oneself among other social actors. As a result, complex social and normative components have arisen within these environments to further influence the development of the virtual self (p. 42)

Reflexivity

An instantiation of reflexive online identity is exemplified by the book Dr. Celia Pearce wrote in 2009 crediting her avatar Artemesia, called *Communities of Play*: *Emergent Cultures in Multiplayer Games and Virtual Worlds*. Pearce described the phenomenon of *intersubjective flow*. While seeking an appropriate term for the phenomenon she observed, she came up with four factors related to intersubjectivity. Pearce said:

> First, seeing a representation of oneself projected into the virtual world appears to enhance one's ability to emotionally project into the world, whether it be single – or multiplayer. Second, the sense of proprioception (the awareness of where our bodies are in space) produced by the avatar may create a more direct embodied relationship with the 3-D world, particularly through play – running, jumping, and the like. Third, the emotional attachment to the player's character seems to create a deep connection both to other avatars and to the virtual world they share. Finally, it may be that one of the key aspects of experiencing presence in an online virtual world is the quality of being perceived within a play context (Pearce, 2009, p.123).

Pearce takes this one step further and argued, "… the ability to be perceived through one's play identity creates a unique mode of being perceived that may not be shared in other modes of computer mediated communication. I termed this 'seeing and being seen'" (Pearce, 2006c as seen in Pearce, 2009, p.123).

Character

The term character, not to be confused with virtue, is used in this study as a representative in games and provides varying degrees of choice of customizing appearance and behavior depending on the game. Dickey (2007) said a character becomes a type of avatar for the player:

> Character development in MMORPGs is one element which fosters intrinsic motivation in the course of gameplay. There are no final victory or loss conditions in MMORPGs, therefore, the game continues to evolve. In turn, players continue to evolve their character (and/or develop new characters to play) (Dickey, 2007, p.258).

Embodiment

Embodiment concerning an avatar or character is distinguished by the degree of choice allowed to control and customize appearance and behavior resulting in the feeling of being immersed and present for experiences. Van Looy et al. (2010) studied embodiment and gaming stating: "Hence we propose to refer to the feeling of presence induced by gaming as ‘Embodied Presence’ with embodiment being a notion that has been used in virtual reality theory to refer to the embodied nature of an experience" (Van Looy, Courtois & De Vocht, 2012, p. 127).

Media scholars as well as psychologists often study the range of attachment and identification that creates a feeling of immersion within reading, watching media, and playing games. Film professor Margrethe Bruun Vaage at Kent University in the UK refers to "empathic identity" to distinguish between different types of spectator engagement in fiction and proposes a continuum of empathic experiences ranging from the affective to the cognitive, in which true empathy only occupies the middle position ("embodied empathy" and "narrative empathy") (Vaage, 2006, p. 33 as seen in Tronstad, 2008, p. 251). Group interactions within CVE’s offer a wide range of expression affordances to provoke feelings of embodiment, empathy, and contagion. Combinations of these expressions are demonstrated in Transformed Social Interactions (TSI).

“‘Emotional contagion’ is the affective phenomenon that, for instance, makes us laugh when we witness other people laughing, even when we don't share their reason for laughing and we don't know what they are laughing at"(Tronstad, 2008, p. 251).

Somatic

The term somatic is multi-referential and does not have a universal meaning. Science, medicine, and leadership development use the term somatic in different ways. The Free Dictionary (2013) defines somatic “of, relating to, or affecting the body, especially as distinguished from a body part, the mind, or the environment; corporeal or physical.” Mehling et al. (2009) reported: “‘concrete somatic monitoring’’’ or ‘sensory discrimination’ of the precise details and present-moment characteristics in physical sensations appear to be adaptive" (Cioffi, 1991; Cioffi & Holloway, 1993 as seen in Mehling et al., 2009, p. 2). Measuring somatic response is typically performed in university research laboratories with specialized equipment. Some serious games have ventured into monitoring biometrics to engage physiological responses into gameplay. Harris, Bailenson, Nielsen & Yee (2009) used a university lab to conduct an experiment surrounding phobias and found: "when individuals had to speak to virtual rooms populated by a small virtual audience, phobic participants had significant increases in self-reported anxiety and somatic responses" (p. 438).

Dialogue

Dialogue is a distinct phenomenon different than discussion and conversation. The German philosopher Hans-Georg Gadamer saw openness as a forerunner to dialogue essential for understanding and solidarity. “Dialogue is rooted in and committed to

furthering our common bond with one another to the extent that it affirms the finite nature of our human knowing and invites us to remain open to one another" (Gadamer, 2013).

In the United States, management and leadership practices have been influenced widely by Dr. Peter Senge, Senior Lecturer from MIT. The Fifth Discipline, a seminal business book by Senge (1990), has been cited widely for its advocacy of dialogue. Dr. Otto Scharmer, also a professor from MIT said "Companies that use dialogue to focus on shared mental models and cultural assumptions are believed to be more flexible in respect to other key variables like action, structure, and processes" (Scharmer, 2000). Senge and Scharmer conduct events where they participate in dialogue and observe patterns of participation as part of their ongoing research. "In a reflective dialogue participants shift from advocating their own opinions to inquiring into the assumptions that underlie them. That shift involves *redirecting* the collective attention from exterior to inner sources and assumptions" (Scharmer, 2000). CVEs offer subtle affordances for structured and unstructured communication promoting dialogue that occurs among groups, in communities of practice and within guilds.

Concerning the fragmentation of disciplines, Bruce Janz (2006), Philosophy Department Chair at the University of Central Florida, wrote that transdisciplinarity "must not only be the place where dialogue between disciplines is fostered, but also the place where dialogue concerning the nature of transdisciplinarity itself is fostered" (p. 11). Can such 'places' include collaborative virtual environments? Janz also asked the rhetorical question whether conversation is made safe because of the unexamined assumptions of transdisciplinarity (p. 13).

Presencing

Presencing is an activity that emerged from the work and research of MIT faculty members, Drs. Peter Senge and Otto Scharmer. Presencing has been implied as the sixth discipline, favorable for individuals to engage in building learning organizations and other forms of mutual understanding. The five previous disciplines foundational to build a learning organization were 1) personal mastery 2) mental models 3) shared vision 4) team learning and 5) systems thinking (Senge, 1990).

Without necessarily knowing of Senge's and Scharmer's work, Barbara Gray (2008) describes some of the tenets of presencing in her article on collaborative leadership in transdisciplinary research:

> "Most importantly for transdisciplinary projects, such visioning encourages members to reframe their extant conceptual frameworks. Such reframing requires the suspension of current assumptions and the introduction of a vision that turns participants' current mindsets upside down, jars them loose from their conceptual moorings, and creates an opening in which the previously unthinkable can become reality. (Moore et al., 1999; Schon, 1994). These frame shifts can result from the introduction of a new metaphor, (Lakoff, 1980) from the adoption of a new gestalt (e.g., a figure/ground shift), from moving up or down a level of abstraction in thinking, (Schon, 1994) or from deciphering meaning that transcends two cultures (Von Glinow et al., 2004). In this sense, then, transdisciplinary leaders attempt to create breakthrough visions for their colleagues" (as seen in Gray, 2008, p. S126).

It is helpful to contrast the terms presencing with presence. Michigan State University assistant professor Robby Ratan (2011) describes the elusive notion of 'presence' in CVEs: "Presence, as a concept within the field of Communication, grew out of the need to understand the effects of technologies and media that increasingly embody the user, namely robotics and virtual reality" (p. 7). Ratan distinguishes a further definition of self-presence based on neuroscientist Antonio Damasio's framework for consciousness as "the extent to which some aspect of a person's proto (body-schema)

self, core (emotion-driven) self, and/or extended (identity-relevant) self is relevant during media use" (p. 12). The entanglement of virtual self and avatar identity challenge assumptions creating a need for dialogue, which may foster group affinities.

Virtual intersubjective presencing

Virtual intersubjective presencing is a construct created for this dissertation after the review of literature revealed a gap for a particular type of group interaction in collaborative virtual environments involving the reflexive relationship with one's avatar. *Virtual intersubjective presencing* occurs in a collaborative virtual environment between constellations of identities represented by avatars embodying varying states of human self-consciousness that engage in concerted intention to create the art-of-the-possible. A future orientation is deliberately noted with the inclusion of the 'art-of-the-possible' in the definition to align with the presencing discipline suggested by Scharmer, 2000. *Virtual intersubjective presencing* is particularly suitable for transdisciplinary pursuits of concerted inquiry. Regan (2012) cited the philosopher Gadamer who summed up the potential of the art-of-the-possible through collaboration in a virtual environment using dialogue: "A questioning mind ensures that language fills in any gaps towards a shared understanding opening up human potential for infinite dialogue with others in a fusion of horizons" (Gadamer 2004b, p.68 as seen in Regan, 2012, p. 289).

Transformed Social Interaction

Transformed Social Interaction (TSI) occurs within a CVE allowing 'interactants' to use novel techniques to change the nature of social interaction and communication

(Bailenson & Beall, 2006, p. 2). TSI is not just something occurring within a CVE, it is a force that drives the development of the technology and it has become a paradigm:

> The goals of the Transformed Social Interaction paradigm are threefold: (1) to explore and actually implement these strategies in collaborative virtual environments, (2) to put human avatars in CVEs and to measure which types of TSI tools they actually use during interaction, and (3) to examine the impact that TSI has on the effectiveness of interaction in general, as well as the impact on the specific goals of particular interactants (Bailenson & Beall, 2006, p. 4).

Decoupling channels of communication impact the nature of dialogue in CVE. Bailenson & Beall (2006) described the dynamic:

> Taking away a channel of communication is one thing, but scrambling and transforming the natural correlation among multiple channels is another level of disruption entirely. Transformed Social Interaction does exactly that, decoupling the normal pairing of behaviors during interaction and, at the whim of interactants, changing the rules of the conversational dance completely (p. 14).

Dignity

Dignity is a theme of theoretical transdisciplinarity going beyond the notion of people to Nature (Nicolescu, 2007, p. 79). The Universal Declaration of Human Rights was created by the United Nations in 1948 following World War II. Article 1 states: "All human beings are born free and equal in *dignity* and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood" (United Nations, 1948).

The Charter of Transdisciplinarity was drafted and adopted by participants in 1994 at the first World Congress of Transdisciplinarity held in Portugal. A broad, unified perspective was evident that extended to Nature as well. Article 8 states:

> The dignity of the human being is of both planetary and cosmic dimensions. The appearance of human beings on Earth is one of the stages in the history of the Universe. The recognition of the Earth as our home is one of the imperatives of transdisciplinarity. Every human being is entitled to a nationality, but as an

> inhabitant of the Earth is also a transnational being. The acknowledgement by international law of this twofold belonging, to a nation and to the Earth, is one of the goals of transdisciplinary research (Nicolescu, 2007a, p. 89).

Dignity is a virtue practiced by individuals, groups, and organizations committed to transdisciplinary values. Professional development is a cornerstone of military education for which dignity is a basic tenet, often a challenge to practice under duress. Stricker, McCrocklin, Calongne, Scribner & Holm (2010) cited their goal to build a positive, collaborative culture among military staff through incorporating Christopher Peterson's work. Peterson helped define positive psychology stating that positive culture is referenced as, "Dignity: the treatment of all people in the organization as individuals regardless of their position (p. 7). The military needs transdisciplinary values to extend between enlisted, officers, across services, and beyond to civilians and multi-national cultures.

Dignity in CVEs may require respect beyond professional courtesy displayed in the military or among cultures when salutes and hijab are substituted for more ornate avatar wings worn by their human owners.

Motivation

Motivation in this study is a foundational framework based on participants' demonstrated motivation mostly of an intrinsic and sometimes altruistic nature. "Intrinsic motivation refers to engaging in an activity for its own sake, because one finds it enjoyable and interesting. Extrinsic motivation refers to engaging in an activity for instrumental reasons, such as acquiring a reward (Millette & Gagné, 2008, p. 12). Motivation is necessary for learning and for collaborating in groups.

Guilds are formal group structures in MMOGs offering groups the ability to learn inside and outside gameplay. Cordova & Lepper (1996) stated:

> In the specific case of instructional games, for example, one may examine the relationship between the goals of winning the game and learning the material. In the best of circumstances, these two sets of goals are congruent and mutually supportive; under such conditions, the added motivational value of presenting instruction in a game format should result in increased learning (p. 727).

Self-determination, self-leadership, and self-cultivation may be advantageous through collaborative engagement in CVEs. Online games and participating in guilds are playgrounds for building a learning organization. Garris, Ahlers & Driskell (2002) stated "The goal (of instructional games) is to develop learners who are self-directed and self-motivated, both because the activity is interesting in itself and because achieving the outcome is important" p. 445). A special edition of the Journal of the Association for Information Systems cited Bessiere et al. (2009) who hypothesized that intrinsic motivation in MUVES is attributed to users desire to participate for the purpose of creativity and intellectual pursuit (as seen in Boughzala, de Vreede & Limayem, 2012, p. 720.)

Grit

Intelligence quotient (IQ) is one indicator of success. Angela Duckworth, associate professor of Psychology at the University of Pennsylvania researches how motivational and psychological factors combine with cognition to help some individuals meet their goals. Duckworth and her co-researchers stated: "Grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress" (Duckworth, Peterson, Matthews & Kelly, 2007, p.

1087). Individuals possessing grit emphasize long-term stamina rather than short-term intensity (p. 1089).

Research into what makes people gritty is important for understanding the motivation necessary for performing collaborative research in CVEs where the technology is maturing. Discovering grittiness is also helpful to understand challenge levels in games. "Whereas individuals high in need for achievement pursue goals that are neither too easy nor too hard, individuals high in grit deliberately set for themselves extremely long-term objectives and do not swerve from them— even in the absence of positive feedback" (Duckworth, Peterson, Matthews & Kelly, 2007, p. 1089).

Wicked problems

Horst Rittel was a German design theorist and professor who coined the term 'wicked problem.' Rittel was also the inventor of the Issue-Based Information System (IBIS) structure on which dialogue mapping is based (Rittel, 1972a as seen in Rittel and Weber, 1973). Dialogue mapping is a structured approach to communication in groups. Rittel's research provided a foundation for a systems analysis methodology reported as leading to research in the Science of Design to overcome the linear nature of systematic design arising over 30 years ago (Conklin, 2005, p. 13). The second type of transdisciplinarity is phenomenological, which is cited as a pragmatic approach for addressing wicked problems in some literature reviewed in this study.

Examples of wicked problems include issues such as the AIDS epidemic, threat of pandemic in healthcare, global climate change, international trafficking in drugs and slavery, and terrorism (Horn & Weber, 2007 p. 1). Wicked problems are often systemic and resistant to long-term improvement.

Rittel & Webber (1973 described the following 10 properties of wicked problems:

1. There is no definitive formulation of a wicked problem
2. Wicked problems have no stopping rule
3. Solutions to wicked problems are not true-or-false, but good-or-bad
4. There is no immediate and no ultimate test of a solution to a wicked problem
5. Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial-and-error, every attempt counts significantly
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan
7. Every wicked problem is essentially unique
8. Every wicked problem can be considered a symptom of another problem
9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution.
10. The planner has no right to be wrong (p. 161- 167).

CVEs offer a stage for problems solving on which collaboration occurs within a distributed, international network combining Web 2.0 and the semantic web. Dr. Chris Dede, professor of education at Harvard University, advocated an infrastructure to support collective inquiry:

> An interconnected suite of Web 2.0 tools customized for research would provide (a) a virtual setting in which stakeholders of many different types could dialogue (b) about rich artifacts related to practice and policy (c) with a set of social supports to encourage community norms that respect not only theoretical rigor and empirical evidence, but also interpersonal, experiential, and moral/ethical understandings (Dede, 2009, p. 9).

Such infrastructure serves to address wicked problems.

Educational reform is necessary to lead in the creation of societal architectures to prevent and solve wicked problems. Collaborative, international transdisciplinary research has taken root in the last decade. "Overcoming the disciplinary divide is a precondition to finding long-term, durable solutions to the current planetary and local crises. The complexity of the problems, and their fast becoming irreversibility, cannot be

solved from within our mono-disciplinary knowledge-systems and institutions" (van Breda, 2010).

Citizen science

The availability of the Internet, Web 2.0 tools, and broadband access has led organizations to tap into society for assistance with appropriate tasks. "Citizen science is a form of research collaboration involving members of the public in scientific research projects to address real-world problems (Cohn, 2008). The SETI (Search for Extraterrestrial Intelligence) Project is an example of citizen engagement to use extra computing power rather than assisting with actual science. Firehock & West (1995) reported “Citizen science is related to long-standing programs employing volunteer monitoring for natural resource management and is often employed as a form of informal science education or outreach to promote public understanding of science" (as seen in Wiggins & Crowston, 2011, p. 1).

Citizen science is not to be confused with open science that includes the use of open source software and open data. Citizen science projects may share data, but the research process may not be publicly viewable for comment. CVEs offer the potential to stage mass citizen science activities especially as the technology becomes available via web browsers. "Access to computer scientists may also be a significant factor enabling domain researchers to coordinate the development of impressive custom platforms for human computation" (Wiggins & Crowston, 2011, p. 7).

Galaxy Zoo is a primary example of a project where registered users of a web site can classify galaxies based on shapes observed from massive data that experts and computational power are insufficient to keep pace with discovery (Galaxy Zoo, 2013).

The socially-constructive nature of 3D environments presents an emerging platform for citizen science. "All in all, new technologies are changing roles so that a citizen science is coming both from the expert-side and the lay-side: we are going to face (more or less professional) knowledge-able citizens" (Yue, 2013, p. 70).

Crowdsourcing

Crowdsourcing makes an open call for contributions from a large, undefined network of people to work on distributed production models (Howe, 2006; Brabham, 2008) as seen in (Wiggins & Crowston, 2011, p. 1). The University of Washington created a serious game using crowdsourcing for science called Foldit that allowed players to manipulate protein chains. (van Woud, Sandberg & Wielinga, 2011, p. 201). Foldit accelerated findings researchers sought for approximately 15 years. A Mars game was reported by van Woud, Sandberg & Wielinga (2011) that identifies how help functions were used to provide enough knowledge to accurately identify Mars' surface concepts (p. 201). The game has received financial backing and is being professionally developed for crowdsourcing (p. 208).

van Woud, Sandberg & Wielinga (2011) cite (Hoffmann, 2009) who identifies the status of human-computing ability: "Crowdsourcing is the deployment of a crowd in order to process data and is mainly used with datasets where human perception exceeds the capabilities of computers. At this moment people are still often better and faster in the recognition of shapes and objects than automatic devices" (p. 201).

Complexity

Transdisciplinarity embraces complexity. Basarab Nicolescu described Edgar Morin as a solar presence, the "The Apollo of complexity" providing help and hope to live and to hope as a major contribution to transdisciplinarity" (Morin, 2008, p.1) Typically a tension exists between systems thinking such as advocated by Peter Senge and design thinking that involves creativity. Anfonso Montuori wrote the Forward in Morin (2008) stating Morin advocated a kind of thinking that 1) reconnects that which is disjointed and compartmentalized, that 2) respects diversity as it recognizes unity, and that 3) tries to discern interdependencies (p. vii). The realm of the imagination may be required for concerted inquiry to achieve breakthrough ideas necessary to solve wicked problems. Integration of 'self' mediated through communities that authentically collaborate via virtual environments may capitalize on greater democratic participation. Olson, Olson & Hofer (2006) stated that collaboratories must not be democratic; their participants must feel they have a voice in decision-making (p. 3).

Transdisciplinarity has three pillars according to Nicolescu (2002, p. 45). Alfonso Montuori advocates a fourth pillar of transdisciplinary uniting 'being' with complexity stating:

> Morin points us beyond this way of thinking and toward a paradigm of complexity: toward a way of thinking and being that does not mutilate life, but allows us to live it more fully by being more present to the complexities, paradoxes, tragedies, joys, failures, and successes. He points us toward a way of thinking that is not disembodied and abstract, but rich in feeling, intuition, and connection to the larger social and historical context. A thought that is holographic and contextual, showing us how we are embedded in time and space. But a thought that is also transformative, self-eco-re-organizing, by including all of who we are and indeed stretching our understanding of who we are and pointing us toward new possibilities (Morin, 2008, p. xxiv).

Morin referred to influence of on Aristotelian logic on Western thought that resulted in either/or logic as disjunctive thinking; it's either A or B. It cannot be both A and B. "Creativity offers an opportunity not only to deconstruct, but to see how the two terms are not in a binary hierarchical opposition, but rather mutually interacting" (Morin, 2008 as seen in Montuori, 2013, p. 210).

Montuori (2013) also summarizes the following list of paradoxical contradictions based upon the Mihaly Csikszentmihalyi's research on the theory of flow involving characteristics of the creative person:

> 1. Creative people have a great deal of physical energy, but they are also often quiet and at rest.
> 2. Creative people tend to be smart yet naıve at the same time.
> 3. Creative people combine playfulness and discipline, or responsibility and irresponsibility.
> 4. Creative people alternate between imagination and fantasy, and a rooted sense of reality.
> 5. Creative people tend to be both extroverted and introverted.
> 6. Creative people are humble and proud at the same time.
> 7. Creative people, to an extent, escape rigid gender role stereotyping.
> 8. Creative people are both rebellious and conservative.
> 9. Most creative people are very passionate about their work, yet they can be extremely objective about it as well.
> 10. Creative people's openness and sensitivity often expose them to suffering and pain, yet also to a great deal of enjoyment (Csikszentmihalyi, 1996 as seen in Montuori, 2013, p. 210).

Creativity remains within the domain of humanity at present, but will inevitably be improved upon within the realm of artificial intelligence used in advanced applications of computing and robotics. Research into human and robotic teams involves new levels of complexity.

CHAPTER ONE: INTRODUCTION

"The lightning spark of thought generated in the solitary mind
awakens its likeness in another mind." - Thomas Carlyle

Humans have voluntarily sought means to cooperate for millennia. This dissertation delved into several academic disciplines to explicate the socio-technical and cultural nature of phenomena reported among professionals regarding collaboration in virtual environments (CVEs). The affordances of immersive CVEs provide a current stage upon which individuals regularly work, teach, learn, play and cooperate using avatars or characters. Little is known about the nature of the effects collaboration has among interdisciplinary, distributed groups. Infrastructure to support distributed collaboration spans human networks and cyberinfrastructures suitable for eScience that often require time beyond project schedules (Lee, Bietz, Derthick, & Paine, 2012, p. 1347).

The challenge of depending upon and leading virtual teams is expected to increase placing a premium on virtual leadership skills (Olson, Olson, & Venolia, 2009, p. 1). Shared leadership in virtual teams requires skills and acceptance of others at times in more fluid delegation (Hamons, Calongne, Stricker & Armstrong, 2011, p.82). Self leadership is thought to be foundational to promote strengths-based collaboration whether one disciplinary context is pursued or many.

Transdisciplinarity is a concept that reflects the unification of knowledge and has association with interdisciplinary research endeavors tied to complex, global challenges. Transdisciplinary experiences have potential for research through concerted use of advanced computing power accessible to CVEs. Socio-cultural adaptation among users of

CVEs will increase as bandwidth and computing power expand while costs decrease. Other indicators of expected adoption include the ease of use, ubiquitous computing, and opportunities to congregate rich, diverse communities across geographic boundaries.

Professional development and personal growth opportunities abound in CVEs. Engaging in collaborative virtual activities led to the design of this study that sought to develop a deeper understanding of real virtual world teams as called for by Boughzala, de Vreede & Limayem (2012, p. 727) rather than relying on student subjects. The qualifications for conducting this research included approximately eight years of experience participating in collaborative virtual environments that began through association with the New Media Consortium (NMC) in 2005 (see APPENDIX H: Curriculum Vitae). Advanced professional events were held by the NMC demonstrating the artistry, power and challenges inherent with the emerging technology of virtual worlds. Dr. Larry Johnson, CEO of the NMC, was the former principal investigator for MacArthur Foundation grant centered on the exploration of Second Life. Johnson and other NMC staff facilitated relationships that culminated in the motivation for this study. The NMC led in the use of Second Life in higher education in the United States through events.

Figure 1, *New Media Consortium's Symposium in Second Life, Fall 2008,* shows an example from a bi-annual, online symposia hosted by the NMC where Dr. Cynthia Calongne and her avatar persona, Lyr Lobo, called, Rock the Academy: Radical Teaching, Unbound Learning, Symposium in Second Life. Other groups also held events regularly *in world* for their members. The NMC reached out to university educators to

help them gain experience with immersive learning environments by providing events in the immersive environments. Photo credit Cynthia Calongne.

Figure 1. New Media Consortium's Symposium in Second Life, Fall 2008

In 2012, the first massively open online course (MOOC) was created in the United States combining activities involving a learning management system, Second Life and explorations into MMOGs such as World of Warcraft, Eve Online, and later Minecraft. Called, The *GamesMOOC*, the professional development offering was at the time of this writing, operating as a continuous online community responsible for spawning other communities that surrounded joint, synchronous explorations (Nokak, Luchs, Truman & Calongne (2013). The platform used for initial community engagement was based on Shivtr, a cloud-based application as seen in Figure 2, *GamesMOOC Portal on Shivtr*. The antecedents of collaborative relationships may have been a factor of the ongoing success of the GamesMOOC. Other new contributors became regular participants and joined in the World of Warcraft guilds spawned or fortified by the GamesMOOC.

Informal, ethnographic experience obtained through participation of group tours revealed that members often did not talk most about the game while in the environment similar to findings reported by Ellis, Luther, Bessiere & Kellog (2008, p. 295). Rather the game played was used for participants to connect and share knowledge. Photo credit Kae Novak.

Figure 2. GamesMOOC Platform on Shivtr

In fall 2013, the first professional development MOOC was offered integrating the learning management system Moodle combined with OpenSim using Dreamland Metaverse. The CVE was called The Loire Learning Campus and the associated MOOC was called Design Thinking for Virtual Worlds. Dr. Andrew Stricker led in the development of the Loire campus and Dr. Cynthia Calongne was also a close collaborator in the MOOC. Figure 3, *Design Thinking in VWs MOOC in Loire Learning Campus*, shows an image of a tour hosted for the Virtual Worlds Best Practices in Education

(VWBPE) Conference MOOC attendees. Colorful avatars reproduced their identities in open simulation for the event. Photo credit Barbara Truman.

Figure 3. Design Thinking in Virtual Worlds MOOC, Loire Learning Campus

In 2010, Stricker and Calongne received the $25,000 first place award for the Federal Consortium of Virtual Worlds (FCVW) Challenge based on the Mars Expedition Challenge. Figure 4, *Mars Expedition Challenge, $25,000 FCVW Award Winner 2010*, illustrates the phases of the interactive engagement designed into the simulation and a soundtrack explaining the simulation (see http://www.slideshare.net/lyrlobo/mars-expedition-game-tech-2010). Photo credit Andrew Stricker and Cynthia Calongne.

Figure 4. Mars Expedition Challenge, $25,000 FCVW Award Winner 2010

The antecedents of the communities that staged such professional development events are beyond the scope of exploration in this investigation. Determining antecedents for successful virtual world acceptance by groups and user motivation for collaborative processes are two of seven key research challenges identified by Boughzala, de Vreede & Limayem (2012, p. 725).

The GamesMOOC and Loire MOOC involved a core cadre of dedicated volunteers who built virtual communities. Such examples form the basis of virtual community learning organizations. Leadership demonstrated within such online communities has resulted in an ability to unite participants across international borders and domains of industry forming collaborative relationships within government, military,

industry, and K20 educational sectors. Shared vision for realizing the collaborative potential of such online communities using CVEs surrounds the inquiry of this study.

Professional ‘self’-development opportunities were available in CVEs to engage in 3D tours and to play online games. Some of the games were for entertainment and some were simulation used in model-based reasoning. Role-play available in the creation of machinima (machine video) for digital storytelling challenged assumptions about identity. These types of engagements challenge one’s epistemology and through careful self-examination may lead to a paradigm shift in inquiry. The professional self and personal self intertwine through use of an avatar in diverse CVE communities over time. "Transdisciplinarity is radical, in the sense that it goes to the roots of knowledge, questions our ways of thinking and our construction and organization of knowledge, it requires a discipline of self-inquiry that integrates the knower in the process of knowing" (Nicolescu, 2008, p. xvi).

The sophistication involved in playing online computer games often requires assistance from others to achieve the object of the game. Millions spend considerable amounts of time, energy, and money to *cooperate* in online games. Others forge their destiny through the vehicle of a favorite avatar or character used to associate among peers in professional development and service groups. The distinction is the association occurs almost exclusively in an immersive virtual environment. Some professional associations have demonstrated commitment to incorporate CVEs and gaming into their operations. Some K12 educators are forging game-based paths to learning new literacies based on their experience of gameplay. A report funded by the US National Science Foundation describes the new literacy:

> From many perspectives, games can be thought of as a new form of literacy that will require support from intelligent authoring tools, both for expert game designers as we move towards more radically adaptive and generative experiences in new content areas and for novices in order to open this new medium to broad participation and authorship. Similarly, games or game-inspired virtual worlds can serve as new media for original artworks, such that tools that facilitate the artwork creation process also merit further study and experimentation (Scacchi, 2012, p. 33).

The notion of computer games and virtual world environments (CGVW) is gaining traction for business and research as an engine of innovation that also involve serious leisure (Scacchi, 2012, p. 67). Simulation-based research is expected to benefit from open source software and data as well as provide a means to communicate findings through new media. Greater awareness may exist for funding to support science, technology, engineering, and mathematics (STEM) education, but CGVW is also expected to serve the needs for education and research in the sciences, health, energy, environment, and defense (SHEED) (Scacchi, 2012, p. 93).

The interpersonal element required for collaboration indicated humans naturally cooperate. Uzzi (2013) reported university faculty sought collaborators across distance before the advent of the Internet. Ubiquitous computing now enables faculty researchers and scientists to collaborate on grants, research projects, and academic publications regularly. Advances in computing, especially in collaborative virtual environments, offer promise for an emerging field of *virtual* Team Science. Grant funding agencies have increased selection requirements to improve the return on investment among shrinking resources. Some grant requests for proposals (RFPs) seek interdisciplinary projects perceiving concerted involvement from diverse researchers creates better outcomes. Measuring the effectiveness of such collaborations is a research endeavor in itself. Hence,

the Science of Team Science was created by the United States' National Institutes of Health.

This study embraced complexity by combining Appreciative Inquiry's patterns of unleashing human potential *and* embracing transdisciplinarity's pragmatic application to address wicked problems. International collaboration is an imperative, but collaboration is not enough. Operational shifts require routines and habits to evolve to reduce costs of travel. Can time and stress be saved through more reliance upon similar technologies used across homes, schools, and work places? This study sought what is currently working among power users of CVEs to achieve their concerted goals. Previous studies of virtual world collaboration often relied upon novice users placed within generated situations to test effects. Familiarity was not overcome in time for more optimal study (Saunders, Rutkowski, van Genuchten, Vogel & Orrego (2011). Climate change, interconnected economies, threat of pandemic, and instability of fledgling democracies are examples of wicked problems requiring radical collaboration (World Economic Forum, 2014, p. 53). The open source community is an area of collaboration reported as effective and efficient under certain circumstances. Murray (2013) found models to assist with the development of collaborative software projects using the web-based site, SourceForge. Open source tools and communities are being used with greater frequency as budgets become tighter.

Culture change is required in higher education for the research community to risk tenure and promotion for speculative scientific gains. Open data provides a basis for new partnerships to attain broader impacts grant agencies seek through transdisciplinary projects. One measure of broader impacts involves publications that communicate the

merit of discoveries and findings. Gone are the trials of Oldenburg, founder of the first scientific journal, who begged scientists to share discoveries in the *Philosophical Translations of the Royal Society*, in 1665. Subterfuge was necessary by Oldenburg to compel the likes of Newton and Huygens to publish (Nielsen, 2011, p. 189) and although scientists today freely publish, understanding what promotes collaboration is not as clear.

Measurement of scientific progress includes citations in journals. Keeping up with emerging knowledge published is challenging for one academic discipline. Jacobs (2013) warns of the fragmentation of disciplines through the interdisciplinary endeavors designed to connect university departments. Jacobs reported his research found 28,000 active, peer review journals and the new field of nanotechnology had more than 75 journals (Ulrich Periodic Directory, 2011 as seen in Jacobs, 2013, p. 13). The concern of supporting interdisciplinary and transdisciplinary disciplines was cited by Jacobs for a workshop held in Washington, DC on Team Science in October 2013. Research grants and university organizations may engage in transdisciplinary endeavors at the cost of existing disciplines. Jacobs said, "The boundaries between academic fields that are ostensibly fixed and rigid are in fact remarkably porous" (Jacobs, 2013, p. 5).

The same workshop included a report by Olson & Olson (2013) on collaboration technologies. Bainbridge (2007) described later in this chapter, was cited under the Virtual Worlds heading along with a scientific group that operated in Second Life (p. 5). The group, Meta-Institute for Computational Astrophysics (MICA) closed the site in 2012 perhaps due to the end of funding from the US National Science Foundation. Plans to move to OpenSim were cited to experiment with large data sets (Djorgovski et al., 2010, p. 37). MICA was affiliated with a group represented in this study called Virtually

Speaking that produces events in Second Life and streams the audio on a blog found at http://www.blogtalkradio.com/search?q=virtually-speaking-science.

The intent of this study is to bring together paradigms of collaboration, scientific research, and virtual environments to explore relationships of interactions that yield new inquiry leading to transdisciplinarity. This chapter describes the foundation for range of inquiry under study.

Background of the Study

A grants day event was held to promote professional development at the University of Central Florida in April 2012 where the concept of transdisciplinarity was shared in the context of Team Science. The notion that some of the most urgent priorities of research required transdisciplinary approaches meant faculty and institutions needed to examine their faculty development and reward structures to support Team Science (Fiore, 2012). Faculty traditionally sought insights on preparing grant proposals to further their individual research. A new paradigm was proposed to enable faculty researchers to embark on a path requiring personal development to transition toward concerted inquiry. Most faculty at research universities must integrate their teaching, research, and service. The technologies used across these functions have become almost the same and for home use as well.

The topic *transdisciplinarity* is relatively new to the United States and will be discussed in Chapter Two and it has an entry in the nomenclature section that contrasts with other disciplinary approaches.

Transdisciplinary Research

American Sociologist- William Sims Bainbridge is a co-director of Human-Centered Computing at the National Science Foundation (NSF), an independent federal agency in the United States created in 1950 whose mission supports non-medical fields of science and engineering. The NSF has a budget of about $7 billion in support of about 20% of all federally funded basic research. The NSF has a director accountable for all staff and operational administration and a board made up of 24 members that serve six year terms and meet six times a year to create policy. These members are appointed by the president of the United States and approved by the Senate (National Science Foundation, 2012, p. 14).

Bainbridge (2007) is a staunch advocate for advanced computing for socio-technical integration. He stated online virtual worlds such as Second Life and World of Warcraft have great potential for research (p. 472). At the time of writing, Bainbridge observed video games were surpassing the motion picture industry indicating a major historical transition to ubiquitous computing. Researchers such as game designer, Dr. Jane McGonigal, are exploring a new form of games called pervasive live-action role playing games (LARPs) where players use the physical world while interacting over the Internet. LARPS pose an opportunity for players to engage in crowdsourcing research. Some gamers regularly meet in Second Life, OpenSim, or in MMOGs such as the Special Interest Group for Virtual Environments (SIGVE) within the International Society for Technology in Education (ISTE). Figure 5, *Special Interest Group Virtual Education of ISTE in Second Life*, shows the outdoor and indoor meeting spaces where events are held on a regular basis in Second Life. Photo credit ISTE SIGVE.

Figure 5. Special Interest Group Virtual Education of ISTE in Second Life

Bainbridge's article in Science was published just before the national economy began to lag in 2007. The economy took a toll on many educational institutions that made investments into the virtual world, Second Life to provide online learning opportunities. Many institutions withdrew when their 50% educational discounts were withdrawn by Linden Lab. It is unclear whether any of the institutions were serious about pursuing research options such as those proposed by Bainbridge where the potential to recruit thousands of research subjects may be obtained (p. 473). In July 2013, Linden Lab announced the return of the 50% educational discount, but it may be too late for universities to go back into Second Life, especially as the use of OpenSim matures.

Computer-mediated collaboration between human-controlled avatars and multi-agent artificial intelligence combine in virtual worlds enabling rigorous experiments to be conducted in these venues (Bainbridge, 2007, p. 473). As of this writing, more research in virtual worlds has involved participant observation such as the comprehensive qualitative ethnography of Second Life by anthropologist Tom Boellstorff (2008).

Intellectual property rights are a challenge posing a barrier to conducting research in virtual worlds as they are in the physical world (Olson, Olson, & Hofer, 2006, p. 3).

Another possible barrier to conduct mass research in virtual worlds is the requirement to protect human subjects. Some people prefer to engage in virtual worlds to have a separate experience apart from their physical lives. In these cases, privacy is paramount. Adding communication channels may also lead to unwanted effects that impede privacy (Ijsselsteijn, de Ridder, Freeman & Avons, 2000, p.526).

Quantitative research holds great promise in virtual worlds. Bainbridge (2007) stated World of Warcraft allowed authoring of modifications that could permit scientists to create custom add-on tools to improve measures used in quantitative research (p. 474). Machinima is another computing potential noted for its ability to enhance and capture prototypical methods of information visualization (p. 475). Readiness factors for collaborating and using technology have been studied to formulate the theory of remote collaboration (TORC) and the Theory of Remote Scientific Collaboration (TORSC) for which distance poses particular challenges to success. Olson et al. (2008) outlined a set of success factors applicable to scientific researchers (p. 80). A paper presented the year before compared TORSC principles in a corporate study and found the freedom to control the collaboration impacted incentives as reported in Cherian & Olson, 2007, p. 2323.

Without referring specifically to the topic of transdisciplinarity, Bainbridge referred to the potential of interdisciplinary research collaboration:

> Given the great variability across virtual worlds and human participants, the multiplicity of feasible research methodologies would permit a range of overlapping research studies, adjudicating between alternative theoretical

> propositions and thereby connecting the currently isolated schools of thought (Bainbridge, 2007, p. 475).

A more recent NSF innovation is the Science Across Virtual Institutes (SAVI) program, designed to promote international collaboration described as a grass roots effort originating from within the Research Directorates. SAVI provides a common umbrella useful as a new model for cost sharing and ownership to support projects. India is reported to be investing four times the amount of funding applied jointly for each SAVI project than the United States. Endorsement throughout and across the NSF is required to approve the funding to make grants happen. The collaborations described across the three inaugural projects suggest there is significant overhead required to manage the projects on the socio-technical level for transdisciplinary research (National Science Foundation, 2011).

Shared Visions for Transdisciplinary Research & Development

Creating and evolving shared vision is a practice used among groups engaged in problem-solving offered by the Society for Organizational Learning (SOL) and the Presencing Institute. Habitual practice provides a foundation for a discipline. Pennington (2008) describes examples of approaches to build shared vision such as Appreciative Inquiry, communities of practice, and soft system methodology. These approaches were formulated for use in business organizational environments and “Analogous methods need to be developed for scientific collaborations" (Pennington, 2008, p. 13). Evidence of scientific collaboration involves measuring social network analysis using bibliometric data of joint publications. Advanced social network analysis attempts to model collaborations to predict the lifecycle of collaborations. A review of the term

collaboration networks revealed a body of literature on scientific network collaboration that also included space design and device tracking to observe patterns of walking around.

A broader sense of collaboration networks was described in a conference paper made for an international emergency management event by a US State Department employee who said, “Collaboration networks should be designed to dismantle institutional stovepipes, facilitate the sharing of information among organizations, capture lessons learned and best practices, and provide a common knowledge base for the community of interest” (King, 2005, p. 4).

Problem Statement

Diverse, collective, and concerted expertise is required to engage wicked problems where transdisciplinary research applies. Timely, effective, and efficient means of advanced forms of computer-mediated collaboration are sought to achieve broader impacts.

Collaborative Problem Solving

Assessing collaboration is a goal of agencies such as The National Institutes of Health, National Science Foundation, and the National Cancer Institute that rely on Team Science. Such collaboration can use rich, socially-mediated, networked computing found in virtual environments advancing distributed Team Science. An example of demand for collaboration involves the Organization for Economic Co-operation and Development (OECD), an organization created in 1961. Its mission is to assist governments in making wise policy decisions for economic development and sustainability among its 34 member

countries. Publications are produced and research is conducted annually to seek solutions to common problems. In 1997, OECD launched an international study called the Programme for International Student Assessment (PISA) aimed to evaluate education systems worldwide every three years. Over 70 countries have participated. Traditionally PISA has evaluated competencies within reading, science, and mathematics among 15 year olds. Measurement instruments are available on the PISA web site (see http://www.oecd.org/pisa). In 2015, the assessment topic will be collaborative problem solving (OECD, 2013, p.11). The assessment methods accommodate meta analyses.

Retooling educational institutions to be ready for the 2015 PISA assessment requires curricular and infrastructure change as well as support for teachers and students. "There has been virtually no research on how to reorganize higher education institutions for collaborative work" (Kezar, 2005). Educational providers of fully online learning programs often offer courses that are individualized and competency-based. Convenience is often valued over collaboration for busy, adult learners. Some group-based projects use asynchronous participation preserving convenience to participate with the tradeoff of experience of real-time interactions.

Group-based, synchronous projects requiring greater collaboration skills are more difficult for faculty and educational institutions to support online, especially to support large classes where participants live in different time zones. Table 1, *Online Collaboration Considerations*, illustrates benefits and costs to participate successfully using technology. A blended approach using combinations of synchronous and asynchronous collaboration capability offers the greatest potential to meet the needs of participants and the tasks. The collaboration fluency required is higher using a blended

approach. This study provided insights into how groups managed their individual and collective capability to collaborate.

Table 1 *Online Collaboration Considerations*

Modality	**Asynchronous**	**Synchronous**	**Blended**
Attributes	Convenient	Engaging	Convenient and Engaging
Collaboration Skills	Fundamental	Literacy	Fluency

Government funded research is also facing competition from groups such as Stand Up to Cancer (see SU2C see http://www.standup2cancer.org). The SU2C group provides significantly higher grant funding than the National Institutes of Health and the National Cancer Institute. SU2C was formed by national celebrities of television and Hollywood who lost loved ones to cancer such as Katie Couric. The American Association for Cancer Research (AACR) supervises the research performed focusing on translational research relying upon multi-disciplinary collaboration among research faculty and scientists housed in leading universities and cancer centers. More funds are being invested into the research problem, but are the methods and tools transdisciplinary? How will discoveries and innovation be translated into manufactured treatments? These are some of the questions surrounding the wicked problem of cancer research.

Purpose of the Study

For the purpose of this study, we explored socio-technical and socio-cultural interactions that contributed to effective collaboration in mediated-virtual environments. Upon review of the pertinent literature, two constructs were created to broaden the

understanding of collaborative phenomena where identity manipulation creates effects on interactions. Exemplary groups were targeted for their collaborative outcomes resulting from the service of mostly voluntary members. The study built upon work of prior research that examined identity, collaboration, and learning, but strove to explore personal reflections of embodiment in the service of deeper inquiry.

The interplay of identity and group contribution expressed via avatar relationship was central to construct emergence. Knowing is experienced from deep listening to self. This generative listening involves mind, heart, and gut that constitute somatic awareness. Neuroscientist Antonio Damasio (2004) wrote in Looking for Spinoza, “Emotions play out in the theater of the body. Feelings play out in the theater of the mind" (p. 28). Perhaps instincts play out in the theater of the gut and when all three theaters are examined through construction of ideal, authentic identity, they inform the ability to engage in transdisciplinarity. The theoretical framework of Transformed Social Interaction has as one of its three pillars, self-representative transformations (Blascovich & Beall, 2010, p. 63). It is within this category of TSI that the phenomenon was explored.

The proposed construct *virtual-physioception* involves the relationship of ‘self’ and avatar, especially in pursuit of higher ‘Self’ as described by Scharmer (2009). The scope of this study does not delve into the realm of ‘Self” described by Swiss psychiatrist and psychologist Carl Jung although many disciplines are called upon to illuminate phenomena under study. The goal was to identify heuristics for advanced, technology-enabled collaboration. Burnes (2011) described an entangled relationship between the father of quantum theory, Wolfgang Pauli and Jung illustrating the challenge of interdisciplinary collaboration. The pair explored the connection of mind with matter or

synchronicity providing individual experience and meaning through joint events (Burns, 2011). Jung was hesitant to publish on the philosophical topic of synchronicity, which leaned toward eastern views. Pauli's legacy of scientific stature was called into question for his dealings with Jung whom many academics dismissed perhaps due to disciplinary differences. Personal writings tell the story of how the two giants were served through transdisciplinary dialogue (Burns, 2011).

Virtual-physioception is explored for its relationship to another construct created for this study called *virtual intersubjective presencing*. The study aims to bridge a gap in the literature between previous research conducted on collaboration in virtual environments performed among subjects who did not necessarily participate in virtual worlds before studies were performed. Often study subjects involved students. This study involves professionals who are already using the environments and therefore, do not have the challenges of learning to use the software.

Currently, collaborative events are conducted in international face-to-face groups committed to find solutions to wicked problems, such as the Society for Organizational Learning (SOL) led by Dr. Peter Senge from the Massachusetts Institute for Technology (MIT). Such events do not appear to extend into virtual environments at the present time. Opportunities exist to research the place-, time-, self- and physical-bound constraints preventing more access to engage. Predisposition for face-to-face gatherings may be complex including the belief that transformative understanding can only occur face-to-face. Budgetary and time constraints combined with concerns for carbon footprint associated with travel may increase research on the nature of *virtual-physioception* providing renewed efforts for hosting events to engage in collaborative outreach.

In science conducted at research universities, collaborations are often conducted with a myriad of tools supported in ad hoc means. Often burdens exist on researchers to purchase, learn, and apply the technology in support of collaboration on their own. Complex collaborations spanning across departments and campuses are compounded by the challenges of transdisciplinary research. Centers of Excellence for Collaboration may provide support for socio-technical and socio-cultural computing needs necessary to support transdisciplinary research. Figure 6, *Lyr Lobo Nanotechnology Lab in Second Life*, shows an example of science education available for formal and informal instruction. Photo credit Cynthia Calongne.

Figure 6. Lyr Lobo Nanotechnology Lab in Second Life

Previous Studies

Virtual worlds have been researched for a variety of applications. Studies of collaboration within virtual environments have not used an Appreciative Inquiry approach reliant upon highly functioning groups powered with creative, motivated volunteers.

Faculty researchers in psychology, media studies, educational psychology and philosophy have published studies regarding identity and character relationships. Previous studies rely on subjects who are college students not representative of professionals working in the field. Other studies relied upon a task designed to measure cooperation more so than the type of paradigm-shifting collaboration. The management practice of Peter Senge and Otto Scharmer have led to a de-facto sixth discipline (Senge, 1990; Scharmer 2009) useful for dealing with global challenges in business and society. No studies appear to apply these management principles in collaborative virtual environments.

Chapter Two differentiates between the literature surrounding existing collaborative practices and the socio-technical trends affecting socio-cultural introspection. Several studies using virtual worlds have researched the effects for application within teaching and learning. This study did not target literature available for different disciplines and educational levels in virtual worlds such as the scholarship of teaching and learning (SoTL). Literature related to 'presence', 'social presence' and identity are explored for how they inform individual and group collaborative interactions. The relationship of embodiment in CVEs and its reflexive properties of the primary avatar or character are explored to relate to the theoretical framework of transdisciplinarity.

Research Methodology

The study design was informed through various sources leading to an interpretive, humanistic approach employing the strengths of both qualitative and quantitative paradigms. A phenomenological design involved the exploration of perceptions of how

individuals and groups interact when in the height of collaboration in a virtual environment. “The word phenomenology comes from the Kantian phenomenon meaning ‘‘…that which shows itself in itself…” when entities become manifest as the first signification of the word shows itself (Heidegger 2003, 51 as seen in Regan, 2012, p. 287).

Three primary exploratory questions guided the inquiry:

1. What is the nature of how people use avatars to collaborate in virtual environments?
2. What is the nature of how avatars engage in dialogue?
3. What is the nature of reflexive self-awareness in the context of avatar relationship?

Two constructs emerged from the literature review. *Virtual-physioception* and *virtual intersubjective presencing* were analyzed to explore their relationship providing greater insights into how collaborative virtual environments may serve such causes as networked science.

"Hans-Georg Gadamer’s philosophical hermeneutics is a qualitative research interpretive method that aims to explore the meaning of individual experiences in relation to understanding human interpretation" (Regan, 2012, p. 286). Five domains are discussed in Chapter Two that led to two constructs and fourteen factors used within a three-part comprehensive survey exploring interactions using avatars in collaborative virtual environments.

The guiding research question of the study was summarized:

Do high levels of self-reported *virtual-physioception* correlate to self-reported higher levels of perceived *virtual intersubjective presencing* in CVEs?

Two hypotheses were postulated. They are stated in the null:

> H_0: collaborative virtual environments users report no experience of *virtual-physioception*.
>
> H_0: collaborative virtual environments users report no experience of *virtual intersubjective presencing*.

Significance of the Study

The dearth of studies involving cross-industry collaboration makes this study significant. The potential to discover heuristics for use in rich-context scenarios using collaborative virtual environments may save time, money, carbon footprint, while accelerating desired research outcomes, and transform personal self-concept. Increasing calls for transdisciplinary collaboration among diverse experts suggest an inflection point in history to change the paradigm of how research is performed.

Limitations of the Study

This study has several limitations. Voluntarism is assumed among subjects where motivation does not come into question. The technology explored is a fraction of activity that occurred mostly in the worlds of Second Life, OpenSim, and World of Warcraft. The experiences described by subjects varied widely. The use of qualitative and quantitative methods required finesse to manage the range of variables under study. Fuller exploration of phenomena will benefit from participant observation and ethnography in the future to

explore actual events in real time. These qualitative approaches were not used due to research constraints. Caution is advised to interpret findings especially concerning the two framed constructs measured through limited, self-reported means and sample size. Finally, researcher bias must be a consideration in regard to the selection of the invited collaborative groups where exposure as participants existed. Representational collaborative groups are a slice of what takes place on a regular basis.

Phenomenology as an approach requires a researcher to bracket personal bias and experience when engaging in qualitative research. The use of self-reported data helps avoid bias in this case at the price of reliability (Creswell, 2012, p. 57). Transdisciplinarity suggests a researcher is inseparable with the observed. Transdisciplinarity encourages us to learn about "being" to better experience phenomena, data collection, analysis, and interpretation to better integrate a researchers' experience (Montuori, 2013).

Summary

This chapter has provided the background for the orientation to the research perspective based on socio-technical and socio-cultural dynamics. The study has been framed to provide the context for the phenomenological inquiry to explore self-reported perceptions among a purposeful sample of individuals and groups interacting within select collaborative virtual environments. In Chapter Two, the literature review surrounds foci of previous studies involving collaborative virtual environments to illustrate how two constructs emerged.

CHAPTER TWO: REVIEW OF THE LITERATURE

> "A key difference between a dialogue and an ordinary discussion is that, within the latter people usually hold relatively fixed positions and argue in favor of their views as they try to convince others to change. At best this may produce agreement or compromise, but it does not give rise to anything creative." (Bohm & Peat, 2010, p. 241).

This study concerned how collaboration occurs in virtual environments on activities for which individuals and groups voluntarily commit to dream upon, create, build, solve, and concertedly will reality into being. The glossary of nomenclature provided prior to this chapter serves as a backdrop for how terms and concepts build the narrative. It is recommended to become familiar with terms. The sections do not overlap, rather they are complementary.

Theories from disciplines including phenomenology, neurophenomenology, cognitive psychology, and management were explored to describe the nature of individual and group collaborative activity transpiring in virtual environments. Four theoretical frameworks informed the study design. Appreciative Inquiry was foundational. Cultural historical activity theory was applied for use among exploration of individual collaborative phenomena. Group collaborative phenomena employed the framework of Transformed Social Interaction (TSI). Computer science domains of machine learning, distributed computation, and networks are informed through this research.

The study employed five domains of which two evolved significantly during the literature review providing a basis of inquiry for two new proposed constructs. The

chapter unfolds with examination of the five domains that spanned from simple motivation to complexity framed within transdisciplinarity.

Motivation is the first domain discussed. The literature provides studies foundational to the attraction of individuals and groups to game play, engagement with guilds, and personalizing appearance of one's avatar or characters. The connection to theories of creativity, flow, and volunteerism are linked. The primary theories examined involve intrinsic motivation for the organic nature.

The second domain involved the stage. Collaborative virtual environments (CVEs) have witnessed rapid advancements bringing immersive experiences out of university laboratories to the desktop and in some cases notebook computers, and tablets. CVE use pervades homes for entertainment and finds increasing merit for training and education. The inquiry does not explore the vast realm of worlds and platforms making up *The Metaverse*, the term coined by Neal Stephenson in his famous book published in 1992, *Snow Crash*. The study primarily explored the use of Second Life, OpenSim, and World of Warcraft as an MMOG.

The third domain within the study originated as metacognition as an associate for computer-supported collaborative learning (CSCL). Learning is necessary to effectively collaborate. Psychological theories surrounding metacognition are varied and many and yet do not account for the full emotional experience of using CVEs. Advances in neuroscience provide a backdrop for how neural networks and processes create more interoceptive information crossing metacognitive bounds. Studies exist surrounding identity, appearance and personality within virtual worlds. No studies were found combining the range of somatic input explored involving CVEs. A new multidimensional

construct was formed called *virtual-physioception* involving the virtual environment and the combinatory information that informs the relationship between an individual and his or her avatar.

The fourth domain in the study began with the notion of dialogue, thoroughly researched for use in face to face, formal and informal contexts. Studies on ‘presencing’ noted by MIT researchers Otto Scharmer and used by Peter Senge in The Society for Organizational Learning (SOL) involved mostly structured dialogue requiring deep, personal introspection. The scope of this inquiry for this study surrounded informal, voluntary collaboration using an Appreciative Inquiry approach to discover what is perceived as working in CVEs. From a management perspective, a differentiator of an Appreciative Inquiry approach from other visioning or planning methodologies is that images of the future emerge out of grounded examples from an organization’s positive past (Cooperrider, & Whitney, 2001).

Communication patterns vary within CVEs and are significantly different than traditional communication methods. These differences create advantages and disadvantages for individuals and groups. Dialogue as referenced in the literature, does not occur in the same fashion at present time in CVEs. Considering the notion of Scharmer’s presencing and studies regarding presence and social presence, the question arose of how presencing occurs within a CVE. Dialogue in CVEs became a second multidimensional construct termed *virtual intersubjective presencing.* It was created to explore interaction involving group collaboration. Bailenson, Beall, Loomis, Blascovich & Turk (2004, p. 430.) stated "CVEs promise to produce major advances in the understanding of social interaction, both dyadic and group, by allowing much more

ecological validity while maintaining a high level of experimental control (Blascovich et al., 2002; Loomis, Blascovich & Beale., 1999). *Virtual intersubjective presencing* follows the construct of *intersubjective flow* created by Celia Pearce (2009) to describe the flow state between people (p. 133).

The fifth domain of the study created a third potential theoretical framework where the two formulated constructs may be applied. Dr. Alfonso Montuori (2013), Professor of Transformative Leadership at the California Institute of Integral Studies, advocates heightened self-awareness stating, "The complexity-based approach I draw on integrates the inquirer into the inquiry." (p. 205).

Transdisciplinarity

The term transdisciplinarity represents the fifth, intersecting domain of the study permeating and uniting other parts. Transdisciplinarity is in itself and at once an approach, a paradigm, a framework, a vision, a way of being, seeing, and thinking. In a study presented in 1992, a reported 8,530 definable fields of knowledge were identified (Kim, 1998, p. 30). What transdisciplinarity is not is a discipline or a field of study. *Yet*.

Basarab Nicolescu, considered the father of transdisciplinarity, spoke at conference in 2007 on transdisciplinarity in Philadelphia, Pennsylvania in the United States. He described the emerging philosophy and ideology between the theoretical, phenomenological, and experimental aspects of transdisciplinarity that illuminate differences in science and religion (Nicolescu, 2010). The theoretical origin that Nicolescu and Piaget began with included the importance of ‘being’ in unity with knowledge and Nature as differentiated by the pragmatic, phenomenological approach, focused on integration of knowledge. Helga Nowotny, Chair of the European Research

Advisory Board, along with Michael Gibbons, Chairman of the United Kingdom's Regulatory Policy Committee, are oriented more toward goals of solving wicked problems. Nowotny and Gibbons have written several articles espousing a pragmatic application for transdisciplinarity. Concerning the development, production, and quality control of science involving education reform and inclusion of, and accountability to society, Nowotny (2004) frames a goal of the transdisciplinary paradigm:

> Actually, we should go beyond value-added; we should start to speak about value-integrated. There is something of a societal value that needs to be integrated into the definition of good science. The potential of transdisciplinarity lies precisely here: to obtain a better outcome, to produce better science (p. 13).

In the United States, Alfonso Montuori has written and edited works on transdisciplinarity that resonate with Nicolescu's theoretical approach. Montuori echoes the call for a fourth pillar of transdisciplinarity to unite the inquirer with the inquiry, the observer with the observed (Volckmann, 2009, p. 280). The inclusion of Montuori's pillar unites the approaches of being and doing along the philosophical and experiential tenets of Hans-Georg Gadamer and John Dewey. Further, the use of avatars and characters in collaborative virtual environments applied to a vision of transdisciplinarity affords potential synchronicity reminiscent of Carl Jung. Studies of avatar relationship to 'self' suggest reflexive qualities that are little understood. To date, research has surrounded the study of avatars or characters for entertainment purposes. Studies are only beginning to explore the potential for educational, scientific and societal gain. Many educational studies within CVEs are limited in mimicry of existing learning paradigms and follow similar patterns of early adoption of online learning with the World Wide

Web. Today, it is hard to imagine the skepticism higher education held for learning online using the Internet in the early 1990s.

The Entertainment Industry has outpaced educational uses of media, especially in the gaming sector. The rise of such terms ‘serious’ games, ‘serious’ play, communities, and events indicate a critical mass of convergence surrounding informal Team Science and ubiquitous computing. The original notion of ubiquitous computing implied undertones of differentiation between virtual reality inside computers (*away from people*) and computing projected everywhere (*among people*) with the premise of fading into the background as calm technology (Weiser, 2013) [emphasis added]. Jane McGonigal extrapolated on the origins of ubiquitous computing in her dissertation inferring application to socio-cultural trends through gaming. McGonigal referred to the phenomenon as ubiquitous play and associated the socio-technical impact as having an accelerating effect upon the development of computing capability needed to serve the masses. Mediated identities are entangled within entertainment, education, and work converging through the combination of ubiquitous computing and ubiquitous play (McGonigal, 2006, p. 51). In 2011 McGonigal published her best-selling book, *Reality is Broken* that contained several themes discussed in her dissertation research. Collective intelligence is a by-product of such participation. McGonigal added players:
“gain confidence and fluency in emerging technologies and CI [collective intelligence] strategies by playing with new network platforms and multi-user applications in increasingly complex scenarios" (McGonigal, 2007, p. 25).
Transdisciplinarity holds potential to connect and unite people and knowledge through the unifying stage of CVEs integrating the physical world and web 2.0. The image in

Figure 7, *Tower ruins, Abbaye de Royaumont, Val-d'oise, France*, represents a 2D glimpse of scant remains of a 3D physical structure built around 1230 as a Cistercian abbey in France. The abbey was dissolved during the French Revolution and a private family bought the property in 1964 to preserve it as a cultural center. The location served as the setting for an International Symposium on Transdisciplinarity in 1998. The ruins are symbolic for the suggestion of a whole structure compared figuratively with current fragmented disciplinary lenses. The cooperation and collaboration required to construct the abbey and later to tear it down was not insignificant. Within collaborative virtual environments such representative constructions can be made with incomprehensible ease compared to the time, cost, and human suffering required to make and tear down such stone. The study of semantics is required to explore the significance digital representations make of current day abbeys, vibrant in the lives of avatars. A tenet of transdisciplinarity also involves sustainability considerations in respect to Nature. Photo credit Creative Commons License 3.0 http://commons.wikimedia.org/wiki/File:Abbaye_de_Royaumont_-_Tourelle_d'escalier_01.jpg

Figure 7. Tower ruins, Abbaye de Royaumont, Val-d'oise, France

The ruins were the location of an UNESCO sponsored International Symposium on Transdisciplinarity held in May 1998.

Many educators and users of CVES have in some cases co-constructed and experienced 'cathedrals' where emotional, cultural, and intellectual engagement is shared within communities. When 3D environments disappear, diaspora occurs similar to how Celia Pearce (2009) described in her book, *Communities of Play*.

Networked Team Science Research

Northwestern University is the home of the Science of Networks in Communities (SONIC) Lab, led by Dr. Noshir Contractor, who is one of the founders of the Web

Science Trust. The SONIC Lab has several projects involved in researching networked applications of Team Science. One project in particular concerns translational innovation exploring Team Science to determine the mechanisms of effective collaboration. Resources, consultation, and expertise are provided on the web site http://sonic.northwestern.edu.

The SONIC Lab has another project dedicated to the study of virtual worlds. The focus of the exploration is to model the dynamics of group behavior. The virtual world mentioned as part of the study is a massively multiplayer online game, Everquest. (See http://sonic.northwestern.edu/projects/online-games). Science research does not appear to be a focus of this grant. Modeling group behavior by analyzing large scale networks has the potential to reveal patterns of groupings that lead to teaming and collaboration.

A third project at the SONIC Lab is called VOSS: Understanding and Enabling Network Dynamics in Virtual Communities. The focus to date appears to center on the nanoHub community of scientists studying nanoscience. The VOSS Project appears to have the most interesting collection of connections among the SONIC projects including people, cyber-infrastructure, documents, data, workflow, and tools. The VOSS Project received an NSF grant from 2008-2011. This grant involved Contractor as the principle investigator (PI). Dr. Brian Uzzi was a co-principal investigator. Uzzi presented a TEDx Talk describing emerging research in collaboration (Uzzi, 2012). Dr. Luis Amaral was the other co-PI on the VOSS NSF grant and has a lab named after him called the Amaral Lab for Complex Systems and Systems Biology. Amaral and Uzzi co-direct the Northwestern Institute on Complex Systems (NICO). One of the grant programs NICO

offers is a $2.7 million award to crowdsource how new words are formed and adopted (NICO, 2013).

Team Science involves studying how people cooperate and collaborate in a myriad of ways. As researchers, faculty members, and scientists become aware of what makes collaborations effective, transdisciplinary research will advance. Some participants will become accomplished transdisciplinary leaders. Self-awareness assisted through the use of avatars or characters in collaborative virtual environments provides a sandbox to rehearse actions and play with roles. Leadership skills may be practiced in CVEs.

Dr. Barbara Gray (2008), co-founder and director of Penn State's Center for Research in Conflict and Negotiation describe the qualities needed among faculty and staff researchers:

> Transdisciplinary leaders need to be able to envision how various disciplines may overlap in constructive ways that could generate scientific breakthroughs and new understanding in a specific problem area. They themselves need to appreciate the value of such endeavors, be able to communicate their vision to potential collaborators, and construct a climate that fosters this collaboration (p. S125).

Montoya, Massey & Lockwood (2011) reported work was more dynamic and engaging, promoting collaboration and effectiveness as gaming environments and leadership behaviors were integrated in 3D CVEs (Reeves, Malone, & O'Driscoll, 2008 as seen in Montoya et al. 2011, p. 452). Participating within a community as a member of a CVE provides the opportunity to not only conduct research in CVEs such as Second Life and OpenSim, but CVEs may help develop the scientific habits of mind described by Steinkuehler & Chmiel (2006) about MMOGs:

> These patterns (scientific argumentation, model-based reasoning, and theory evidence coordination that arise in the context of online discussion of MMOG play) point to certain characteristics of MMOGs, both as designed objects and

> emergent cultures, that seem to afford the emergence of some scientific habits of mind and constrain others, characteristics of off-the-shelf MMOGs that may be of interest to designers of online mediated environments specifically for science education (p. 728).

Effective cooperation and collaboration of a team requires individual and team abilities. Habits are constructed consciously or unconsciously (Duhigg, 2012). Is an avatar a cognitive tool for developing 3D reasoning habits? Soleimani (2013) found support for knowledge gains through collaborative use of model-based reasoning involving a scientific, geothermal visualization (p. 39) as shown in Figure 8, *Model-Based Reasoning Geothermal Experiment in OpenSim*. Photo credit Andrew Stricker.

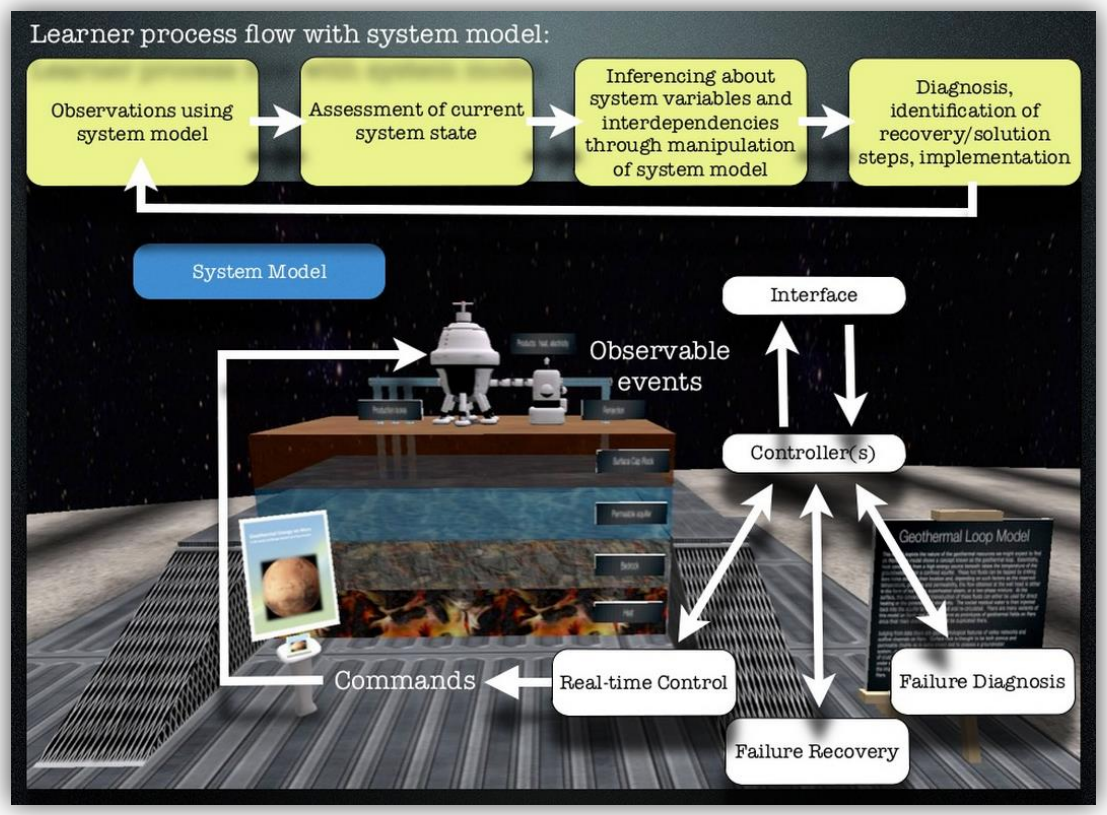

Figure 8. Model-Based Reasoning Geothermal Experiment in OpenSim

Outreach across domains of industry is an example of effectiveness as cited by Contractor, Amaral, Uzzi & Monge (2009) described the following collaborative outputs within a higher education, research university setting that summarized the innovative potential of transdisciplinarity:

> i) new knowledge and inventions, including publications and patents; (ii) visual analytics tools, simulation tools, remote instruments, and workflows; (iii) digital repositories for structured or unstructured data and knowledge, (iv) formal and informal training of undergraduate and graduate students via learning modules, curriculum development, and (v) outreach partnerships with industry as well as community organizations such as schools and museums (p.8).

Collaborative Virtual Environments (CVEs)

The initial review of literature surrounded 3D computational systems rather than existing literature on Computer Supported Collaborative Work (CSCW) and Computer Supported Collaborative Learning (CSCL). CVEs were chosen as the universal concept term for the range of 3D environments that hosts distributed groups. The communication channels to explore dialogue were of most interest. Bailenson, Beall, Loomis, Blascovich & Turk (2004) reported "Collaborative virtual environments (CVEs) that employ 3D computer-generated avatars to represent human interactants (as opposed to direct video feeds) may provide an ideal balance between the limited information offered via audio communication and the problems that seem inherent to videoconferences" (p. 429).

The study of dialogue in CVEs must include the foundational relationship with the avatar for its impact to develop self and identity. As personal agency is gained to overcome cognitive load, the ability to focus attention shifts, providing opportunities for enhanced communication. "Unlike telephone conversations and videoconferences, the physical appearance and behavioral actions of avatars can be systematically filtered in immersive CVEs idiosyncratically for other interactants, amplifying or suppressing

features and nonverbal signals in real-time for strategic purposes" (Bailenson, Beall, Loomis, Blascovich & Turk, 2005, p. 513)

Second Life Communities and Organizations

Dr. Beth Coleman (2011) in her book, *Hello Avatar*, summed up what for many organizations represents the opportunity of CVEs: "What Second Life actually delivers is not so much an escape to another life rather an experience networked across virtual and real engagement" (p. 12). In the United States, the military has been a strategic user of virtual environments. The US Air Force A4/6I team, pictured in Figure 29, *USAF Innovation and Integrations Team*, has created reusable virtual environments, cross industry events, and encouraged the development of virtual community. The Global Learning Forum (GLF) facilitated events to save funding and time to gather decision leaders across industries.

Content created in Second Life in the My Base lands conveyed memes of Air Force history associated with values exemplified by pioneers of flight. The My Base lands contain a wide range of air craft similar to the U.S. Smithsonian's Air and Space Museum. It is not clear whether any physical museums are connected to the virtual environment. The New Media Consortium mentioned in Chapter one has been working at both ends of physical and virtual continuum.

The USAF A4/6I team members work collaboratively, face-to-face, across grids and services to broaden capability development using CVEs to innovate. Research and development across media and technologies are sought to improve individual and collective performance. Spinoza Quinnell, pictured bottom left, is Andrew Stricker who shares the photo credit.

Figure 9. USAF Innovation and Integrations Team

Building capabilities is a hallmark of a learning organization resulting in replicability of performance, scalability, and sustainability. Team members who apply CVE technologies across operational needs strategically are poised to adapt. "Future research is needed to explore the learning curve associated with a 3D CVE. From a practice perspective, this insight will help managers understand what the start-up costs will be to transition a virtual team to a 3D platform" (Montoya, Massey, & Lockwood, 2011, p. 468).

New Media Faculty Seminar

Within higher education in the United States, the New Media Consortium allowed its Second Life land to be used as part of a New Media Faculty Networked Seminar. In fall 2011, Dr. Gardner Campbell conducted his course at Virginia Tech in the United States while a small group of participants from around the world spontaneously gathered around a virtual campfire to share insights regarding the assigned readings. The sessions were coordinated by avatars Chimera Cosmos and Spiral Theas. These virtual world

sessions preceded the GamesMOOC mentioned in Chapter One that used a combination of technologies to create a virtual community. Figure 10, *New Media Faculty Seminar*, shows the NMC campsite where Stanford University's visiting lecturer, Dr. Howard Rheingold, was the week's guest speaker. Photo credit Liz Dorland.

Figure 10. New Media Faculty Seminar

Non-Profit Commons

Industry benefits from the affordances of Second Life for collaboration. The Non-Profit Commons weekly meetings attract regular citizen residents as seen in Figure 11, *Nonprofit Commons Meeting*, sponsored by TechSoup Global. The tree in the center of Figure 11 is no tree; rather it is an avatar who often illustrates what can be done in virtual worlds. Non-profit companies in physical and Second Life lease space on the Nonprofit Commons' land. Insights and resources are shared to help companies serve their communities that often span physical communities. The Nonprofit Commons group in Second Life is led by Rhiannon Chatnoir, seen on the right in Figure 11 facing attendees. Photo credit Barbara Truman.

Figure 11. Nonprofit Commons Meeting

TeamSTEPPs

An example of an interdisciplinary, collaborative initiative spanning across industry, non-profit organizations, government, military, and education involved a project in the United States called TeamStepps.

The Agency for Healthcare Research and Quality (AHRQ) and the Health Research & Educational Trust sponsored a conference in June 2013 funded by the United States Department of Defense (DoD) and the U.S. Department of Health and Human Services. The topic of the conference was to promote a methodology for improving performance and collaboration surrounding patient safety called TeamStepps. (See http://www.teamsteppsportal.org). The TeamStepps methodology has been empirically researched and literally battle tested. The procedures have been used in systemic

improvement of entire organizations and deployed in battlefield health care scenarios in Iraq and Afghanistan during crises. The TeamStepps methodology involves team competencies for shared mental models, trust, communication, leadership, and support. Previous simulation practices involved two extremes, the use of high cost, technical manikin simulators and low cost, no tech role play. Both examples of simulation were place bound and time bound. The training needs to be available anytime, anywhere.

The DoD had few participating attendees due to the government sequestration preventing travel. During the closing session, Dr. James Battles, father of TeamStepps, spoke of the need to provide online training and community building. All the training was provided at no cost, but was only offered face-to-face. Waiting lists were fully subscribed for the remainder of the year among the five universities offering the training. The researcher spoke with Battles about using avatars for training after he spoke of the idea at the conference. Attendees wanted to learn more about the notion of making computer-based simulation as rehearsal to combine with place-based mannequin simulators.

An inquiry was made to the MOSES listserv regarding whether any CVE immersive learning involvement surrounded TeamSTEPPs. Within hours a response came from a Dr. Rachel Umoren (Rachel Gloedu in Second Life), a physician-educator from Indiana University who immediately invited the researcher to take a virtual field trip. The Clarence Hospital, located on the Glasgow Caledonian University Second Life land, was visited as shown in Figure 12, TeamSTEPPs in Second Life. Dr. Evalyn Gossett (Shawnta Clarence in Second Life),a nurse educator also from Indiana University, was also credited for developing the use of TeamSTEPPs in Second Life. Dr. Umoren pictured as her avatar (below center) in Figure 11, is currently building in

OpenSim where she has made a health simulation to practice intercultural communications as part of an East Africa Traveler Safety Activity (see https://sites.google.com/site/globalhealth3dgrid). Photo credit Barbara Truman.

Figure 12. TeamSTEPPs in Second Life

Distributed Conference Event: VWBPE

The Virtual Worlds Best Practices in Education Conference (2012) is a special event that occurs once a year and in 2012 over 2,000 unique attendees spent an average of three hours in the Second Life venues. Sessions were broadcast from the virtual world to the Web by Treet.tv. The affordance to be able to watch events without having to log into the client software provides some convenience at a cost of socialization with others in the event. In some cases the ability to log into sessions was not possible due to lag from the server software trying to manage the demand. Figure 13, *Chris Dede at the 2012 VWBPE Conference*, shows Dr. Chris Dede, professor from the Harvard University

Graduate School, who provided a keynote called, *How Immersion in Virtual and Augmented Worlds Helps Students in the Real World*. Conference executive coordinators, Abacus Capoli and Kavon Zenovka appear behind the steampunk-themed stage (Virtual Worlds Best Practices in Education, 2012, p. 2). The conference depended upon volunteers to manage the variety of events.

Exploration tours were held showcasing international, cultural, and historical builds such as a Chinese Space Program Simulation, Eve Online MMOG tour, and Tour of a Maya Temple. World of Warcraft was also showcased for use in K12 as well as machinima contests. Social events were held featuring live musicians who played through avatars. Photo credit Barbara Truman.

Figure 13. Chris Dede at the 2012 VWBPE Conference

The Dance of Universal Cultural Interaction

Dancing is a universal language helping avatars relax and share experience in CVEs. Conference events frequently have a social event allowing attendees to network. Dances are usually provided to offer a choice of movements an avatar can attach. Music may be streamed like a radio channel or provided using digital recordings by a DJ, or performed live via computer. Some avatars have produced lifelike artistic dances that orchestrate synchronized movements among a few users.

Figure 14, *Synchronized Dancing at the 2013 VWBPE Conference Social*, shows avatars Chimera Cosmos, Delightful Doowangle (the researcher) moving in step through a dance huddle customized by Lyr Lobo (center) who also supervised this study. Fire sticks attached to avatar hands added to the visual appeal similar to a Hawaiian luau. Objects can be scripted and scripts can be nested and worn to achieve avatar actions. The colorful spots in the image resulted when the DJ released motion particle effects floating through the air until dissipating. Chimera Cosmos is a well-known educator and certified virtual world builder who also hosted a Gordon Research Conference on Scientific Visualization sponsored by a grant from the US National Science Foundation.

Dancing at events provides bonding opportunities among avatars from different nations around the world. The graphical user interface for the Second Life or similar software offers the ability to control lighting to enhance visual effects. Social events also provide nonthreatening, social means to gather with frequency. As the dances improve through the use of kinesthetic movement interaction to encode dance moves in the physical world, the technologically-driven interactions will give way to more naturally human interactions (Moen, 2007, p. 252). Photo credit Barbara Truman.

Figure 14. Synchronized Dancing at the 2013 VWBPE Conference Social

Tips are often collected at events where live artists perform in their homes or studios with musical equipment hooked up to their computer. Figure 15, *Beatles Concert Simulation Event at 2012 VWBPE*, is an example of a social event where as many as 100 avatars have gathered for distributed dance events. It is not uncommon to experience lag or get kicked off if the load becomes too great. Photo credit Barbara Truman.

Figure 15. Beatles Concert Simulation Event at 2012 VWBPE

Government Sponsored Science Learning

Figure 16, *NASA's Second Life Experience for the Mars Curiosity Rover*, was part of a tour at a VWBPE conference where attendees were provided scripted space suits possessing bouncing properties to mimic the gravity levels on Mars while walking. Such environments are being used for STEM across grids. The team members who worked with the actual Mars rovers were reported to anthropomorphize the machines as social agents believed to contribute toward the success of the mission (Vertesi, 2008, p. 2524). Scientists have been experimenting with embodied avatars that mimic engineering designs to build innovative capabilities. Will design improve if an engineer had deeply experienced the embodied avatar of a multi-armed octopus or the villain of Spiderman? Photo credit Barbara Truman.

Figure 16. NASA's Second Life Experience for the Mars Curiosity Rover

Other groups also regularly sponsor events in Second Life surrounding science learning such as the group Virtually Speaking. Figure 17, *Virtually Speaking Science Event in Second Life*, where audio blogs are also created for users who cannot get together in Second Life (Virtually Speaking Science, 2013). The topic of the session below was about the Mars Atmosphere and Volatile Evolution Mission (MAVEN) involving the research of Dr. David Brain (2012). Another example of a group conducting events in Second Life to promote international, interdisciplinary science education is called Science Circle made up of a consortium of 12 universities and government research organizations such as NASA eEducation (Science Circle, 2014). Photo credit Barbara Truman.

Figure 17. Virtually Speaking Science Event in Second Life

American Cancer Society's Relay for Life

Non-profit fundraising associations and causes such as the annual fundraiser for cancer research, Relay for Life raised over $375,000 (US funds) in 2013 by avatars who pledged to honor persons who were fighting cancer or honor those who had been lost. Figure 18, *American Cancer Society Relay for Life*, shows the track where a few thousand avatars gathered to create builds around a track where lumimaria lit up the track. Delightful Doowangle, researcher of this study is picture bottom left. Photo credit Barbara Truman.

Figure 18. American Cancer Society Relay for Life

Preserving History – Virtual Pioneers

Historical significance is often a theme of builds created in Second Life. These builds may have content that is shifted to OpenSim as the marketplace matures to obtain objects such as furniture and clothing. Figure 19, *Virtual Tour of US Holocaust Museum*, represents an image of a tour coordinated by the group, The Virtual Pioneers in Second

Life. The Holocaust Museum build is a replica of the physical museum located in Washington, DC. Such environments serve multiple purposes. They are useful to experience virtually if the opportunity to experience the physical museum is not possible. The virtual experience also serves as rehearsal for the in person visit and as refresher once the physical museum has been visited. An OpenSim MOOC was made about the life of Anne Frank for which some tour participants were able to engage. Photo credit Barbara Truman.

Figure 19. Virtual Tour of US Holocaust Museum

The Virtual Harmony OpenSim build mentioned in Chapter One also has a replica of New Harmony, Indiana from 1826.

Practicing Virtual Health Advising in Second Life

The phrase *practicing* medicine takes on new meaning when physicians are able to interact with avatars in CVEs to practice motivational interviewing. Dr. John Weicha, co-principal investigator on a US National Institutes of Health funded grant, described how patients benefitted from gaining confidence over their uncontrolled diabetes

(Weicha, 2011). A video described the strengths-based team that enabled partnering on the building, training, and advising of doctors and users to research benefits of virtual world to change behavior (Heyden, 2012). The project was conducted through Boston University and represents one example of a health-based use of CVEs. The project was called Women in Control (DePaoli, 2012).

OpenSimulator

In early 2007, the OpenSimulator project began after the Second Life client software produced by Linden Lab was released into open source. The goals of the OpenSimulator initiative were to enable the use of multiple 3D platforms for multiple users. Developers can customize environments by downloading the open source software (see http://opensimulator.org). The software code was released through a license allowing minimal restrictions to anyone. The initiative continues to depend upon its community as an open source project. Developers hold regularly scheduled meetings and use wiki, mailing lists, and other communication channels (OpenSimulator, 2013). The growth of OpenSim (short for OpenSimulator) continues to increase as reported by the news outlet, HyperGrid Business (2014). The news outlet provides more than news as it tracks virtual world activity and provides resources to the community. http://www.hypergridbusiness.com/

OpenSim Inaugural Distributed Conference Event

In Fall 2013, volunteers and members of the OpenSim community conducted the first grass roots OpenSim Community Conference produced through support from the nonprofit organizations, AvaCon, Incorporated and the Overte Foundation. Over 400

attendees participated representing multiple industries for the multi-day event where keynote, panels, and concurrent sessions were held as seen in Figure 20, *The OpenSim Community Conference 2013*. A by-product of producing the conference advanced the creation of reusable software code available for the broader community to use (OCSS13, 2013). Metaverse veterans and community leaders such as Rhiannon Chatnoir and Fleep Tuque are gaining capabilities rapidly to extend to other non-profit endeavors. They seek volunteers from all sectors of education, government, industry, and military. Photo credit Barbara Truman.

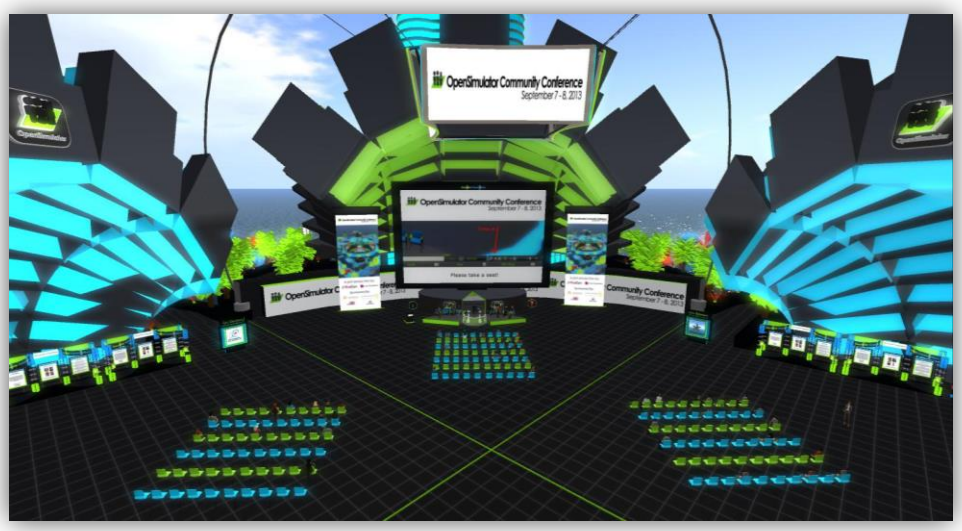

Figure 20. The OpenSim Community Conference 2013

Temporal Cultural Preservation for Sustainability

Another OpenSim project was created by Andrew Stricker called Virtual Harmony. The grid contained multiple regions representing historical environments. Informal discussions were sponsored by committee member, Andrew Stricker, to share insights about significant people and memorable events from history that shaped current

events. Figure 21, *Virtual Harmony OpenSim Grid*, illustrates some of the regions found that represent recreation of historical sites such as Mt. Vesuvius and New Harmony, Indiana as it appeared in 1826. Virtual Harmony content was also repurposed across multiple grids as a means to explore differences in the platforms. Photo credit Andrew Stricker.

Figure 21. Virtual Harmony OpenSim Grid

Hypergridding across CVEs, Dune Environment

Pathfinder Lester, former employee of Linden Lab, the makers of Second Life, led a group tour of the Hyper Grid Adventures Club (HGAC) to the Dune region. The sim [simulation] is based on the science fiction movie and hosted by LaniGlobal who shares necessary items to experience the region. Figure 22, *OpenSim Dune Region*, shows a spacecraft flown by Pathfinder during the HGAC tour where large sand worms appear

from underground. The site features an extensive role play area. The tools and clothing increase the potential to experience immersion. Photo credit Barbara Truman.

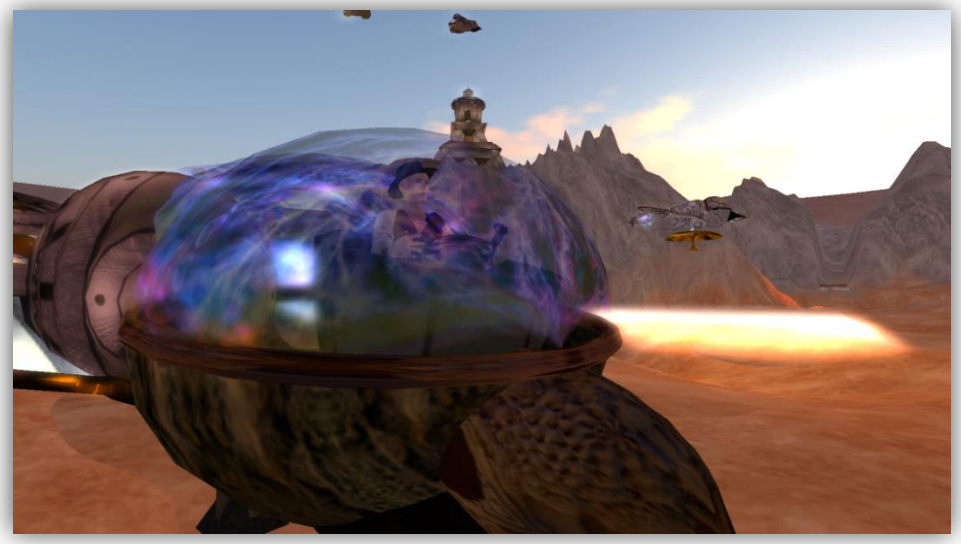

Figure 22. OpenSim Dune Region

Community Meetings VWER

The Virtual Worlds Education Roundtable has been meeting weekly for the last four years to share knowledge across grids. Meetings have been hosted in Second Life at Montclair State University, Bowling Green State University, and Glasgow Caledonian University in Scotland. Figure 23, *Virtual Worlds Education Roundtable Session***,** shows Agile Bill and Pathfinder's Andragons illustrating how guest speakers make presentations about once a month to the community. Sessions are led by dedicated volunteers such as Kali Pizzaro, a registered nurse educator and researcher and AJ Brooks, educational leader who helped found the VWER. Photo credit Barbara Truman.

Figure 23. Virtual Worlds Education Roundtable Session

Regular events are held in Second Life by the United States Air Force, primary hosts of the Global Learning Forum. Lunch and learn sessions are conducted where guest speakers make presentations on topics relevant for the military research and development agenda. Figure 24, *US Army Research Lab Presentation to US Air Force Lunch & Learn*, shows Douglas Maxwell of the US Army's Research Lab within the Simulation Technology and Training Center. Maxwell facilitates the MOSES OpenSim Initiative described in the nomenclature section. The US military collaborates in collaborative virtual environments to share knowledge and resources. Photo credit Barbara Truman.

Figure 24. US Army Research Lab Presentation to US Air Force Lunch & Learn

MMOGS, Training and Simulation

Military and industry sectors have been active in the adaptation of CVE and gaming platforms to achieve performance objectives in innovative ways. Literatures surrounding the use of CVE and MMOG technology in the military exist, but are sometimes difficult to obtain for the lay person. Understanding the myriad of acronyms is also a barrier to translating the research gains into industry and education from the military. In the United States, The Advanced Distributed Learning (ADL) Co-Laboratories were created in part to serve joint strategic and operational needs. The ADL Colabs offer programs and services designed to share awareness of emerging technologies including virtual worlds and games.

Within education sectors in the United States, fewer examples are found where universities or school systems apply CVEs, and especially MMOGs for strategic, operational use. Considerable research is performed about CVE use for teaching and

learning. Literature is available through subscription libraries or through paid, face-to-face conference attendance posing a barrier for many innovators operating in education on limited budgets. Funding agencies have provided specific incentives to promote research and development into the use of gaming to promote college readiness (Next Generation Learning, 2013). Alternative models of blended learning and more recently MOOCs compete with systemic, game-based learning initiatives. "MMOGs can be a thoroughly collaborative space, not only within the game but also beyond the game (via fan websites and discussion boards). Moreover, because these virtual worlds are played in real time they function as a highly visible and thoroughly traceable medium for the study of social exchanges." (Meachem, 2009, p. 50).

Mentoring in MMOGS

The GamesMOOC, discussed in Chapter One, arose out of the Colorado Community College Online System as part of strategic, institutional funding. Figure 25, *Mentoring Examples in CVEs*, illustrates a collage of images where educators used World of Warcraft and Second Life to help each other learn about MMOGs. The mentoring led to accelerated learning and agency arising from community participation. Educational professionals committed their own time to engage for personal and career development.

> …MMOGs have an added feature for users that movies, television and music lack. That feature is agency. The user can alter the pace, flow, and outcome of the game. Such control in online games 'can also cause a user to identify with a mediated character to a greater degree than is possible with characters portrayed in other media because the user, to some degree, actually is the protagonist in the game' (Smith, B. 2006, p. 43) as seen in (Meachem, 2009, p. 17).

Serious leisure is a concept referred to in Scacchi (2012) and for many educators who have experienced reduction in professional development funds, online communities

such as the GamesMOOC are a better investment in career development (p. 67). The upper left image in Figure 25 shows World of Warcraft guild leaders (a community college and K12 educational leader) discussing lessons with university faculty administrators (the researcher is seated). The lower image in Figure 25 shows a gathering of educational leaders in Second Life listening to a talk about game-based learning sponsored by ISTE's SIGVE. The upper right image in Figure 25 shows dissertation chair, Cynthia Calongne, mentoring the researcher. Photo credits, Gridjumper (Tanya Martin) and Barbara Truman.

Figure 25. Mentoring Examples in CVEs

Meachem (2009) reported benefits of game play that also serve to build community as exemplified by the GamesMOOC and ISTE's SIGVE, "Players of

MMOGs often must trust other players to successfully navigate the game but additionally, the trust built through game play can lead to a more personal trust between individual players" (p. 102).

Strategizing for Collaboration

Dialogue in World of Warcraft is often achieved through distributed meetings while using additional audio capabilities such as IRC. More recently, the use of Google Hangouts allowed educational leaders to stream and share activities of what was happening for those who could not take the time or expense to experience the game directly. The gathering in Figure 26, *Briefing and Debriefing in World of Warcraft*, shows an example of a briefing session among key educational leaders who discuss in game plans, review past actions, and conduct dialogue concerning out of game opportunities such as applying game-based learning to various curricula and learners. Photo credit Gridjumper, (Tanya Martin).

Figure 26. Briefing and Debriefing in World of Warcraft

US Military MMO: EDGE

A military training project called EDGE provides an exemplary project similar to the Unites States Army's MOSES Initiative (see CVEs in nomenclature). The Enhanced Dynamic Geo-social Environment (EDGE), is not a MMOG, rather it is a government-developed Massively Multiplayer Online (MMO) environment built to capitalize on state-of-the-art game technology and traditional military simulation physics and models (Dwyer, Griffith & Maxwell, 2011, p. 3). EDGE is included as a strategic example of how open source MMOG technology can be adopted.

Will environments such as EDGE and MOSES provide a virtual staging area not only for the military to develop its training, but also where other leaders can congregate to appreciate diverse stakeholder interests, develop joint policy, share research findings and perhaps build a *virtual learning organization community (VLOC)*? Such organizations could serve communities through civil defense and for emergency management in addition to preparing warfighters. Figure 27, *MOSES Distributed Scene Graph Load Test with Intel Labs,* illustrates a debriefing of volunteers after a scenario test to see how training could be performed as rehearsal for physical exercises.

The United States Army's Learning Concept for 2015 Report stated one of its required capabilities as having leaders who are comfortable serving on civil military teams (Dempsey, 2011, p. 59). Civil-military operations (CMO) are made up of civil-military teams whose collaborative actions require diplomacy, military, economic, and informational capability lending stability to an environment. Some civil-military teams involve inter-agency and multinational representatives (United States Department of Defense, 2013, p. xi). Researching CVE use for training, simulation, and joint, inter-

agency collaboration could virtually bring together diverse parties not traditionally involved due to cost and logistic limitations similar to how scientists collaborate across institutions and national boundaries. Photo credit Barbara Truman.

Figure 27. MOSES Distributed Scene Graph Load Test with Intel Labs

Dwyer et al. (2011) stated projects like EDGE acknowledges growing trends in online communities for the use of “soft-skills, such as leadership, problem-solving cultural norms, and teambuilding, which virtual environments foster (p. 3). Simultaneously, the visually-rich, 3D environment of the MMO allows for the exploration of strategic initiatives to conduct training and rehearse missions. “Imagine a living, breathing virtual space that persists 24 hours a day, 7 days a week, is accessible from anywhere in the world through Internet connectivity, and is influenced by the actions of those who visit. EDGE is that place" (Dwyer, Griffith & Maxwell, 2011, p. 3).

In January 2014, a field experiment was conducted in central Florida involving a modified version of the MOSES OpenSim technology for guided training. The exercise was performed with Army reserve soldiers who accessed the technology in a face-to face lab setting as shown in Figure 28, *MOSES Field Training Experiment*. The experiment used a portable server that involved an orientation, practice activities, and scenarios similar to those used in physical training. Photo credit Douglas Maxwell, 12 January, 2014, Apache Company Armory, Leesburg, Florida.

Figure 28. MOSES Field Training Experiment

The training experiment served as an example of new dynamics of using OpenSim for a variety of physical and virtual training needs that may improve outcomes while saving costs and time.

Virtual Organizations

As research findings increase in Team Science and more researchers are attracted to Virtual Team Science, cultural adaptability will become more important. DeSanctis

and Monge (1999) define virtual organizations (VOs) as being geographically networked and distributed, functionally and/or culturally diverse that relies on coordination based on lateral, dynamic relationships (p. 693 as seen in Contractor, Amaral, Uzzi & Monge, 2009, p.4). The availability of open data as found on the United States Government Open Data web site may accelerate the development of virtual organizations. http://www.data.gov.

Contractor et al. (2009) cited Bos, et al. (2007) as reporting functionalities of virtual organizations included "shared instruments, community data systems, virtual communities of practice and learning, community infrastructure, open community contribution systems, and distributed research centers" (Contractor, Amaral, Uzzi & Monge, 2009, p.9). Matching services for facilitating Team Science and virtual collaborations are limited. Tracking expertise, willingness to volunteer, and availability to partner on grants, projects, and papers will be improved with time. Will there be software similar to how X-Box Live on the Microsoft console gaming platform can put teams together and track team performance?

Liu, Myers, Minsker, & Futrelle, (2007) reported a major challenge is needed to assist individuals "discover" the most appropriate human and digital resources. Lui et al. add "The cyberinfrastructure community has been making ontologies, web services, service oriented architecture, Web 2.0 technologies, and semantic grid technologies (Contractor, Amaral, Uzzi & Monge, 2009, p.5). How these technologic innovations become integrated into organizations is a matter of urgency.

Metacognition

Software used in collaborative virtual environments allows the user to choose how they wish to experience the scenes and interactions such as seen in Figure 29, *Second Life Viewing Perspectives.* This power of perspective control comes at the cost of ease of use. Overcoming the learning curve often encourages social engagement to obtain assistance. Grit is needed to obtain full-benefit of the software and by extension, events and community. Selection of how to view the environment creates the ability to reflect on seeing one's avatar as it reflects back on the user. Mastering the camera controls in the software promotes a visibility of perspective similar to how Lindgren (2008) describes drifting between viewpoints (p. 23). Photo credits Barbara Truman.

Mouselook perspective Over the shoulder perspective Avatar view perspective

Figure 29. Second Life Viewing Perspectives

Studies by Bailenson reported users exercise more, eat better and save more money after seeing their likeness in an avatar. Figure 30, *Society Impact from Video Games*, came from a televised segment from the Public Broadcasting Service (PBS) featuring the research of Jeremy Bailenson (Image attribution see http://www.pbs.org/newshour/bb/business/july-dec13/games_07-11.html).

Figure 30. Society Impact from Video Games

Avatars or characters in a CVE can be a tool for developing metacognition to build collaboration skills, participating in teams, and for solving complex problems suitable for scientific research. The specific question of how avatars and characters in CVEs assist users to become more of a team member in physical life is a topic for further research.

Developing an avatar or character in a CVE builds self-knowledge. Tarricone (2011) reported "Self-knowledge unites reflection and metacognition, and therefore would provide a rich theoretical framework to investigate how self-knowledge supports metacognition and how reflection interacts with both metacognition and self-knowledge to facilitate decision-making" (p. 215). Lane (2007) quoted the work of Dr. Milton Bennett who is a professor at Portland State University and serves on the board of directors for the Intercultural Development Research (IDR) Institute. Bennett served with the Peace Corps and is known for the Bennett scale of Developmental Model of Intercultural Sensitivity broadly used across industries.

Regarding metacognition, Bennett said:

> The integrated person understands that his or her identity emerges from the act of defining identity itself. This self-reflective loop shows identity to be one act of constructing reality, similar to others that yield concepts and cultures. By being conscious of this dynamic process, people can function in relationship to cultures while staying outside the constraints of any particular one (Bennett, 1993, p.60 as seen in Lane, 2007, p. 4).

Body Awareness Research

Metacognition is just one level of activity useful for avatar and character development in CVEs. In 2009, researchers from the United States at the University of California San Francisco and University of Washington, in Seattle conducted a study analyzing 1,825 abstracts and 39 instruments related to body awareness. The study was funded by the National Institutes for Health to assess psychometric qualities of self-reported measures and associated constructs. Body intelligence was one of the measures examined in the review defined as: "the awareness and use of bodily sensations to (a) support health and well-being, (b) supply information about environmental safety and comfort, and (c) enhance personal and spiritual development over a lifetime" (Mehling, et al., 2009, p. 7).

Young & Whitty, (2011) posited what they termed supermorphic persona (discussed later in this chapter) representing an extension of a framework of progressive embodiment. Supermorphia is a term they created to describe the transitory state of progressive embodiment that includes a body-schema constituting:

> The body-schema constitutes a tacit system of sub-intentional motor functions which plays a dynamic role in the governance of a subject's postures and movements; and although the body-schema cannot be experienced directly, it nevertheless influences how we experience our embodied interactions with the world (Young & Whitty, 2011, p. 548).

Young & Whitty's progressive embodiment body schema is consistent with the construct, *virtual–physioception* created for this study.

Figure 31, *Body Awareness Dimensions (Mehling et al., 2009)*, shows the four dimensions of the body awareness construct (p. 11) resultant from the analysis. Image credit Creative Commons License 3.0 by Mehling, Gopisetty, Daubenmier, Price, Hecht, & Stewart, 2009. Body awareness: construct and self-report measures. PLoS ONE, 4(5), e5614. doi:10.1371/journal.pone.0005614.t005

Dimension	Sub-Domain	Explanation
1) Perceived Body Sensations	A) Sensations of distress, worry, pain and tension	Ability to note changes in body processes, to identify inner sensations (e.g. a tight muscle, fatigue, warmth, pain) and discern subtle bodily cues indicating varying functional states of the body or its organs and the emotional/ physiological state of the body (relaxed – tense).
	B) Sensations of wellbeing	Sensory and affective aspect of sensations.
	C) Neutral/ambiguous sensations	
	D) Affective aspect of sensation: Bothersomeness i.e. of pain	
2) Attention Quality	A) Intensity: Actively paying attention (incl. exaggerated focus) vs. ignoring and suppressing perceptions.	A) Bi-polar continuum from paying attention towards sensations (understood as *active* response to the perception of sensations) to distracting avoidance, ignoring and suppression of perceptions. Active focus can be involuntarily reactive as well as intentional ("mindful"). Intensity also reflects the importance of one's body sensations to the individual.
	B) Self-efficacy in attention control	B) Confidence in the ability how well one can focus on a sensation, sustain focus and control the mode of attention.
	C) Mode: thinking/labeling vs. experiencing the present-moment immediacy of sensations	C) Bi-polar continuum from reflective, mental, analytical, thinking, labeling, ruminating mode to non-judgmental, immediate, felt sensory awareness, mindful presence (includes kinesthetic sense).
3) Attitude	A) Trusting	General (trait) bias in appraisal/interpretation of sensations: Variance in how we relate to bodily cues: (A) trust and viewing sensations as helpful for decision-making and sense of self;
	(B) Catastrophizing	(B) catastrophizing and worry.
4) Mind-Body Integration	A) Emotional awareness	A) Awareness of physical sensations in emotions as their sensory aspect ("somatic markers").
	B) Overall felt sense of embodied self vs. feeling disconnected.	B) Bi-polar continuum from feeling embodied (with awareness of interconnectedness of mental, emotional, and physical pro-cesses) to a sense of alienation from one's body.

Figure 31. Body Awareness Dimensions (Mehling et al., 2009)

Of the four dimensions shown in Figure 31, Mind-Body Integration most associates with the research explored in this study. Two associated subdomains were categorized as emotional awareness and sense of embodied-self. Awareness of physical

sensations such as when breathing gets shallow indicates emotional awareness. Mehling et al.(2009) describe the overall sense of embodied-self as “representing a second-order perception of sensations that contains within it a felt sense of the interconnectedness of mental, emotional, and physical processes as opposed to a disembodied sense of alienation and of being disconnected from one’s body (p. 12). Young & Whitty (2011) describe embodied-self as an extension of the boundary of one’s body even when one does not have the physical body part. An example was a handicapped child using a stick to play in cyberspace through appropriation (p. 552).

Presence to Presencing

For the purpose of this study, presence has multiple connotations. Various dimensions of presence are discussed later in this chapter to illustrate the gap in literature and define aspects of a new construct, called *virtual intersubjective presencing* that occurs in a collaborative virtual environment. ‘Presencing’ as used in the research of Peter Senge, Otto Scharmer and colleagues at MIT who participate in the Society for Organizational Learning and Presencing Institute involves generative listening to one’s self and others. Deep self-awareness is required to engage in presencing to practice opening one’s mind, heart, and will.

Senge, Scharmer, Jaworski & Flowers (2005) described presencing:

> We came to see the importance of letting go of old identities and the need to control and as Salk said, making choices to serve the evolution of life. Ultimately, we came to see all these aspects of presence as leading to a state of "letting come," of consciously participating in a larger field for change. When this happens, the field shifts, and the forces shaping a situation can move from re-creating the past to manifesting or realizing an emerging future (p. 14).

Managers and business leaders are most likely familiar with the management practices resulting from awareness for systems thinking made popular after the book, *The Fifth Discipline* was published in 1990. Building organizations focused on learning was the central theme of *The Fifth Discipline* that remains a seminal work for management studies.

Otto Scharmer referred to presencing as a sixth discipline, essential for business leaders to successfully operate in the global business environment. Scharmer stated in a presentation to leaders, in order for them to grow, they needed: “the capacity to sense, enact, and embody the future as it emerges” (Scharmer, 2000).

Scharmer added that discussions with Bill Torbert (2000) and Senge led to what Scharmer referred to the discipline of ‘presencing’. This discipline has been observed through action research in management consulting for many years and in many sectors including international management. Scharmer said presencing means “to use your highest Self as a vehicle for sensing, embodying, and enacting emerging futures" (Scharmer, 2000).

From an epistemological view, presencing may be related to interpolating the future rather than extrapolating it.

Dialogue

Dialogue is essential as a practice for building shared mental models, vision, and for team learning. These are some of the core management practices espoused by the research surrounding what characterizes a learning organization (Senge, 1990). In order to build a learning organization, attending to the individual must be addressed. Of the five disciplines leading to building a learning organization, personal mastery is the first

discipline. It is foundational as personal mastery addresses how people *think*. Montuori quoted anthropologist Gregory Bateson as saying, “anybody claiming not to have an epistemology simply has a bad one” (2013a, p. 204). Montuori added that in France, epistemology and philosophy of science are used interchangeably (2013a, p. 204).

Physicist David Bohm (1996) expressed concerns regarding the need to change thinking through suspending the emotion associated with thought without suppressing it (p. 75). Bohm characterized the challenge as one of attention, “By being more attentive, we can be aware of how thought produces a result outside ourselves….Perhaps we could even be immediately aware of how it affects perception (1996, p. 79). Duncan (2009) elaborated on the evolution of thinking that impacts our ability to engage in Dialogue:

> To him, (Bohm) the real crisis in the (external) world are not in the ‘events which are confronting us,’ but in the thinking that is creating the patterns of thought that perpetuate these crises (p. 58). Duncan adds, in a metacognitive sense then Bohm asks us to go deeper, beyond the binary of "your thoughts are wrong, mine are right…thought *pervades* us” (Duncan, 2009, p. 58).

Nicolescu and Montuori cite Bohm for his conveyance of the levels of reality inherent in transdisciplinarity. Bohm is cited often for his writings on dialogue.

The discipline of presencing as Scharmer framed it (2000) is consistent with the notion Duncan shares about Bohm’s requirement for dialogue to embrace and transcend the complexity to understand.

Duncan (2009) added:

> It is through this process of deep thinking and dialogue that the possibility and potential of transforming communication beyond the duality, and co-constructing shared meaning occurs, where “each person does not attempt to *make common* certain ideas or items of information that are already known to him. Rather, it may be said that the two people are making something in common, i. e., creating something new together” (Bohm, 1996, p. 3 as seen in Duncan, 2009, p. 89).

Dr. Vicki Suter was familiar with face-to-face dialogue through her experience with EDUCAUSE in the early years of the Learning Initiative development. Suter's (2011) research implies multiple instantiations of collaboration involving dialogue in collaborative learning using the virtual world, Second Life. The role of the avatar and dialogue were part of an equation for collaboration. Suter added "collaboration limited to dialogue is still 'talking about' a domain and field of practice, and not 'talking within,' (Lave & Wenger, 1991, p. 109) which is necessary for the change in identity and ultimately, membership in the community of practice" (Polin, 2004 as found in Suter, 2011, p. 39). What can we learn about collective wisdom from virtual communities of practice?

Chris Dede (2009) originated the term distributed learning and has researched immersive learning environments for suitable applicability to support reasoning necessary for learning certain types of concepts. Dede wrote "the interpersonal and ethical dimensions of *wisdom* transcend the epistemology-based expertise of knowledge to include moral, axiological, and subjective/inter-personal capacities of high value to oneself and others" (p. 10) [emphasis added]. CVEs may offer the opportunity to create a positive dialogue with self through creative expressivity of identity afforded by avatar appearance and interaction. The use of avatars appears to have made our thoughts and ways of thinking more transparent to us. Can they help make us wise?

Allmendinger (2010) studied desktop use of CVEs specifically to explore non-verbal signals used by avatars in synchronous situations. Her theoretical review extended to multiple media scenarios involving theories supporting computer-mediated communication, media richness, media equation, and task media fit. Allmendinger's

findings make this researcher question the quest to appear credible at the cost of originality in pursuit of ideal self, expressed with an avatar or character (Young & Whitty, 2011, p. 539). The distinction of just 'being' verses teaching, influencing, or selling a message puts the onus on the pursuit of being understood and hopefully understanding others. Discernment required for this level of engagement may require wisdom.

Structured Dialog Processes

A discussion of dialogue must include the more formal processes frequently used in groups, face-to-face and occasionally online. No evidence of structured dialogue was found in the literature regarding the use within CVEs, although conferences and events have been hosted by volunteer and professional groups. Professional associations and non-profit organizations advocate a variety of practices to obtain involvement of members. Some groups are moving away from less than representative advisory groups to a more collective approach using technology to obtain involvement. Table 2, *Summary of Influences on Dialogue*, contains key literature explored for this study related to dialogue and social interaction.

Table 2 *Summary of Influences on Dialogue*

Researcher(s)	Notes	Key Elements
David Bohm (1996) On Dialogue. http://bohmkrishnamurti.com/bohm-consciousness-seminars/	Quoted in most transdisciplinary literature. Differentiates between dialogue and discussion	Influenced by Quantum Physics. Seminal definition. Studies in consciousness
Alexander Christakis (2006) How People Harness Collective Wisdom and Power to Construct the Future in Co-Laboratories of Democracy http://www.harnessingcollectivewisdom.com/	Structured dialogue process. Useful for individuals who wish to lead groups. Greek origins. Democratic orientation	6 Consensus Methods, 7 Language Patterns, 3 Application time phases 4 Stages of inquiry
McDonald, Bammer, & Deane (2009) Research Integration Using Dialogue Methods. The Australian National University	Practical descriptions of various methods. Structured and applicable to groupwork	Figures useful for description of possibilities
Eigenbrode, O'Rourke, Wulfhorst, Althoff, Goldberg, Merrill, Morse, Nielsen-Pincus, Stephens, Winowiecki, Bosque-Perez (2007) Employing Philosophical Dialogue in Collaborative Science	Questioning. Gets at the underlying issues to prepare for different types of collaboration.	Toolbox for philosophical dialogue
Senge, Scharmer, Jaworski & Flowers (2005) Presence: An Exploration of Profound Change in People, Organizations, and Society	Systems thinking, somatics, definition of *presence*. Thoughts create reality. Useful for leadership development.	Morphic fields Force of nature Suspension Fundamental transformation
Otto Scharmer (2009) Theory U: Leading from the Future as it Emerges	Identification of process and elements to build personal mastery for collective use	Pathway to opening for greater understanding of self and others
Mark Heyward (2008) From International to Intercultural – Redefining the International School for a Globalized World (Indonesia)	Definition of intercultural literacy	Multidimensional model of intercultural literacy
Jeff Conklin (2005) Dialogue Mapping	About wicked problems. Uses questions Personal and group use	Build collective intelligence
Hanne De Jaegher & Ezequiel Di Paolo (2007) Participatory sense-making: An enactive approach to social cognition	Practical for research distinctions. References Francisco Varela's writings	Social cognition. Enacted social interaction. Embodied perspective

The New Media Consortium uses a modified Delphi approach to develop its Horizon Report publications. Figure 32, *New Media Consortium's 2013 Horizon Wicked Problems*, represents a visual display of comments gathered from the face to face meeting of campus and organizational leaders in Austin, Texas, where the NMC has its headquarters. Photo credit Barbara Truman.

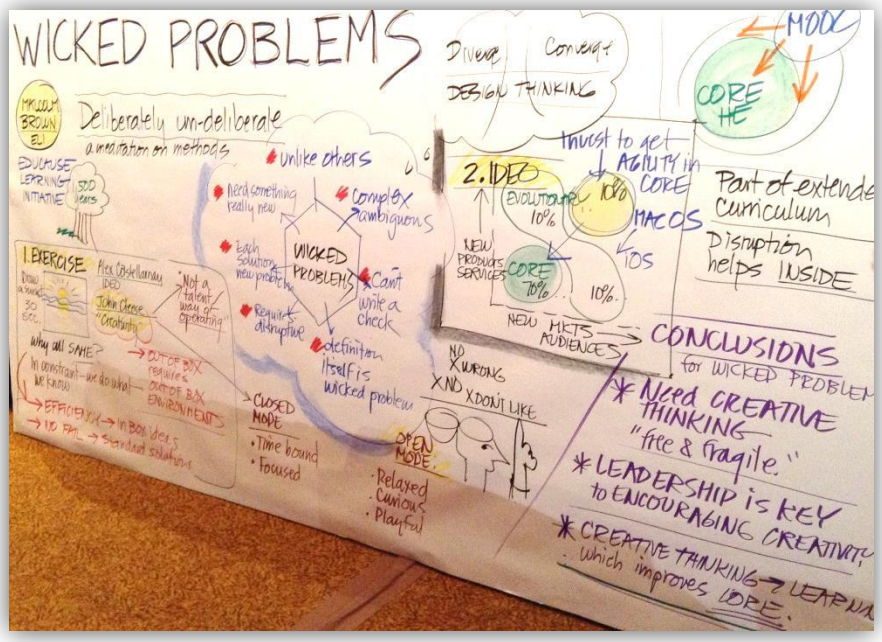

Figure 32. New Media Consortium's 2013 Horizon Wicked Problems

Mess Mapping and Resolution Scenario Mapping

Informal dialogue takes advantage of the motivation possessed by individuals to achieve desired results. For more formal governance, formal processes are often required to achieve collective goals or solve problems. The process of Mess Mapping is a formal dialogic process that evolved into a proprietary process. Robert Horn, is a political scientist who helps governments and corporations deal with Mess Mapping ™ techniques. Horn and his associate, Dr. Robert Weber, a serial entrepreneur and inventor who deals with Resolution Scenario Mapping, teamed to propose the following alternative to addressing wicked problems:

> Resolution Mapping and Mess Mapping are each powerful process and analytic tools for helping stakeholders resolve Wicked Problems. These tools can be successful where others have failed (or have feared to tread) because they incorporate or address:

• Uncertainty and risk;
• Complexity;
• Systems interacting with other systems;
• Competing points of view and values;
• Different people knowing different parts of the problem (and possible solutions);
• Intra- and Inter-organizational politics " (Horn & Weber, 2007 p. 5).

The linearity of the formal process and the expertise required to facilitate a process are two challenges contributing to the successful approach. Combinations of processes are worthy of study to apply effective strategies for whom and when called upon. Horn & Weber (2007) cited "When a Mess Mapping project precedes Resolution Mapping, the Mess Map process and diagram provide significant input for Resolution Mapping while creating efficiencies (2007 p. 24).

Trans-Cultural Dialogue

Cultural intelligence is one area not discussed in this study in depth. CVEs provide a venue to promote cultural awareness and appreciation. Dr. Jacqueline Wasilewski, retired professor of Intercultural Communication and Conflict Resolution at International Christian University (ICU) in Tokyo, Japan wrote of her experiences in working with indigenous populations. She described elements that together add up to a transliterary cultural literacy capable of challenging the most learned scholars. Wasilewski (2013) stated:

> The concept of Transformative Communication Skills puts our focus on the development of our ability to participate in constructive discourse so that we can collectively design better social spaces. Such skills involve the use of the experience of others to assess the reasons justifying our assumptions, and they enable us to make action decisions based on the resulting insight. We, thus, become aware of how we come to our knowledge and of the values that lead us to our perspectives (Mezirow, 2000, p.7).

Wasilewski said the result is a kind of responsible agency or a relational responsibility, that is, the ability to take responsibility within a dynamic system" (Pearce, 2004, p. 43 as seen in Wasilewski, p. 13).

Avatar and Character Dynamics

Studies surrounding avatar persona and social interaction within collaborative virtual environments imply transdisciplinarity through conveyance of *simultaneously* being apart while being with people. To clarify, a duality exists representing 'both and' rather than 'either or' thinking as advocated by a transdisciplinarity theoretical framework. Presence and self-presence of avatars and some characters allow persons to extend their 'being" and in the case of some fluent collaborators using CVEs, people create their own futures or metaverses. This notion is not the same as the 'alone together' phenomena made famous by Dr. Sherry Turkle. Ducheneaut, Yee, Nickell & Moore (2006) discussed the notion of alone together in MMOGs in regard to motivation in entertainment games (p. 1). This study sought indicators of intimate sharing of identities deliberately for a shared common purpose.

Research was analyzed from media researchers mostly from the United States who built upon the work of scholars such as Sherry Turkle, Semour Papert, James Paul Gee, Henry Jenkins, John Seely Brown, Celia Pearce and Frank Biocca. Studies related to CVEs broke down into components related to presence and identity. The studies investigated include: presence (Scoresby & Shelton, 2011; Yee, Bailenson, Urbanek, Chang & Merget, 2007; Persky, Kaphingst, McCall, Lachance, Beall & Blascovich 2009; McCreery, 2011; Suter, 2011) co-presence (Bente, Rüggenberg, Krämer & Eschenburg, 2008) social presence (Allmendinger, 2010; Biocca, Harms & Gregg, 2001; Biocca,

Harms & Burgoon, 2003; Harms & Biocca 2004) identity (Deihl & Prins, 2008; Roesler, 2008) self-presence (Ratan, 2011), character identity (Van Looy et al., 2011), supermorphic persona (Young & Whitty, 2011), virtual self (McCreery, 2011), selfhood (Roesler, 2008), self in cyberspace (Roesler, 2008).

Presence and co-presence are frequently researched in terms of engagement useful to explore motivation and learning. For the purpose of this study both motivation and presence were presumed evident as the subjects were volunteers who participated freely in groups to collaborate. Identifying whether presence or co-presence existed was less important than what the effects of presence meant in terms of collaboration and cultivating identity.

Suter (2011) examined the constructs of presence and social presence. She developed a construct to explicate her study findings of presence used in collaborative learning design for use in virtual environments. Suter cited Bartle's (2005) progression of identification with one's avatar as:

> (a) initially regarding the avatar as an object that one can create and control as their representative in the virtual world; (b) coming to recognize their avatar as their representation, or extension of themselves within the virtual world; and (c) if the relationship progresses, the avatar becomes a persona or actual identity in the world. He notes that if individuals "consider it [to be] them in the virtual world . . . [this delivers an] affirmation of identity (Bartle, 2005, p. 11 as seen in Suter, 2011, p. 96).

In a separate study of player activity, Ducheneaut, Wen, Yee, & Wadley (2009) found that people may indeed invest their identity into a singular avatar persona useful for enhancing dialogue, metacognition, and collaboration in virtual environments, "Broadly speaking, we found that a large majority of users across the three environments focus their energy on one main avatar" (p. 1154).

Representation

A 3D display of the researcher's study premise was made into a poster session at the 2013, fifth annual gathering of the Virtual Worlds Best Practices in Education (VWBPE) Conference held online in the CVE Second Life. Figure 33, *Delightful Doowangle's 2013 VWBPE Poster Display*, shows an image of the poster display where avatars visited, walk through and clicked on objects to obtain information. The scene was made to illustrate concepts researched in this study. Lyr Lobo is shown in front of the display and Delightful Doowangle (the researcher) is on the right side. Photo credit Barbara Truman.

The VWBPE represents a unique gathering online where educators from around the world gather and share their experiences at no cost. In 2013, near 2,400 avatars participated representing a savings of thousands of dollars for educational institutions. The carbon saved in travel was not insignificant considering one of the most wicked problems affecting everyone is climate change. VWBPE sessions were conducted on topics extending far beyond the use of immersive learning environments. The conference illustrated the range of avatar representations educators often wear to teach. Some attendees shapeshifted into a variety of avatar representations frequently.

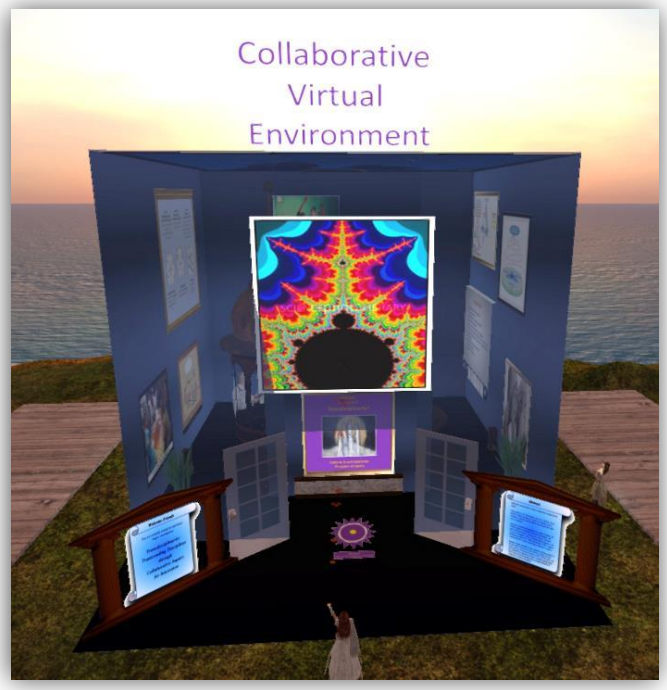

Figure 33. Delightful Doowangle's 2013 VWBPE Poster Display

Care is sometimes required to interact naturally and comfortably with avatar representations that can appear other-worldly. The question of whether diverse avatar representations increase or reduce cultural barriers was posed in a study of avatars conducted by the University of Nebraska at Omaha (Davis, Murphy, Owens, Khazanchi, & Zigurs, 2009, p. 104). Ethno-relativism has been a beneficial outcome of traditional travel and study abroad experience. The ability for individuals and companies to afford international travel is diminished. Diverse avatar interactions were theorized to increase cultural intelligence, which was the goal of a study designed by IBM (Seigel, 2010, p.49). The use of created worlds and inhabitants warrant the same type of dignity provided in the physical world despite differences in appearance (United Nations, 1948).

The study of Virtual Team Science is greatly enhanced by CVEs and the use of representational avatars. Montoya, Massey, & Lockwood (2011) reported:

> From an objective media capacity perspective, the media-converged nature of 3D CVEs that include avatar representation of users makes team members aware of each other's presence and what team members are doing (or not doing). Thus the classic "out of sight, out of mind" problem associated with virtual work is somewhat mitigated by the nature of 3D CVEs (p. 468).

A new breed of managers will be more comfortable in managing staff at a distance that are comfortable with dynamic self-representations fashioned via avatars. It is no longer cost effective to routinely operate through the managerial lens of 'must be present' to perform. Mediated technologies created new forms of wielding influence. Virtual leadership studies are a burgeoning area of research with the combinatorial use of social media and CVEs. The range of professional development that continue to offer events at no cost where communities gather is unsurpassed within CVEs such as Second Life. Suter (2011) concurs for collaborative learning use:

> Virtual worlds such as Second Life which were designed for entertainment may have new features that support formal collaborative learning. Virtual world design features of interest include 3D graphical interfaces, customizable avatars, synchronous and asynchronous communication, support for self-generated social structures such as groups, built-in infrastructures for world-building and creation and distribution of learner-created content (objects, simulations, documents), scripting for programming intelligent objects, customized application development, and integration with external web resources and learning management systems (p. 4).

Ducheneaut, Wen, Yee, & Wadley (2009) describe avatars as "a virtual body created by users to project his or her identity and actions into the world. These interactions are therefore based on a simulated face-to-face metaphor, with users 'puppeteering' a virtual body to control fine-grained actions such as their gestures, posture, or eye gaze." Programming emotion is one of the research areas witnessing enormous gains in virtual humans such as areas the University of Southern California leads. This research is timely as Ducheneaut et al. (2009) adds:

> … an avatar fulfills more than communication needs: it is also a visual representation of the user, a "tangible" embodiment of their identity. The choices users make when creating (and later when customizing) their avatar will have repercussions on their interactions with other users: selecting black hair, dark Victorian clothing and piercings is obviously making a different statement than opting for an athletic, tanned body in a swimsuit (these examples are far from extreme: the diversity of avatar choices in highly-customizable worlds like Second Life is truly amazing... (p. 1151).

Self-Presence

For the purpose of this study, participants were fluent collaborators and power users of CVEs; therefore the notion of measuring whether participants felt 'presence' was not a priority. Regular, voluntary participation in groups was a keen indicator of sufficient presence. But what type of presence? A deeper look into the literature however revealed nuances worthy of future study. Describing nuances among the types of presence was a priority.

Ratan (2011) stated *presence* came out of the field of Communication to understand and explain the effects of technologies and media that increasingly "embody the user, namely robotics and virtual reality" (p. 7). Ratan applied neuroscientist Antonio Damasio's consciousness framework within the use of MMOGs. Ratan conducted multiple research studies summarized in his findings. Ratan (2011) defined 'self-presence' as "the extent to which some aspect of a person's proto (body-schema) self, core (emotion-driven) self, and/or extended (identity-relevant) self is relevant during media use" (p. 12). For this study, Ratan's findings are relevant, although his study was MMOG-based rather than CVE based.

Concerning the emotional connection to mediated use of the environment and with one's avatar, Ratan found:

> When the experience of self-presence is strong… people who are induced to feel a stronger connection to their avatar, via avatar customization, gender consistency, or the interaction between these variables, may exhibit more physiological arousal or stronger emotional responses during avatar use. (p. 82).

Concerning the face-to-face practice of presencing advocated by Senge and Scharmer , the concept of whole self-image should not be confused with self-presence. Whole self-presence is associated with creating relational space. Bradbury- Huange, Lichtenstein, Carrol & Senge, (2008) reported participants who shared both personal and business goals within and between individual meetings … "related to one's whole self – e.g., values, family, feelings, and concerns far beyond one's company--offered a powerful dimension to the meetings which appeared to be fundamental to the creation of Relational Space" (p. 16). What dynamics would a 'whole avatar' concept include?

Ratan expressed skepticism for applying Damasio's framework in the areas of emotion and identity. He was most confident in the application of proto-self, which Ratan described as proto self-presence:

> using a virtual object as if it is an extension of the body. This requires significant comfort or experience with the interface used to control the virtual object. For example, people who experience high levels of proto self-presence control their avatars with the same ease using a pen after years of practice. Just as the pen is integrated into the hand's movements with little thought, the avatar becomes part of body schema, like an anthropomorphized fingertip (Ratan, 2011, p. 12)

Embodiment and Phenomenal Self

The literature surrounding embodiment in mediated technology environments does not extend to the concept of embodiment believed to interact with the new construct of *virtual intersubjective presencing* (described later in this chapter or see nomenclature). A mindful, connected consciousness is referred to by the characterization of embodiment described by Mehling, Gopisetty, Daubenmier, Price, Hecht & Stewart (2009) as

"overcoming the constraints of Cartesian dualism, embodiment recognizes the role that our body plays in shaping our thinking and culture" (p. 2). Transdisciplinarity as a theoretical and phenomenological framework goes further to unite wholeness and being.

Young & Whitty (2011) conducted a study to explore progressive embodiment and its psychological impact within cyberspace citing two fundamental components of embodiment: The body-image and the body-schema. “Body-image is ‘a system of perceptions, attitudes, and beliefs pertaining to one’s own body’ (Gallagher 2005a as seen in Young & Whitty, 2011, p. 542). An example of body-image involves how consciousness has:

> “object-directedness, and the object it is directed towards… the body. As such, I possess an image of myself as I would any other object. The product of this reflective act of awareness—of being aware of myself as an object—is known as the self-as-object” (James, 1890 as seen in Young & Whitty, 2011, p. 542).

Gallagher (2005a) provides another distinction in the definition that make up the elusive concept of embodiment:

> Body-image therefore forms pre-reflective awareness of ‘myself’ as an embodied agent. This pre-reflective sense of self, we refer to as the phenomenal self. In contrast to these dual components of body-image, the body-schema is ‘‘a system of sensory-motor capacities that functions without awareness or the necessity for perceptual monitoring’’ (p. 24) that operates below the level of consciousness (as seen in Young & Whitty, 2011, p. 542).

Distinctions between conscious and unconscious awareness of psychological factors are challenging to measure and discern. Awareness of these interactions provokes the ability to more deliberately choose representative actions with dynamic constellations of other beings representing varying states of awareness.

Transcendent Authenticity

Avatars and characters are often noted for their expressions of creativity and originality. Subconscious psychological processes are activated that create meaning as people relate to their avatars or characters over time. How important is it for the psychological avatar representation to be authentic? Imagine this question in regards to face-to-face collaboration. Young & Whitty (2011) differentiate between actual and representation of self-expression in terms of potential (ideal) and conformity (idealized):

> An authentic presentation of the self is that which is typically realised by the person and/or that which he/she has the potential to realise. The latter we refer to as an ideal realisation of embodiment. Importantly, this is not to be confused with an idealised realisation, which we equate with inauthentic embodiment: an example of which might be to present oneself in a manner congruent with culturally held ideals of beauty and desirability, irrespective of one's potential to realistically meet these ideals (p. 539).

We experienced and observed a type moral authority that for some people is sparked from creative expression and embodied authenticity in CVEs. Could this be the ideal self that Young & Whitty (2011) describe?

> . . .the freedom cyberspace affords for the discovery and development of a persona congruent with one's ideal self should be viewed in a positive light (but only if the persona is authentic). By developing one's ideal rather than idealised self, the authenticity constitutive of this identity is able to transcend domains, meaning that an individual is not restricted by where he/she can express it (p. 540).

The nature of Young & Whitty's (2011) study included the realm of CVEs. Considering the extant literature surrounding presence, self-presence, and the impact of social presence in CVE, authentic transcendence appeared to be consistent with the construct of *virtual-physioception* proposed as part of this study. "The transcendent quality of authenticity is such that rather than cyberspace constraining someone to certain context-specific spaces, it extends the repertoire of environmental and social encounters

in which one's authentic self is expressible" (Young & Whitty, 2011, p. 540). Somatic awareness was also called upon to promote embodiment of leadership to enact authenticity in expressing one's true self by Ladkin & Taylor (2010), but the notion was not meant for CVE use in particular (p. 27), although the concepts may apply.

Supermorphic Persona

According to Young & Whitty (2011), progressive embodiment becomes a state of consciousness, a state called supermorphia that transcends the physical body, but not embodiment, according to anthropologist Gregory Bateson, who refers to the ability to transcend as somatic flexibility (p.537). The construct created for this study, *virtual-physioception* is most closely related to the notion of supermorphia and somatic flexibility. V*irtual-physioception* requires greater exploration for how the somatic awareness and cognitive perspective affect interactions with one's avatar or character.

Authenticity appears to be a source of moral authority and is achievable in CVEs even if one is empowered to choose exotic representation that aligns with original self. The valence of effect on self beyond CVE use is dependent on where the avatar expression originates:

> … cyberspace is utilised as a means of realising one's potential to be authentic—in a manner one finds difficult to do in non-virtual social engagements—then in the context of relationships at least, if this supermorphic persona can be taken offline, evidence suggests that it can have a long lasting positive effect (McKenna et al., 2002 as seen in Young & Whitty, 2011, p. 545).

The authenticity does not appear to translate back and forth between cyberspace and physical life. Young & Whitty (2011) added ". . .if one's supermorphia is based on computer-mediated enhancement then the authenticity cannot transcend domains (p.

554). Jane McGonigal describes a phenomenon in her book, Reality is Broken (2011) how gamers face the challenge of dealing with the typical grind of daily life. Young and Witty (2011) echo a similar notion based on the cognitive perspective of one's 'self' balanced with the tendency of supermorphic preference. They add:

> Large discrepancies between the offline body-image and one's supermorphic persona may lead some individual's to favor and even fixate on their supermorphic self, resulting in the psychological dominance of the virtual over the non-virtual which, in turn, may result in individuals spending more and more time in a space where one's self is perceived to be enhanced (p. 554).

Selfhood and Virtual Self

This study explores the nature of self-reported behavior based on interactions that occurred in CVES where individuals created some type of relationship with their avatar or character. The impact of this relationship has some bearing on our ability to collaborate, especially to experience the premise of what Scharmer calls *presencing* (2000). The valence of the interaction between avatar and person is both positive and negative. Transdisciplinarity purports that valence is neither fixated as positive or negative, rather it is 'both and'. Michael McCreery's research into 'virtual self' modelled the use of an avatar survey similar to the one created for this pilot study. McCreery (2011) explored personality traits with characters using World of Warcraft. McCreery stated:

> For several decades, researchers have explored the existence of the virtual self, or digital embodiment of self found within an avatar. It was surmised that this new component of one's overall identity not only existed in conjunction with the public and private persona, but was replete with the necessary physical and psychological characteristics that facilitate a broad range of cognitive, cultural, and socio-emotional outcomes found within a virtual environment (e.g., Second Life, World of Warcraft). However, little is known with regard to whether these characteristics do indeed impact behavioral outcomes (p. iv).

Young & Whitty (2011) raise the question of how we respond when we can identify our 'self' as object: "The fact that the virtual self-as-object is an intentional representation of some reflective, object-like conceptualisation of the user's own embodiment raises an interesting empirical question: to what extent is the virtual self-as-object congruent with the user's offline self-as-object?" (p. 543). We are curious when incongruence between online and offline self becomes a positive force through CVE use.

Dr. Beth Coleman is an assistant professor of writing and new media in MIT's program in Writing and Humanistic Studies and Comparative Media Studies. She is a Faculty Director of the C3 Game Culture and Mobile Media Initiative. Coleman (2011) pointed out the allure of CVEs for their ability to draw us into design. Does this include designing our self? Coleman stated:

> Our choice of expressing selfhood in various ways, in a medium with this much fluidity and malleability, means that even when we merely set out to consume mediated experiences, we end up as designers of those experiences – sometimes by embracing that possibility as an alternative to a norm of pure consumption, but often just as a side effect of the ways the tools work in the way we work with them (p. xii).

Scharmer (2009) describes the space between the <u>s</u>elf and the <u>S</u>elf as being the place where practicing the art of presencing affords the development of greatest potential. Sternberg reported cognitive styles represent the bridge between distinct areas of selfhood: cognition and personality (Sternberg & Grigorenko, 1997, p. 701). As artificial intelligence improves how will we feel to have our avatars comprise and transcend the best of all of us?

Motivation

As stated in the nomenclature section, motivation is presumed to be possessed by participants in this study. Participants had motivation to volunteer in groups. Wide variation of reported motivation levels would be curious. Not all motivation is equal and its force varies across individuals. Participants were expected to have more intrinsic motivation, but this was not reviewed to explicate. Finkelstien (2009) conducted a study that found evidence of a prosocial personality, internal motives for volunteering, and the establishment of a volunteer role identity where higher levels of intrinsic motivation were present (p. 656).

Duckworth et al. (2007) reported grit is cited as often as talent for high achievement as discovered during interviews with professionals in investment banking, painting, journalism, academia, medicine, and law. (Duckworth, Peterson, Matthews & Kelly, 2007, p. 1088). "Grit, in contrast, can entail dedication to either implicitly or explicitly rewarding goals" (Duckworth, Peterson, Matthews & Kelly, 2007, p. 1089).

Research from Dr. Nick Yee on motivation for play in online games was summarized by McGonigal (2008) in a report from the Institute for the Future. The report cited Yee's three primary areas of motivation as 1) achievement 2) social and 3) immersion (McGonigal, 2008, p. 16).

Volunteerism

Participant motivation was assumed in the study, therefore a brief examination of volunteerism was warranted. The applicability of this study's findings for faculty scientists at research universities depends upon those who will take a risk to engage in transdisciplinary inquiry inherent with as much challenge as potential rewards. Heuristics

developed for collaborating in virtual environments are applicable to online learning and professional development. The affective domain's influence on the cognitive and behavioral domains is a rich area for future study to improve organizational performance.

Dichotomies exist in the motivation of volunteers. Is motivation altruistic and intrinsic, static, or changeable? These questions were asked by (Schram, 1985 as seen in Lockstone-Binney, Holmes, Smith &Baum, 2010, p. 444) Volunteers have been found to be rarely altruistic. Rather, volunteers expect to benefit in some way from their activities" (Moore, 1985; Stebbins, 1996 as seen in Lockstone-Binney et al. 2010, p. 444).

Mandatory volunteering seems to diminish motivation. Finkelstien (2009) found intrinsically oriented individuals motivated by internal goals may be adversely affected. Mandatory volunteering may help recruit extrinsically oriented volunteers, "spurred as they are by external motives" (p. 657). Regarding volunteerism for participation in a guild or community of practice, Millette & Gagné (2008) cited Wuthnow and Hodgkinson (1990) who found volunteerism as seen by many as a way "to prove to themselves and others that they are nice and decent human beings" (Millette & Gagné, 2008, p. 12). Attracting others to participate in CVEs whether for networked science, virtual teams, or participating in virtual community learning organizations requires leadership.

Generativity

Erik Erikson introduced the theory of generativity that served as a concept useful for personal development including provision for the future and future generations (McAdams, Aubin, 1992, p. 1003). The word generative has been used as a descriptor for learning, science, technologies, and theory development etc. Concerning collaboration,

Scharmer (2000) stated *generative dialogue* reconnects what we "think and say with what we do and see" as a process for development that moves from 'self' to 'Self', one's highest embodiment of potential. Scharmer adds, generative learning is categorized as type II, learning from the future. Type I is learning from experiences of the past. For groups, facilitation is often needed using structured dialogue processes are required to form collective intention (Scharmer, 2000)[emphasis added].

Figure 34, *Generative Listening based on Presencing Process*, originated from The Presencing Institute and illustrates states of consciousness that flow from engagement in dialogue. Image credit Creative Commons 3.0 Licensed http://www.presencing.com. *Generative listening* occurs in a cumulative fashion combining the open mind, heart, and will. Individuals must become conscious of their state to report whether generative listening has occurred. Experienced, expert action researchers have made observations of people from face to face events where shifts in attitudes are visible. What can we learn from how generative listening occurs in a mediated, collaborative virtual environment through the expression of an avatar?

The proposed construct of *virtual intersubjective presencing* is believed to occur as groups engage in generative listening. How does CVEs encourage informal generative listening? How can the environment be fashioned to encourage it?

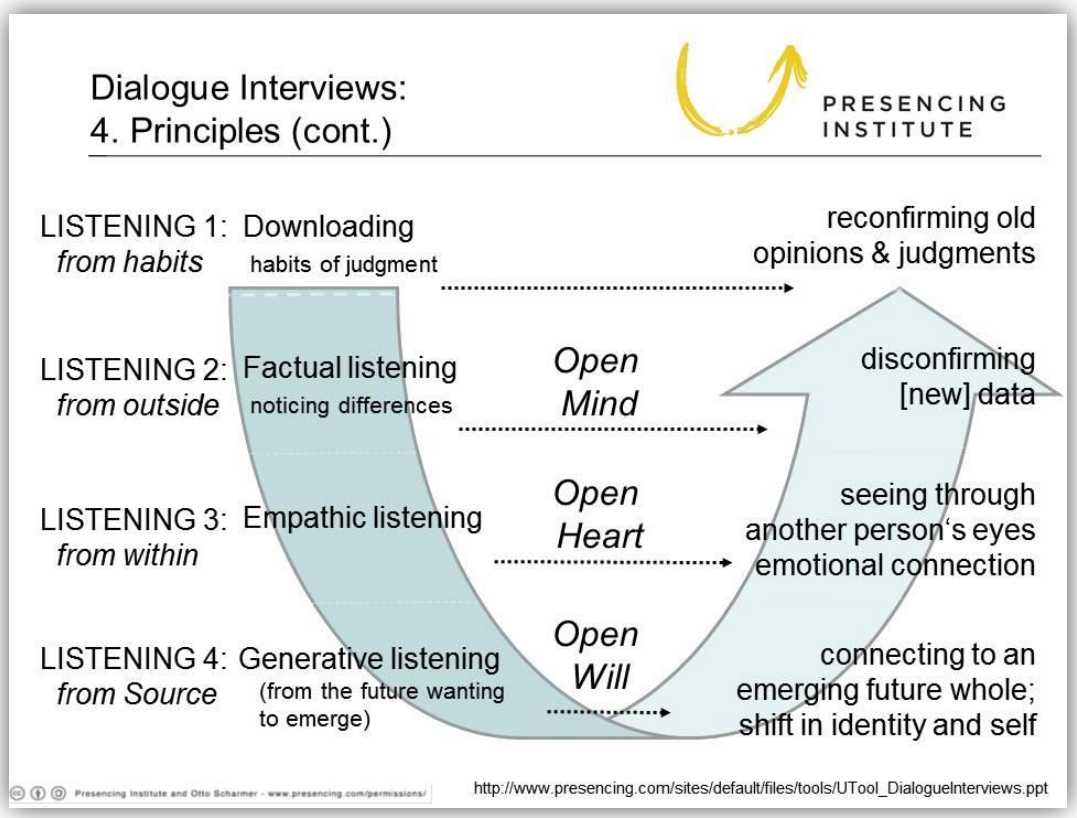

Figure 34. Generative Listening based on Presencing Process

The National Academies (2004) defined *generative technologies* that hold promise to serve transdisciplinarity through scientific and research collaboration:

> Generative technologies are those whose novelty and power not only find applications of great value but also have the capacity to transform existing disciplines and generate new ones. An early momentous example was the use of microscopes by Hooke and van Leeuwenhoek to view "cubicles," or cells, in animal and plant bodies and to make it possible to see living "animalcules" (bacteria) with their own eyes—both critical steps along the path to modern molecular biology (p. 35).

These new disciplines created through the use of generative technologies will most likely involve a combination of fields. Collaborative virtual environments are used as a stage for concerted inquiry, dialogue, and will be used for simultaneous analysis *in*

vivo of research findings. Some technologies change how researchers work on their projects and how they work together through developing ideas assisted by new ways of communicating, manipulating, storing, and analyzing data (National Academies, 2004, p. 182). More meetings are conducted using software allowing participants to conduct virtual meetings where they share images, equations and author documents and works simultaneously.

> Many traditional researchers insist on the need for face-to-face meetings to forge effective collaborations, but younger people growing up in a world of instant messaging may develop virtual modes of collaboration that are equally or even more effective (National Academies, Committee on Facilitating Interdisciplinary Research, 2004, p. 182-183).

Relationship Attraction

Perceptions exist holding that meaningful relationships can only take root and occur face to face. Gamers who participate for extended time in massive online games know bonding can become natural without ever meeting (Pearce, 2009; Steinkuehler, 2006; McGonigal 2008). McKenna, Green, & Gleason (2002) found real, deep, and meaningful relationships do form on the Internet and these relationships are stable over time. For those relationships started through an online meeting did not shorten the relationships later when face-to-face meetings occurred. 'Gating features' that dominate face-to-face situations do not pose a barrier online allowing people to like one another better than if they had initially met face to face (McKenna, Green, Gleason, 2002, p. 28). Greater self-disclosure occurs online due to the lack of concerns regarding physical appearance (attractiveness), visible shyness or social anxiety creating gates to relationships (McKenna, Green & Gleason, 2002, p. 10).

Virtual-Physioception

The multidimensional construct *virtual-physioception* was informed by studies related to presence, identity, self-representation, and body awareness. A robust group measurement of dialogue using avatars requires action research to learn how to observe and detect the shifts in mediated communication. This area of inquiry pertaining to group dialogue in CVEs is suggested for further study. Measuring the physiological responses of individual avatar participation in group dialogue within a CVE could be performed with specialized biometric equipment at a research laboratory, although spontaneity will be lost. Methods required to measure reflexivity of the avatar-human relationship are not clinical, rather they are psychological and idiosyncratic to the individual.

Virtual-physioception is the phenomenological or subjective-awareness of shared self-representation concurrently across virtual and physical spaces arising from meta sensory information from combinatorial interoceptive, proprioceptive, and exteroceptive processing (A. Sticker, personal communication, August 2, 2013).

Receptors such as nerve endings create the reception of stimuli produced within an organism including muscles and tendons to create awareness of position. For example, equilibrium is created from proprioception necessary for common movements and body functions. Persons suffering from brain injury may have to redevelop the ability to learn how to move due to the lack of proprioception. Mehling, et al. (2009) stated "Proprioception is the perception of joint angles and muscle tensions, of movement, posture and balance and has become an integral part of neuromuscular rehabilitation after injuries and of the prevention of falls in the elderly" (p. 2).

An exteroceptor is a receptor as of the five senses e.g. hearing or sight. Extroceptive describes stimuli received from outside an organism. Interoception involves

processing of sensory input from within the body. Exteroception involves processing of sensory input from outside the body (vision, hearing, smell, taste and touch) (Mehling, et al., 2009, p. 2).

> Proprioception and interoception… are processed ‘before we know it’, pre-cognitive, unconsciously. Interoceptive information, for example, is not identical to interoceptive awareness. Some of this information can enter consciousness, and we become aware of it (Mehling, et al., 2009, p. 2).

Collaboration

The literature has extensive models of collaboration that do not necessarily apply within collaborative virtual environments, especially for potentially solving wicked problems. Team Science as a field of study is in its infancy and yet the rise of artificial intelligence and intelligent agents will provide greater socio-technical dynamics for problem solving. Kezar (2005) found “There has been virtually no research on how to reorganize higher education institutions for collaborative work" (p. 832). Conklin (2005) reported on the inadequacy of current managerial approaches to address increasing challenges posed by rapid change, "Because of social complexity, solving a wicked problem is fundamentally a social process. Having a few brilliant people or the latest project management technology is no longer sufficient" (p. 29) as seen in (Australian Public Service Commission, 2007, p. 35).

The United States Army has a broader initiative on which capabilities are being planned and researched surrounding the provision of more adaptive training and education to meet its evolving mission for its forces. Centers of Excellence including the ability to support collaboration are called for as part of The U.S. Army Learning Concept 2015. Of the listed alphabetized requirements, k includes, “the capability to encourage peer-to-peer learning through use of online social media to facilitate problem solving,

collaboration, information needs, and provide virtual learning opportunities" (Dempsey, 2011, p. 58). The US Army Centers of Excellence are part of the supporting infrastructure that includes 1) support staff 2) digitized learning media production capability 3) knowledge management structures 4) policies 5) flexible resourcing models that add up to the ability to "shift from a course-based, throughput-oriented, instructor-led model to one centered on the learner" (Dempsey, 2011, p. 16).

Scharmer (2009) described a more organic association based on collaboration he calls a *circle of intention*. Within the circle of collaborators with whom you associate, Scharmer said:

> The group should consist of people who are interested in regularly exploring some of the deeper issues of their personal and professional journeys and how they relate to organizational and societal transformation- people who share this interest because of a deeply felt need to pursue this deeper inquiry, not just out of purely intellectual curiosity (p. 412).

Collaboration Challenges

The ability and aptitude to collaborate is natural to some individuals. Personality has its role as a factor, especially in satisfaction with collaborating. This study does not explore depths of personality. The literature review supported investing in personal change, growth, and development as a precursor to engaging in collaborative transdisciplinary research. As stated previously, the TTURC Grant Initiatives and ongoing TREC Initiatives funded by the National Institutes of Health in the United States seek to evaluate collaborative grants as a central goal. Provision of training and professional development for awareness of Team Science has become a cornerstone in the TREC Initiative based on lessons learned. Figure 35, *Adapted Model for Transdisciplinary Grant Evaluation*, represents a model useful for evaluation for a grant

similar to a logic model reported by Mâsse, Moser, Stokols, Taylor, Marcus, Morgan & Trochim, (2008, p. S152). Image created by Barbara Truman. This study asked respondents about their perception of group impact. Questions adapted in the survey created for this study were based on resources provided in the United States' National Cancer Institute's Team Science Toolkit produced by the United States' National Institutes of Health.

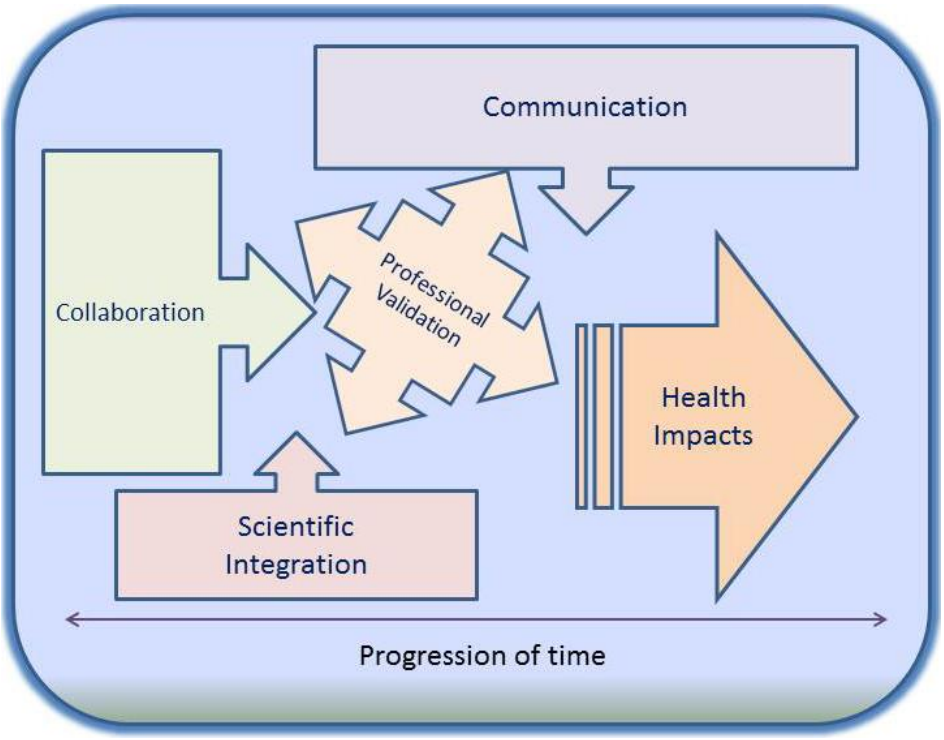

Figure 35. Adapted Model for Grant Evaluation

Bennett, Gadlin & Levine-Finley (2010) reported on a study from Gadlin & Levine-Finley (2010) that found Team Science has been rapidly adopted by biomedical scientists and clinicians working on complex research questions involving human health. A key challenge is the requirement for researchers to adapt from a solo-investigator culture to one of collaboration. Gadlin & Levine-Finley found that some people naturally

function as part of a research team, while others need practice to learn how to contribute developing and applying skills. Collaborators must:

> … embrace a collaborative spirit, meaning they are willing to share data, credit, and decision making with other team members. The strength of these skills is often dependent on an individual's level of personal insight and self-awareness, ability to be in touch with his or her thoughts and feelings, and level of consciousness of his or her impact on other people (Bennett, Gadlin & Levine-Finley, 2010, p. 5).

Collaborative virtual environments offer a platform to practice and develop team skills as a form of rehearsal to imagine what pitfalls may occur before they happen. Indeed, Bennett, Gadlin & Levine-Finley (2010) reported "Of all the aspects of Team Science, sharing recognition and credit is among the most difficult to master" (Bennett, Gadlin & Levine-Finley, 2010, p. 35). As computer science enables the analysis of research in vivo through use of avatars and computational 3D rendering in CVEs, more potential scientists will be inspired to participate.

Transformed Social Interaction

The second primary theoretical framework used to explore collaboration in virtual environments was Transformed Social Interaction (TSI), a research paradigm originating with the work of Dr. Jeremy Bailenson at Stanford University. TSI has three types. For the purpose of this study, the third area, self-exploration is the primary area of interest. The three areas of TSI are:

> 1) Transformations of sensory abilities complement human perceptual abilities 2) Transformations of situational context change the spatial or temporal structure of a conversation
> 3) Self representation transformations involve the strategic decoupling of the rendered appearance or behaviors of avatars from the actual appearance or behavior of the human driving the avatar. Hence, rendering

> avatars of users can deviate from the actual state of the user (Bailenson, Beall, Loomis, Blascovich & Turk, 2005, p. 514).

Bailenson & Beall (2006) stated the goals of the Transformed Social Interaction paradigm as it relates to digital plasticity of avatar representations:

> to explore and actually implement these strategies [changing the appearance and behavior of one's representation] in collaborative virtual environments, to put human avatars in CVEs and to measure which types of TSI tools they actually use during interaction, and to examine the impact that TSI has on the effectiveness of interaction in general, as well as the impact on the specific goals of particular interactants (Bailenson & Beall, 2006, p. 4).

Blascovich & Beall (2010) reported on research experiments that used the TSI paradigm where transformations of self-presentation involved systematically altering the appearance/behaviors of subjects' avatars. Some avatars appeared younger or older and uniquely different to some 'interactants' the avatar represented (p. 63). Yee & Bailenson (2006) reported previous TSI studies demonstrated "quite resoundingly that changing one's representation has large implications on others in terms of social influence" (p. 2). TSI in this study employed the avatar representation applied to group collaboration.

Virtual intersubjective presencing

The potential for research among groups in collaborative virtual environments is a burgeoning subset of Team Science. Yee (2006) described how CVEs can facilitate new relationships formation, but also catalyze existing relationships, and provide insights into them (p. 26). Yee's perspective reflects a socio-technical approach. A structured dialogue approach used in presencing employed more of a socio-cultural approach (Scharmer, 2000). Yee suggested relationships can be thought of as being engineered by the architecture of the environment. This notion raises future research questions for Virtual

Team Science. Yee asked what are the potential effects of Transformed Social Interaction are on social interactions at a community level (p.26) This question involves the larger paradigm of TSI that involves the other two areas besides self-representation, namely sensory abilities and situational context (Bailenson & Beall, 2006, p. 4). Yee wondered, “how a community in the material world could be shaped by allowing them to interact in an engineered virtual environment" (Yee, 2006, p. 26).

French philosopher, drama critic, playwright and musician, Gabriel Marcel, was credited as defining intersubjectivity as the shared experience of presence between two selves. “Marcel’s investigation of presence and intersubjectivity hoped to reveal to us how we are able to recognize another self, and then once we have recognized them, what that means for us” (20th Century Philosophy, 2013).

Virtual intersubjective presencing is thought to occur in a collaborative virtual environment between constellations of identities (selves) represented by avatars embodying varying states of human self-consciousness. The group is significant in that when *virtual intersubjective presencing* occurs, individuals are engaged in concerted intention to create the *art-of-the-possible*, what Scharmer refers to as learning from the future (2000).

This dissertation explored whether *virtual intersubjective presencing* occurred as unstructured, phenomena that transpired as self-reported recollections.

When Celia Pearce coined the term intersubjective flow to describe communities of play, she built on the research of Csikszentmihalyi's flow and DeKoven's Co-liberation (the experience of having fun together). Pearce stated:

> … the concept I am proposing, ‘intersubjective flow,’ situates the flow state between people, rather than within the individual. In this case, flow moves from

> the realm of the psychological to the realm of the social. Intersubjective flow serves to accelerate a form of intimacy that is unique to play. In this context, a group of complete strangers can form a sense of group cohesion in a relatively short period of time. This is played out in simple street game contexts, such as pickup game of basketball. Over time, and prolonged exposure, this intimacy can strengthen, as may be the case with the professional basketball team or an amateur baseball league (Pearce, 2009, p. 133).

The United States Army's MOSES Project (OpenSim) and Global Learning Forum (Second Life) are two examples of initiatives that fostered broad, community-based research using collaborative virtual worlds. Cooper (2009) reported the United States military recognizes the growing global interest in the potential of rapidly evolving gaming and visualization technologies for staying current with training and education needs. Cooper added "efficiencies that may be gained by using virtual worlds for training in collaboration, data visualization, rapid prototyping, combat readiness, or scenario training have piqued serious interest in our military" (Cooper, 2009, p. 28). The use of virtual worlds to enhance data understanding was cited regarding Hall et al. (2008) for visual pattern recognition and new methods to understand and generate hypotheses (as seen in Boughzala, de Vreede & Limayem, 2012, p. 722).

Method Changes

This phenomenological, exploratory pilot study evolved to efficiently target key, self-reported activities. The original study design called for the use of focus groups conducted within collaborative virtual environments. The inquiry intended to emphasize comparing groups as a primary unit of analysis with perceptions of individuals as secondary. As the literature emerged concerning attempts to explicate the nature of the interaction with the avatar or character, the study shifted to focus on the individual as the

primary unit of analysis rather than the group. Interviews of individuals would have been very useful to compare individual-only factors. As the study is about collaboration, groups perceptions are required. A comprehensive survey approach was adopted in the interest to obtain qualitative and quantitative data on both individual and group levels.

The three-part instrument called the Collaborative Virtual Environment Experience Survey is found in APPENDIX A: Survey Instrument.

Summary

This chapter summarized the five domains within the parameter of the study: collaborative virtual environments, motivation, metacognition, dialogue, and transdisciplinarity. Examples were shown how immersive, mediated collaboration is used for Team Science, funded research, and for military training. Two of the five original domains were refined as two constructs emerged due to gaps in the literature related to avatar relationship. The two new constructs are built upon the literature contained within theories surrounding identity, presence, co-presence, social presence, Transformed Social Interaction, and collaboration. A few examples of collaborative virtual environments were shared to provide context for activities engaged by individuals and groups. The constructs have been termed *virtual-physioception* and *virtual intersubjective presencing* and will be discussed in terms of how they were explored in Chapter Three.

CHAPTER THREE: METHODOLOGY

> "What is essential here is the presence of the spirit of dialogue, which is in short, the ability to hold many points of view in suspension, along with a primary interest in the creation of common meaning" (Bohm & Peat, 2010).

Collaboration has been studied extensively. The scope of this investigation involved two dimensions involving two constructs, and fourteen factors created for this study. The goal was to explore interactions among individuals (*virtual-physioception*) and groups (*virtual intersubjective presencing*) surrounding collaborative activities.

The nature of how the CVEs were used for collaboration was not the primary focus nor was the purpose for collaboration. The goal of the study was to explore the relationship of intra- and interpersonal interactions occurring primarily as a result of using CVEs for concerted collaboration for means of interpolation. Several studies created a scenario or task to test to measure participants' behavior, reactions, and perceptions of using CVEs (Schmeil, 2012; Suter, 2011; Harris, Bailenson, Nielsen & Yee, 2009). Often the study subjects were not self-selected, accomplished users. Limitations were reported among studies regarding unexpected difficulties with technology. Other difficulties reported involved the learning curve of using the CVE software because users did not know enough to be adept in using the software, especially for collaborative purposes.

This study relied upon an Appreciative Inquiry approach to harness a purposeful sample of existing, frequent users of CVE software. Cooperrider & Whitney (2001) distinguish the perspective of discovering what is working, "Appreciative Inquiry is a complex science designed to make things better. We can't ignore problems—we just

need to approach them from the other side" (p.7). Table 3, *Summary of Constructs and Factors*, illustrates the constructs and factors explored.

Table 3 *Summary of Constructs and Factors*

Construct	Description	Factor
Virtual-physioception	the phenomenological or subjective-awareness of shared self-representation concurrently across virtual and physical spaces arising from meta sensory information from combinatorial interoceptive, proprioceptive, and exteroceptive processing	*Avatar Relationship* *Avatar Empowerment* *Avatar Generativity* *Avatar Expression* *Somatic Awareness* *Avatar Presencing* *Transdisciplinarity* *Leadership*
Virtual intersubjective presencing	occurs in a collaborative virtual environment between constellations of identities represented by avatars embodying varying states of human self-consciousness that engage in concerted intention to create the art-of-the-possible	*Group Attachment* *Group Engagement* *Group Understanding* *Group Collaboration* *Group Role* *Open Listening*

A purposeful, cross-section sample of collaborative groups were identified based upon performance record of products produced such as 3D objects, shared environments, events, and artifacts that may include published articles. In addition to group participation, the assumption was made that subjects were invested in their avatar or character. In fact the depth of relationship with the primary avatar or character was believed to affect identity formation as previous studies have suggested (Ratan, 2011, McCreery, 2011, Van Looy, 2012). The study employed methods using qualitative and quantitative approaches reliant upon phenomenology. Activity theory, Transformed Social Interaction (TSI) and transdisciplinarity were referenced as the basis for exploring the two constructs that emerged in the literature. Activity theory builds upon the

connection between individual and social through community participation for self-actualization (Mennecke, Triplett, Hassall & Conde, 2010, p. 4).

"A central dimension of transdisciplinarity is that it should be meta-paradigmatic. Transdisciplinarity involves moving across disciplines and across theories. This means understanding the fundamental assumptions underlying disciplines and theories as well as their underlying paradigms" (Montuori, 2013a).

Cultural historical activity theory or activity theory provides the basis for exploration of the construct *virtual-physioception*. Dr. Vicki Suter, former Director of the National Learning Infrastructure Initiative (NLII forerunner to the EDUCAUSE Learning Initiative) conducted a comprehensive study using the CVE Second Life to explore a construct variation of presence developed. Suter said:

> Cultural-historical activity theory introduced the idea of human psychological functions mediated through tools, rules, roles and community. That is, 'the human mind emerges, exists, and can only be understood within the context of human interaction with the world; and…this interaction, that is, activity, is socially and culturally determined' (Kaptelinin, Nardi, & Macaulay, 1999, p.28) as seen in (Suter, 2011, p. 33).

The third dimension of Transformed Social Interaction (TSI) called self-representation was used as the theoretical framework for *virtual intersubjective presencing*. TSI was developed by Bailenson (2006) and has been shown to affect the interactions and behaviors of users in CVEs (p. 8).

Context and Analysis

Typically phenomenology requires a researcher to bracket their bias and experience when engaging in research (Creswell, 2009, p. 13). Within an interpretivist, transdisciplinarity framework, a researcher as observer is united with the observed

(Montuori, 2013). Researchers are encouraged to explore the meaning and experience of "being" in terms of data collection, analysis, and interpretation to better integrate a researcher's experience (Montuori, 2013; Creswell, 2012, p. 57). This study embraced Hans-Georg Gadamer's philosophical hermeneutics, an interpretive qualitative research method aiming to explore the meaning of individual experiences in relation to understanding human interpretation (Regan, 2012, p. 286). Nicolescu (2010) said the word phenomenology implies "building models that connect the theoretical principles with the already observed experimental data in order to predict further results" (p. 23).

Figure 36, *Research Domains in the Study*, illustrates the five underlying domains within the study. Image attribution Barbara Truman. Two domains evolved due to gaps discovered in the literature. Metacognition was integrated with *virtual-physioception* and dialogue was integrated with *virtual intersubjective presencing*.

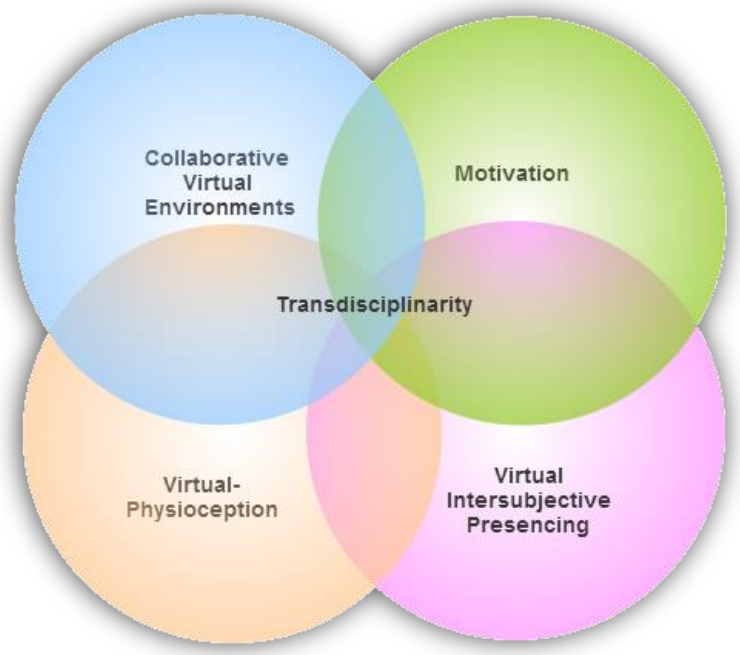

Figure 36. Research Domains in the Study

The guiding research question of the study was summarized:

Do high levels of self-reported *virtual-physioception* correlate to self-reported higher levels of perceived *virtual intersubjective presencing* in CVEs?

Two hypotheses were postulated. They are stated in the null:

> H_0: collaborative virtual environments users report no experience of *virtual-physioception*.
>
> H_0: collaborative virtual environments users report no experience of *virtual intersubjective presencing*.

Research Design

The design of the study was phenomenological combining methods to obtain the strengths of both qualitative and quantitative research (Onwuegbuzie & Leech, 2006). The priority was to explore constructs developed for the study using an inductive approach while confirming the relationship of the variables using a deductive approach. The study employed a concurrent design where data was collected at one time using a survey containing open-ended, binary, and Likert-style questions. The survey was constructed for viewing sections so that participants could see context of the questions and not lose their mental place (Dillman & Christian, 2005, p. 10).

Three primary exploratory questions guided the development of the constructs, factors, and methods:

1. What is the nature of how people use avatars to collaborate in virtual environments?
2. What is the nature of how avatars engage in dialogue?

3. What is the nature of reflexive self-awareness in the context of avatar relationship?

Four theoretical frameworks influenced the study. Appreciative Inquiry provided the philosophical foundation creating the lens and sampling strategy to obtain a purposeful selection of the population representing successful collaboration in virtual environments. Activity theory was the underlying theoretical framework, especially suited for a study of collaboration among individuals involving interactions. Transformed Social Interaction provided the group activity framework, especially for its third dimension of self-representation. Finally, Transdisciplinarity represented the final theoretical framework that is meta-paradigmatic, seeking to unify the inquirer with the inquiry. This unification challenges a researcher to embrace past experience, knowledge, beliefs, values, bias, and way of thinking (Montuori, 2013).

Methods and Instrumentation

The study involved administering an online, three-part survey to participants recruited based on their active contributions to groups operating in collaborative virtual environments.

Suter (2011) reported:

> Through collaborative team members' participation in community, they learn and expand their abilities and understanding. In addition, one of the basic tenets of activity theory is that contradictions and conflicts represent opportunities to learn; that is, opportunities for human development, transformation, and innovation (p. 48).

Johnson & Onwuegbuzie (2004) report on the choice of methods incorporating both qualitative and quantitative paradigms fitting to apply to transdisciplinarity for this study about collaboration:

> Today's research world is becoming increasingly interdisciplinary, complex, and dynamic; therefore, many researchers need to complement one method with another, and all researchers need a solid understanding of multiple methods used by other scholars to facilitate communication, to promote collaboration, and to provide superior research (p. 15).

Figure 37, *Research Study Design*, represents a diagram of the study design illustrating the two phases in the data collection. One formal phase preceded by an informal, internal content validation of the survey instrument constructed for the study. Image attribution Barbara Truman.

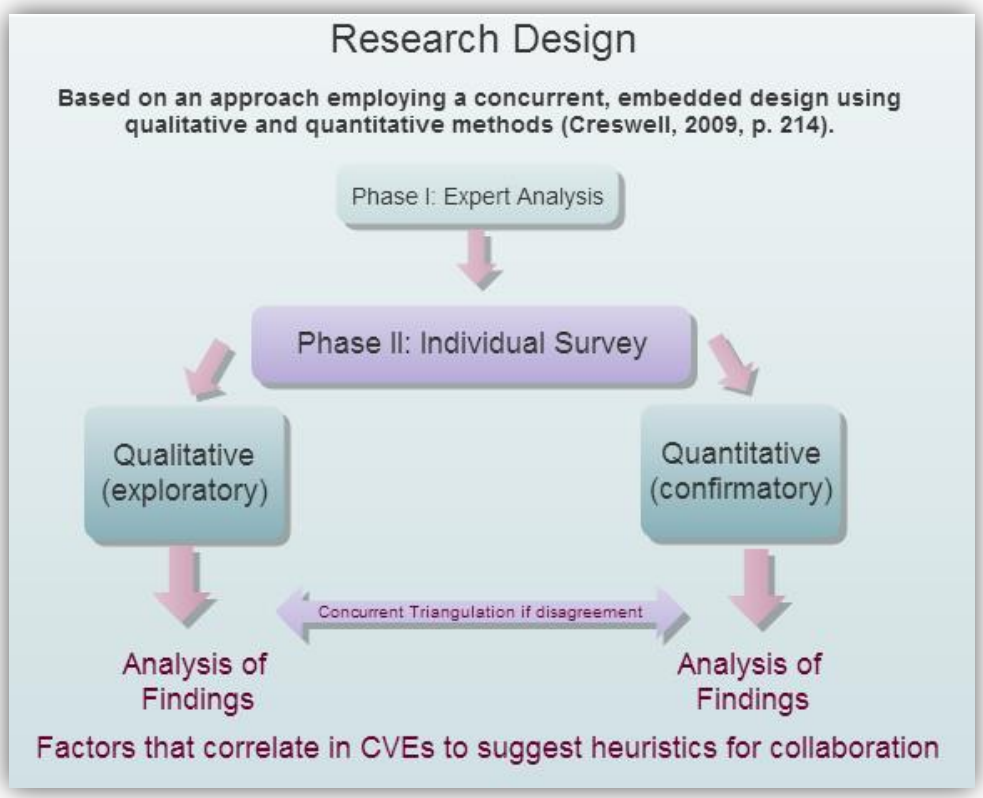

Figure 37. Research Study Design

A concurrent embedded design was used to capture all data in one attempt through a modified survey using open-ended and closed questions (Creswell, 2009, p. 210).

Survey Construction and Factors

After a review of the literature, a three part survey was constructed to measure two dimensions surrounding the use and impact of interactions performed in a collaborative virtual environment (see APPENDIX A: Survey Instrument). The three survey areas included 1) group experience 2) avatar or character experience and demographics 3) individual self-reported experience, perceptions, and demographics. Questions were created and adapted after analyzing several existing questionnaires and instruments including the Metacognitive Awareness Inventory, which was inadequate to measure the somatic indicators suspected to inform engagement in deep dialogue with others using adapted avatars. Committee input was sought for guidance. Andrew Stricker proposed the construct *virtual-physioception* to represent the elusive notion of somatic awareness and reflexive relationship. *Virtual-physioception* was considered to be a predictor variable for intersubjective presencing. More research is needed to explore the two constructs and their interplay. This study relied upon self-reported data based on idiosyncratic experiences, therefore confirmatory analysis is limited.

Fourteen factors were identified across the three areas of the survey. The first survey section used six factors representing group experience.

The fourteen factors initially proposed include:

1. *Group Attachment*- the type and degree of affiliation with one or more groups operating in a collaborative virtual environment.
2. *Group Engagement*- measured the type of group activities and associated frequencies in a collaborative virtual environment as observed in the group's best interests. The activities include creating resources, assisting new members, championing for support etc. Engagement is predicated on the literature involving the construct presence (Scoresby & Shelton, 2011; Yee, Bailenson, Urbanek, Chang & Merget, 2007; Persky, Kaphingst, McCall, Lachance, Beall & Blascovich 2009; McCreery, 2011; Suter, 2011).
3. *Group Understanding*- the perceived clarity of understanding among the individual and group including mission (Allmendinger, 2010; Biocca Harms & Gregg, 2001).
4. *Group Collaboration*- type of activities the group performed such as communication, conflict resolution, and involvement of members (Mâsse, Moser, Stokols, Taylor, Marcus, Morgan, Trochim, 2008; Sonnenwald, 2006).
5. *Group Role*- type of self-reported roles involved in group participation.
6. *Open Listening*- learning from the future (Scharmer, 2000; Scharmer, 2009).
7. *Avatar Relationship*- the degree of identification with and between the mediated representation, virtual self (McCreery, 2011; Deihl & Prins, 2008; Roesler, 2008; Ratan, 2011; Van Looy et al., 2011; Young & Whitty, 2011; Roesler, 2008; McKenna et al., 2002).
8. *Avatar Empowerment*- the ability to overcome limitations in the physical world through avatar relationship (Young & Whitty, 2011).

9. *Avatar Generativity*- participants' self-reported ability to go beyond common behaviors to demonstrate a view of an avatar-mediated future (McAdams & Aubin 1992; Beaumont, 2011; Scharmer, 2000).
10. *Avatar Expression*- the type and degree of participants' self-reported customization of avatar appearance and type of customized interactions.
11. *Somatic Awareness*- participants' self-reported somatic awareness, emotional and regulation especially in the context of CVE use involving a primary avatar (Mehling et al., 2009; Van Looy et al., 2011; McCreery, 2011).
12. *Avatar Presencing*- participants' self-reported openness, awareness of strengths and assumptions, and appreciation of others' views based on the discipline of Presencing (Scharmer, 2000; Scharmer 2009).
13. *Transdisciplinarity*- participants' self-reported scope of activities spanning more than one disciplinary activity (National Cancer Institute, 2013).
14. *Leadership*- participants' self-reported role and actions may indicate responsibility assumed for personal actions. "…VW [virtual world] leadership has been under researched in the VW literature (Boughzala, de Vreede & Limayem, 2012, p. 725).

Onwuegbuzie & Leech (2006) reported "quantitative and qualitative research questions are most aligned or compatible with respect to underlying paradigm and methods used when both questions are open-ended and non-directional in nature and they both seek to discover, explore, or describe a particular participant(s), setting, context, location, event, incident, activity, experience, process, and/or document" (p. 486). These considerations were taken in the survey construction.

Survey contact strategy

Emails messages were sent to individuals within targeted groups. The email contained a web link leading to the researcher's website providing a welcome (Dillman, Tortora & Bowker, 1998, p. 7). The welcome page also described the purpose of the study and contained consent requirements, contact information, and the definitions (see APPENDIX B: Survey Launch Site Example). The three-part survey was delivered via the web survey administration site, Survey Monkey (see APPENDIX A: Survey Instrument).

Research Participants

The study design was phenomenological relying upon self-reported data. Most importantly, the study uses an Appreciative Inquiry approach designed to collect recollections of past, effective practices.

Two levels of participation were created to collect data. On the group level, the targeted groups were required to have the following criteria:

1. The group operated continuously in a collaborative virtual environment for the last two years and was considered active
2. The group met at least quarterly if not more frequently
3. The group was open to professional collaboration and had a collaborative professional development mission as part of its charter to share effective practice that spanned the use of virtual environments
4. The group's leader(s) were known assuring goals of the study were well understood

5. The group's leader(s) was willing to advocate participation in the study to group members

Group leaders were asked to promote the research opportunity to members who attended the group's events regularly and contributed ideas, energy, talent and time to advance the goals of the group. In addition, participants were sought for their active citizenry among the group as community members in the hopes they contributed to dialogue surrounding group direction and governance as a community of practice.

We had some awareness of all the groups selected for inclusion in the study and some experience with some groups. Additional criteria for participation required subjects to be comfortable in sharing their virtual persona and physical persona online. In other words participants were public about who their avatar or character represented. Study subjects were believed to be vested in their CVE communities and their avatars within those communities.

Group leaders helped recruit volunteers within high performing, collaborative virtual environment (CVE) groups. These groups included: the Military Open Simulation Enterprise Strategy (MOSES), Global Learning Forum (GLF), Virtual Worlds Best Practice in Education (VWBPE), Second Life Relay for Life organizing committee, International Society for Technology in Education (ISTE) Special Interest Group in Virtual Environments, GamesMOOC, Virtual Pioneers, Inevitable Betrayal and Cognitive Dissonance Guilds, OpenSim Community Conference 2013, and NonProfit Commons. As stated, we had at least some experience participating in the primary targeted groups and observed their projects, events, and collaborative products and deeds. One type of exception was made to include participation among busy professionals. If an

individual was not currently active in a group, but had served in the last two years in a group or had led a group activity, they were invited to participate.

Threats to Human Subjects

Ethical policies established by Colorado Technical University's Institutional Review Board for the protection of human subjects were followed for this study. The research was classified as expedited. No subjects were recruited or participated from a protected class.

Some of the questions on the survey were of a personal nature requiring introspection. Questions were carefully worded so as to avoid the appearance of threat. The questions involved general information related to motivation, cognition, identity, and communication without reference to any particular context. The subjects chose the context for their answers.

Data Collection and Validity

The data were collected via online software that used secure socket protection for data assurance to protect the identity and privacy of the participants. The items were stored in a database used to perform the analysis using industry-standard, commercial software. Identifying information was aggregated into the collective data set to protect confidentiality of respondents. Table 4, *Summary of Data Collected and Purpose*, shows the informal and formal phase of the survey used in the study.

The survey instrument was validated and modified based on the analysis of committee and content experts during phase I of the study. Questions were also created for the survey guided by previous instruments and measures used in the National Cancer

Institute's Team Science Toolkit. Questions were adapted and created to meet the needs of the study in order to explore the constructs and relationship. The two proposed hypotheses were tested based on the findings among the fourteen factors. The study was mostly exploratory; therefore internal validity tests were limited. External validity was also not applicable as there was no experiment and no treatment in the study. Rather, the study relied upon self-reported data of recollections idiosyncratic to subjects. Further research is required to assess the three-part survey instrument's reliability for measuring the proposed constructs and measures. Analysis of reliability of question items was performed.

Table 4 *Summary of Data Collected and Purpose*

Data Collected	Purpose	Source	Phase
Informal verbal feedback	Content validity of survey Explore construct phenomena Obtain sampling advisement	Consultations	I
Electronic data from survey	Explore self-reported construct phenomena	Electronic data from survey	II

Data Analysis

Feedback for Phase I entailed face validity through analyzing committee feedback for the proposed questions' clarity, meaning, order, and factor association. A few experts reviewed the survey for timing and usability of administration.

The data from Phase II were provided electronically by Survey Monkey and were analyzed using SPSS and NVivo software packages in multiple passes for both the qualitative open answers and quantitative responses. Descriptive statistics were calculated for the fourteen factors. Categorical variables were analyzed and percentages were reported. The distribution of the outcome (*virtual intersubjective presencing*) and predictor variable (*virtual-physioception*) were evaluated for correlations.

Qualitative data were coded into themes and summarized for comparison with quantitative data. Thematic analysis is reported jointly in Chapter Four. Salient comments were also reported to provide thick description of the exploratory phenomena.

Factor analysis was performed upon the fourteen latent factors to evaluate loading and support for the two hypotheses. tTests and series of Univariate Analysis of Variance

(ANOVA) were conducted to examine the relationship between the self-reported levels of *virtual-physioception* and *virtual intersubjective presencing*.

Summary

Chapter Three described the context for the study by illustrating the five domains within the study and the factors leading to a comprehensive three-part survey created to explore two constructs that emerged upon reviewing the literature. The results are presented in Chapter Four.

CHAPTER FOUR: DATA AND ANALYSIS

This chapter presents findings surrounding analysis of data collected through administration of the three-part survey found in APPENDIX A: Survey Instrument. The survey sought insights on collaborative group experience, avatar or character group experience, and individual experience. The chapter begins with a summary of Phase I followed by findings of survey implementation. The study participants, descriptive statistics, and reliability and correlation analyses are summarized and referenced in the appendices. Alternating exploratory qualitative and explanatory quantitative findings are presented related to the study's three exploratory questions, two hypotheses, and two proposed constructs.

Phase I Findings from Expert Analysis

Constructing this study's survey involved critically evaluating the nature of the questions for their exploratory benefit and confirmatory potential. Four expert users of virtual worlds evaluated the instrument and provided feedback including all committee members. The questions were analyzed for their scale value including whether to seek frequency of activities. The notion to identify the degree of formality of CVE use associated with reported activities was abandoned. Exploratory questions required awareness of definitions for dialogue and collaboration to obtain sufficient detail from respondents. The researcher's web page was used to provide context for the study prior to survey launch where the definition of dialogue and collaboration were provided (see APPENDIX B: Survey Launch Site Example). This strategy helped improve self-

selection in the purposeful sample to assure survey participants were not casual virtual world users.

The length of the survey was a concern. Qualitative questions were tapered back enabling easier and faster completion. Only one qualitative question was asked in part 3 regarding individual experience. Thirteen demographic questions were used across all three parts at the end of each section as they related to group, avatar, and individuals.

Profiles of Study Participants

A total of 84 participants initiated the survey administered between October 8, 2013 and November 15th, 2013 using the online tool, Survey Monkey. A total of 61 participants completed the entire survey representing a 72 % completion rate. The data were analyzed using IMB's Statistical Analysis in Social Science (SPSS) software and NVivo 10 analysis software.

The number of groups participating in the virtual environments such as Second Life, OpenSim, World of Warcraft, Active Worlds, is not known. The overall population is speculative and group leaders varied in their solicitation among members to complete the survey. Recruitment occurred mostly through announcements during synchronous meetings.

The survey collected demographic data pertaining to group, avatar, and individual experience. Respondents came from seven countries. The United States made up the majority reporting 53 or 87% (n=61). Respondents were also from Canada, the United Kingdom, Jamaica, Japan, Finland, and Australia. The Kaiser-Meyer-Olkin Measure of sampling adequacy was .526 (Field, 2009, p. 647).

Females represented 54% and males 44% (n=61). One individual preferred not to disclose gender. Respondents reported ethnicity as Caucasian (77%) multiracial (5%), African descent or black (3%), Asian or Pacific Islander (3%), and Hispanic or Latino (2%) and preferred not to disclose ethnicity (7%). One respondent chose other for ethnicity, typing in the word *virtual*, stating, "I believe ethnicity is not relevant."

Table 5, *Summary of Respondent Demographics*, provides a comparative view across demographic information pertaining to age, professional affiliation, educational attainment, and role in the primary group for which the respondent indicated an emotional attachment. Other professional affiliations responses included 'retired', 'nonprofit' 'equal military and education', 'independent contractor' 'public library', 'business owner' and 'consultant.'

Other educational attainment responses included three individuals who are pursuing their doctoral degrees and one who said they were self-taught.

Table 5 *Summary of Respondent Demographics*

Age		Professional Affiliation		Educational Attainment		Role in the Group	
20-29	1.6%	K12	4.9%	Some college	4.9%	Leader	52.5%
30-39	16.4%	Community or Jr. College	6.6%	AA/AS degree (two years of college)	1.6%	Speaker or spokesperson	1.6%
40-49	24.6%	University	32.8%	BA/BS degree (four years of college)	16.4%	Advisor	3.3%
50-60	34.4%	Industry	16.4%	MA/MS masters or graduate level degree	31.1%	Contributor	21.3%
60-69	21.3%	Government	9.8%	Doctorate degree PhD, EdD, MD, JD, DM, DCS	32.8%	Member	21.3%
70+	1.6%	Military	3.3%	Other	13.1%		
		Other	26.2%				

n=61

Table 6, *Group and Avatar Demographics*, provides comparative data related to respondents involvement with their primary avatar as used to collaborate in groups. Sixty seven percent of respondents reported using Second Life as their primary platform. OpenSim accounted for 24.6% of respondents' platform, World of Warcraft 8.2% and

four respondents did not answer. Comments regarding platform use involved the use of other platforms including: Facebook, Sococo, AvayaLive Engage, Google Hangouts, Minecraft, Skype, Stack Exchange, and Open Wonderland. Concerning reuse of their avatar identity across platform, 70.5% of respondents said they use the same name and 29.5% did not. 67.2% did not use their avatar's identity for blogging or social media use. Thirty three percent of respondents involve their avatar in the use of a blog or for social media purposes. Of those respondents that reuse their avatar name and identity on other platforms, the average reported number was 6.3. One person answered "dozens" when asked how many total avatar representatives exist.

Table 6 *Group and Avatar Demographics*

Avatar Age		Time in Group		Average Weekly Time with Avatar		Groups Demographics
< 1 year	6.6%	< 1 year	14.8%	< 1 hour	9.8%	44 unique groups reported
1-2 years	8.2%	1-2 years	26.2%	1-5 hours	24.6%	
3-4 years	27.9%	3-4 years	27.9%	6-9 hours	14.8%	11 respondents listed
5-6 years	29.5%	5-6 years	19.7%	10-15 hours	19.7%	more than 1 group as
7-8 years	24.6%	7-8 years	11.5%	16-20 hours	8.2%	primary
+10 years	3.3%	9+ years	0.0 %	21-25 hours	9.8%	
				>25 hours	13.1%	8 respondents listed two different groups between consent and primary

n=61

Group attachment was theorized as a factor, although the only question that addressed it was demographic. Respondents had the option of adding additional groups for which they felt an emotional attachment. They were asked to report their answer on a primary group to obtain the most suitable recollections of group experience. Some respondents were attached to broader community(ies) and to the milieu of virtual environments in general. On average, respondents provided 2.6 additional groups for which they were emotionally attached.

Crosstabs

Crosstabs were analyzed based on respondents' reported demographic information (see APPENDIX C: Crosstabs). The majority of respondents created an avatar and joined their primary group between three and eight years. Concerning the role in the group, leaders and members spanned all segments of time spent in their group, e.g., <1 year to 7-8 years. Respondents who self-identified as members reported <1 to four years in their groups. Members also spent less time weekly with their avatar, <1 to nine hours. Leaders spent more time above 10 to >25 hours per week.

Analysis of Reliability

Five scales associated with fourteen theorized factors described in Chapter Three were included in the survey design. The five scales corresponded to Group Engagement, Group Collaboration, Avatar Empowerment, Self-Actualization, and Interdisciplinary Professionalism. The alpha reliability analysis for all 44 quantitative variables across the five scales was (α =.93). The breakdown of reliability ratings is reported in APPENDIX D: Reliability Analysis and Quantitative Variable Index.

Frequency Distributions

The items shown in Table 7, *Perceptions of Agreement*, report the collapsed findings through aggregating respondents' valid percentage selections of *strongly agree* and *agree* into the 'Agreed' column. Respondents' selections of *strongly disagreed* and *disagreed* have been aggregated into the 'Disagreed' column.

Table 7 *Perceptions of Agreement*

Item question	Variable Name	Agreed	Disagreed
Perception of whether the group understood respondent	GRPCLEAR	90.2%	3.3%
Perception of whether respondent understood others	CLEARGRP	90.2%	6.6%
Rated relationship of avatar inseparability (Virtual physioception)	AVI_INTE	62.3%	24.6%
Rating of referral to avatar as extension of self when talking with others	AVICOMM	73.8%	18.0%
Rating of overcoming social limitations through avatar use	AOVSOLIM	47.6%	24.6%
Rating of overcoming physical limitations through avatar use	AOVPHYS	36.1%	32.8%
Rating of overcoming communication limitations through avatar use	AOVCOMM	39.3%	27.8%
Rating of overcoming interpersonal limitations through avatar use	AOVINTP	34.4%	31.2%
Rating of acceptance of socio-economic status through avatar use	AVACECON	24.6%	34.5%
Rating of acceptance of educational status through avatar use	AVAEDU	29.5%	27.9%
Rating of acceptance of gender through avatar use	AVAGEND	16.4%	27.9%
Rating of acceptance of ethnicity through avatar use	AVARACE	18.0%	27.9%
Rating of avatar customization for interactions	AVIINTER	65.5%	11.4%
Rating of avatar's contribution to group understanding	AVIEXPRES	57.4%	9.8%
Rating of others' ability to predict physical activities based on knowing avatar	AVAPRED	68.9%	8.2%
Rating of comfort to bequeath avatar	AVIQUEAT	52.5%	18.0%
Rating of comfort to become friends with artificial intelligent avatar	AVIAIFR	24.6%	45.9%
Rating of somatic awareness	SOMATIC	47.6%	9.8%
Rating of emotional awareness	EMOTION	88.6%	11.5%
Rating of regulation of feelings	TRANSLATE	88.6%	11. 5%
Rating of awareness of assumptions	ASSUMPT	80.3%	4.9%
Rating of openness of heart and mind	OPENWILL	86.8%	3.3%
Rating of appreciation for others' viewpoints	IDIFFER	93.4%	0%

n=61

Respondents reported the highest agreement surrounded appreciating others' viewpoints (93%) followed by perceptions of understanding others (90%) and perception of being understood within the group (90%).

The greatest disagreement among all respondents' was permitting their avatars to attain artificial intelligence to become like a friend to them (46%). Several respondents said it was a 'creepy' idea. Additional disagreement surrounded the notion of overcoming socio-economic limitations (35%), physical limitations (33%), race (28%), gender (28%), and educational attainment (28%).

The ratings shown in Table 8, *Rating of Group Collaboration*, indicated respondents' perceptions of the quality of their group dialogue and resourcefulness. The rating scale was changed to reflect perceived quality rating rather than agreement.

Table 8 *Rating of Group Collaboration*

Item question	Variable Name	Excellent	Above Average	Average	Below Average	Poor
Perception of group communication	GRPCOMM	27.9%	54.1%	14.8%	3.3%	0%
Perception of use of group strengths	GRPSTREN	37.7%	37.7%	23.0%	1.6%	0%
Perception of the resolution of conflict within the group	GRPCONFL	23.0%	29.5%	45.9%	0%	1.6%
Perception of the productivity of collaboration	GRPPROD	32.8%	45.9%	19.7%	1.6%	0%
Perception of the impact of collaboration	GRPIMPAC	41.0%	41.0%	16.4%	0%	1.6%

n=61

Overall, the groups reporting in the study appear to be high performing. The greatest challenge was dealing with conflict as nearly half of respondents reported room for improvement with average satisfaction (46%).

Table 9, *Frequency Summed Scores of Group Collaboration Activities,* illustrates a range of group activities performed by all members of groups. Total sum scores were calculated for frequency as *Never* equals zero, *Less than once a month* =1, *Monthly*=2, *2-3 Times a month*=3, *Weekly*=4, and *Daily*=5. The total possible sum score range is between zero if all respondents reported never and 305 if all respondents reported frequency as daily (n=61). The complete breakdown of responses is found in APPENDIX F: Full Frequency Tables.

Table 9 *Frequency Summed Scores of Group Collaboration Activities*

Item question	Variable Name	Sum Score
Frequency in championing the group to stakeholders	G_CHAMP	124
Frequency in providing vision for direction of group activities	G_VISION	189
Frequency in recruiting new members	G_RECRUI	125
Frequency in assisting new members	G_NEWMEM	186
Frequency in using social media to create awareness for the group	G_SOME	212
Frequency in creating resources that the group uses	G_RESOUR	172
Frequency in creating and running events	G_EVENT	140
Frequency in networking with others and groups on behalf of the group	G_NETWRK	224
Frequency in cultivating the identification of the group	G_CULTID	185
Frequency in evangelizing the group to others	G_EVANG	169

n=61

The most frequent activity was networking with others (224) followed by using social media (212), and providing vision for the group (189). The lowest activities were championing the group for obtaining resources (124) and recruiting new members (125). Some groups may be completely self-supporting and not actively seeking members.

The scale used to measure interdisciplinary professionalism included a four point scale. Table 10, *Frequency Summed Scores of Professional Interdisciplinary Activities*, provided total sum scores calculated with a frequency of *Never* equals zero, *Rarely* =1, *Occasionally*=2, *Often*=3, *Very often*=4. The total possible sum score range is between zero and 244 (n=61).

Table 10 *Frequency Summed Scores of Professional Interdisciplinary Activities*

Item question	Variable Name	Sum Score
Frequency of reading diverse journals	JOURNALS	180
Frequency of attending/participating in diverse conferences	CONFEREN	132
Frequency of attending/participating in diverse meetings	COMMITTEE	175
Frequency of gaining insights from others for self	INSIGHTS	178
Frequency of modifying own work as result of others' input	MODIFY	160
Frequency of establishing links with diverse colleagues	LINKAGES	169

n=61

The most frequent interdisciplinary activity was reading broadly (180). The least frequent activity was attending meetings (132).

Correlations

Correlations were performed in SPSS and results are shown in Table 11, *Demographic Correlations of Avatar and Respondent*, where a strong positive relationship exists between the age of the avatar and the amount of time spent in the group.

Table 11 *Demographic Correlations of Avatar and Respondent*

	GRPROLE	GRPPLAT	TIMEGRP	AVIAGE	AVITIME	BLOG	EDUATTA	AFFILIAT	ETHNIC	GENDER	HUMAGE
GRPROLE	1										
	.514										
TIMEGRP	**-.383****	-.087	1								
	.002	.504									
AVIAGE	-.226	-.203	**.592****	1							
	.080	.116	.000								
AVITIME	**-.368****	-.167	.190	.224	1						
	.004	.199	.142	.083							
AVIBLOG	.171	.186	**-.418****	-.324*	-.188	1					
	.188	.152	.001	.011	.146						
EDUATTA	.025	.113	-.065	-.114	-.189	.127	1				
	.850	.388	.616	.383	.145	.329					
AFFILIAT	.080	.069	-.112	-.212	-.191	.217	.046	1			
	.539	.596	.392	.101	.139	.093	.724				
ETHNIC	.195	.141	-.091	.135	-.160	.070	.287*	.077	1		
	.132	.278	.488	.299	.218	.594	.025	.556			
GENDER	-.003	**.339****	.090	-.090	-.207	.227	.152	.104	.161	1	
	.979	.008	.493	.492	.110	.079	.241	.424	.214		
HUMAGE	-.024	.144	.308*	.260*	.103	-.146	-.168	-.120	-.025	.135	1
	.852	.268	.016	.043	.430	.263	.197	.358	.846	.298	

n=61

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

Principal Component Analysis

A factor analysis using principal components identified components of latent variables (Shlens, 2005, p. 6). The pattern matrix is found in APPENDIX E: Pattern and Structure Matrix from Principal Component Analysis. A Monte Carlo analysis confirmed the Eigenvalues of the break points identified in the associated scree plot. Based on these Eigenvalues, four components were used to extract latent variables using principal components analysis with an Oblimin rotation that converged in six rotations. Coefficient values of .40 were omitted resulting in the four components named: EMPOWER,

ENGAGE, COLLAB, and TRANS. The Eigenvalues associated with the four components were EMPOWER: 11.74, ENGAGE: 4.83, COLLAB: 3.58 and TRANS: 2.90. The resultant structure matrix is found in APPENDIX E: Pattern and Structure Matrix from Principal Component Analysis.

Figure 38, *Principal Components Extraction*, illustrates the collapse of questions into factors and how they related to components. Image attribution Barbara Truman.

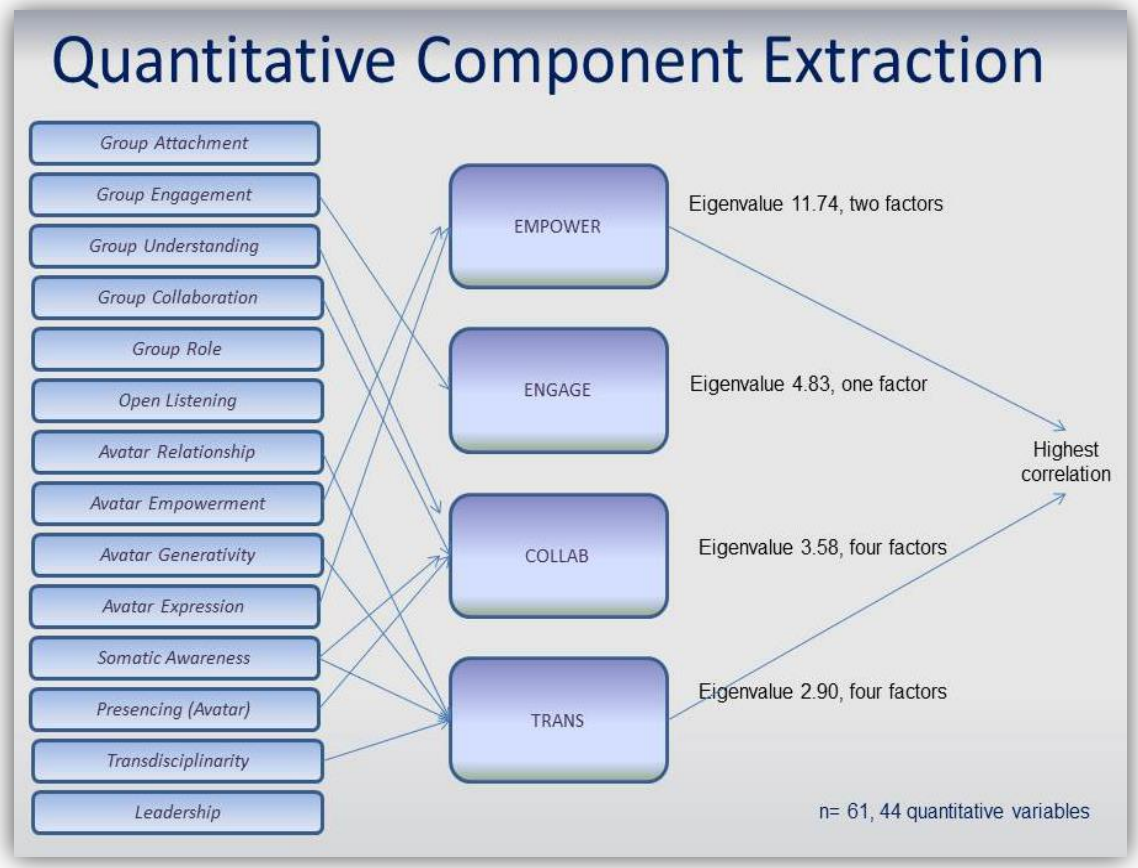

Figure 38. Principal Components Extraction

The pattern matrix's first pattern, labeled EMPOWER was associated with questions surrounding the avatar questions related to physical world abilities beyond the virtual environment pertaining to interpersonal, communication, educational, social, physical, racial, and economic limitations. One additional question was associated with

EMPOWER theorized to belong to another factor. The additional question associated with the EMPOWER component was:

- *My avatar or character helps me express ideas that contribute to group understanding*

The second pattern, labeled ENGAGE was associated with frequency of group engagement surrounding activities that included championing the group to sponsors, provide vision, recruit members, assist new members, use social media, create group resources, orchestrate events, network with others, cultivate group identity, and evangelize the group to others. The ENGAGE component aligned with the theorized factor of group engagement. Questions used in the EMPOWER and ENGAGE components were recommended by Andrew Stricker and were adapted to meet the needs of this study.

The third pattern, labeled COLLAB was aligned with the five questions adapted questions from the "Collaborative Processes" section from the National Cancer Institute's Transdisciplinary Research on Energetics and Cancer (TREC) Baseline Evaluation Survey available in the Team Science Toolkit (see https://www.teamsciencetoolkit.cancer.gov/public/TSResourceMeasure.aspx?tid=2&rid=726). These questions involved rating group experience pertaining to communication among collaborators, use of individuals' strengths, conflict resolution, collaboration productivity and impact. Four questions were grouped with COLLAB and not theorized to associate with group collaborations. These questions surrounded group understanding, presencing, and somatic awareness. The additional questions related to the COLLAB component were:

- *My collaborators' expressed ideas were clear to me.*

- *My expressed ideas were clear to my collaborators.*
- *I pride myself on my ability to appreciate varying points of view.*
- *My emotions are usually clear to me.*

The fourth pattern, labeled TRANS was aligned with questions adapted from the interdisciplinary "Collaborative Activities" section from the National Cancer Institute's Transdisciplinary Research on Energetics and Cancer (TREC) Baseline Evaluation Survey available in the Team Science Toolkit (see https://www.teamsciencetoolkit.cancer.gov/public/TSResourceMeasure.aspx?tid=2&rid=726). The collaborative activities questions asked about frequencies of seeking interdisciplinary perspectives through reading diverse journals, attending meetings outside one's field, integrating others' views. Five questions were grouped with TRANS and not theorized to associate with the transdisciplinarity factor. These questions involved, avatar relationship, somatic awareness and generativity. The additional questions related to the TRANS component were:

- *I am comfortable in having my primary avatar bequeathed for future generations to use for learning about me.*
- *I am deliberative in how I express my emotions.*
- *Others can predict my actions/personality based on knowing my avatar.*
- *I customized my avatar or character to make it interact the way it does.*
- *My avatar or character is inseparable from me.*

Table 12, *Component Correlation Matrix*, reports the correlation between the four components extracted from the Principal Component Analysis.

Table 12 *Component Correlation Matrix*

Component	EMPOWER	ENGAGE	COLLAB	TRANS
EMPOWER				
ENGAGE	.235			
COLLAB	.142	.115		
TRANS	.385	.196	.183	

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Positive correlations exist between all components, but the highest correlation exists between the components TRANS and EMPOWER followed by ENGAGE and EMPOWER. Table 13, *CVE Demographic Correlations*, reports the correlations among the demographic variables associated with avatar and platform use and the four extracted components resulting from an analysis of principal components: ENGAGE, COLLAB, EMPOWER, and TRANS.

Table 13 *CVE Demographic Correlations*

	ENGAGE	COLLAB	EMPOWER	TRANS	GRPROLE	GRPPLAT	TIMEGRP	AVIAGE	AVITIME
ENGAGE	1								
COLLAB	.246*	1							
	.028								
EMPOWER	.329**	.298**	1						
	.005	.010							
TRANS	.255*	.246*	.510**	1					
	.024	.028	.000						
GRPROLE	-.510**	-.048	-.166	-.222*	1				
	.000	.356	.100	.043					
GRPPLAT	-.039	.013	-.266*	-.165	-.085	1			
	.383	.460	.019	.101	.257				
TIMEGRP	.209	.275*	.242*	.334**	-.383**	-.087	1		
	.053	.016	.030	.004	.001	.252			
AVIAGE	.140	.181	.269*	.144	-.226*	-.203	.592**	1	
	.141	.082	.018	.134	.040	.058	.000		
AVITIME	.455**	.171	.462**	.369**	-.368**	-.167	.190	.224*	1
	.000	.094	.000	.002	.002	.099	.071	.042	

n=61
*. Correlation is significant at the 0.05 level (1-tailed). **. Correlation is significant at the 0.01 level (1-tailed).

Table 14, *Demographic Correlations*, illustrates the relationships between the four components, age, gender, ethnicity, affiliation, and educational attainment.

Table 14 *Demographic Correlations*

	ENGAGE	COLLAB	EMPOWER	TRANS	HUMAGE	GENDER	ETHNIC	AFFILIAT	EDUATTA
ENGAGE	1								

COLLAB	.246*	1							
	.028								
EMPOWER	.329**	.298**	1						
	.005	.010							
TRANS	.255*	.246*	.510**	1					
	.024	.028	.000						
HUMAGE	-.049	-.210	-.156	-.057	1				
	.353	.052	.115	.331					
GENDER	-.242*	.009	-.238*	-.131	.135	1			
	.030	.473	.032	.157	.149				
ETHNIC	-.152	-.077	-.291*	-.059	-.025	.161	1		
	.121	.278	.011	.325	.423	.107			
AFFILIAT	-.317**	-.053	-.135	.026	-.120	.104	.077	1	
	.006	.343	.151	.422	.179	.212	.278		
EDUATTA	-.147	-.027	-.246*	-.019	-.168	.152	.287*	.046	1
	.130	.417	.028	.443	.098	.121	.012	.362	

n=61

*. Correlation is significant at the 0.05 level (1-tailed). **. Correlation is significant at the 0.01 level (1-tailed).

Exploratory Qualitative Analysis

Exploratory findings of latent variables are described through use of thematic analysis employing an inductive approach of observations (Boyatzis, 1998, p. 44) and a critical analysis using constant comparison with explicit coding procedure (Glaser & Strauss, 1967, p. 441). Several close readings of the survey data allowed inductive, data driven, exploratory analysis. Open coding was followed by axial coding using Nvivo10 software. 183 nodes were created included nodes for 79 respondents of which 61 completed the full survey. A total of 104 nodes were reviewed containing 2,514 references. References include duplicated source fragments coded to one or more nodes.

Ten qualitative questions were associated with quantitative counterparts within the 44 quantitative questions. Three qualitative questions were exploratory, standalone questions. These three questions anchored each section of the survey to obtain data on group, avatar, and individual experience. Three demographic questions about group involvement, role, and platform were meant to serve as reference. Respondents elaborated on their involvement adding facts and description of the degree and length of

service. Figure 39, *Qualitative Analysis Method*, illustrates the process of collecting data from the survey to coding comments and making queries to obtain resultant themes. Image attribution Barbara Truman.

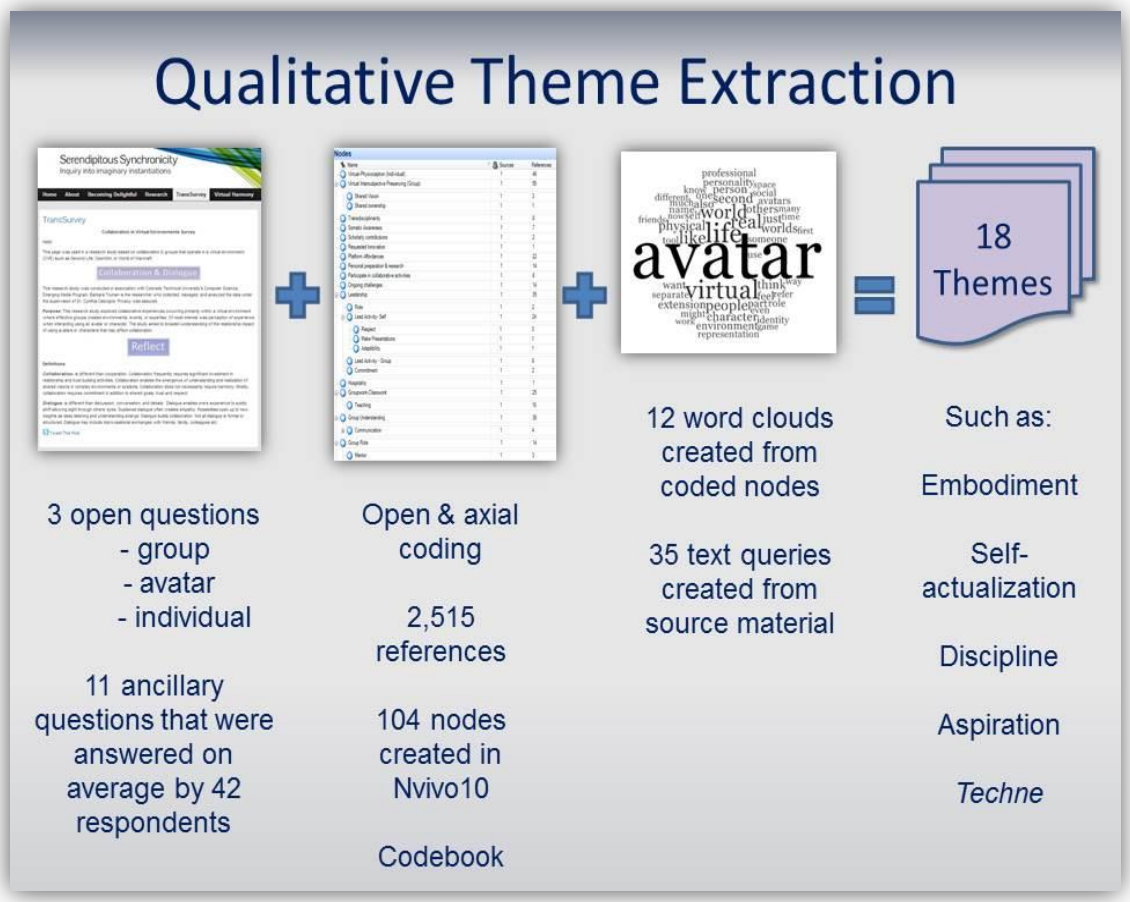

Figure 39. Qualitative Analysis Method

Table 15, *Response Tally of Qualitative Comments*, illustrates the range of elaboration provided on quantitative questions as well as the primary exploratory questions designed to measure the proposed constructs labelled GRPRESE, AVIRELAT, and CULTSELF. The number of responses respondents made on optional qualitative questions was 465 or an average of 42 per question.

Table 15 *Response Tally of Qualitative Comments*

Item	Comments	Label
Elaborate on role in the group	14	GRLDESC
Describe how understanding happened	65	GRPPRESE
Elaborate on group collaboration experience	48	GRPELAB
Elaboration on platform	17	GPLATEL
Describe the development of primary avatar	61	AVIRELAT
Elaborate on avatar inseparability	51	AVINTEG
Elaborate on avatar as an extension when engaged in conversations with others	46	AVI-COMM
Elaboration on abilities in physical world beyond virtual environment- limitations	44	AOVELAB
Elaboration on abilities in physical world beyond virtual environment- limitations	39	AVAELAB
Elaborate on customized avatar to make it *interact*	44	AVQINT
Elaborate on how avatar helps *express ideas* that contribute to group understanding	30	AIMPRES
Elaborate on predictability of physical-life behaviors from getting to know avatar	38	AVIPRED
Elaborate in having primary avatar bequeathed for future generations	38	AVIDEATH
Elaborate on having avatar grow independent, using artificial intelligence	42	AVIFRIEN
Describe how you improve yourself to broaden collaborative interactions	61	CULTSELF
List how many total avatar representations exist	45	REUSEAVI

n=65 for survey part I and n=61 for survey parts II and III

The terms listed below in Table 16, *Nvivo Qualitative Reference Frequencies*, were searched using Nvivo10 on raw survey data, the sources respondents made to open questions. Corresponding frequencies from the search query are reported based on the root word and their close counterparts. Queries enabled cross reference to original context for further selective coding after the open and axial coding.

Table 16 *Nvivo Qualitative Reference Frequencies*

Search Term	References	Search Term	References
listen	13	dialogue	12
community	25	experience	53
relationship	13	think	53
team	16	play	26
strength	3	feel	43
meeting	30	open	24
status	11	overcome	7
custom	12	fun	13

n=65 for survey part I and n=61 for survey parts II and III

Exploratory Research Questions

Three exploratory questions were analyzed among the qualitative data provided in the purposeful sample. This study did not seek to identify the nature and types of collaborative activities. Rather, the study sought to explore the collaborative impact on individuals and groups reliant upon embodied avatars. The group representation suggested a spectrum of culture. Some groups relied upon realism and strict professionalism to support training applications. Some groups were informal performing continuous outreach as part of professional associations. Some groups built environments and other projects together and some had expectations for active participation such as conducting guild business in World of Warcraft. Some groups conveyed a social contract to support the greater community using virtual environments and some groups' contracts extend into the physical and virtual domains. Cultivating culture through developing customs was apparent. One respondent said his or her group conducted fireside chats every other week as a custom. Other word clouds based on coding analysis are available in APPENDIX G: Qualitative Word Clouds Based on Node Coding.

This study did not seek to identify differences between the wide choices of rapidly-evolving virtual environments. Rather, the study sought to identify a few

common platforms withstanding the test of time where communities evolved. Platform differences were mentioned among respondents. The virtual world Second Life and its open simulation counterpart, OpenSim were cited for their rich tools to support multimodal communication. Social media affordance such as friending, tracking friends, group and individual chat and voice capabilities enabled a variety of means to communicate and collaborate. These multimodal communication affordances provide multiple channels one respondent described as not possible in real life.

Getting around in the environment through teleporting also enabled shared experiences, but come at the cost of scalable interactions. Current interfaces offered considerable means to customize experience. Other platforms such as World of Warcraft offered marketplaces to exchange goods creating an ecosystem to support users advancement into complex interactions. Some platforms are embracing the Web browser as the means to support collaboration. At the time of this writing, these Web-based tools did not offer the depth of customization and the marketplace of items to support embodied avatar expression. Simplicity of use had tradeoffs with ability to create and exchange. Respondents reported using graphic, multimedia displays and audience participation within platforms. They also reported using a myriad of tools to support their collaborative activities extending beyond the virtual environments. Google Hangouts, Skype, and other Web 2.0 tools mentioned earlier in this chapter, made up the suite of technological capabilities used to enable collaboration among group members. *Adapting* and *adjusting* were mentioned to accommodate collaboration needs whether for tools or personal preferences.

Figure 40, *Qualitative Summary of Research Question 1*, encapsulates the key themes that emerged to describe the nature of how people in this study used avatars to collaborate in virtual environments. Image attribution Barbara Truman. The crafting nature of participation in virtual environments was expressed by one respondent,

> We started with somewhat different concepts of what we were doing. We discussed things, but also created things, and then modified those things when we understood better. Also, some of the created things gave each of us ideas on how to create better things.

This response related to one of the five disciplines found in Peter Senge's (1990) *The Fifth Discipline*. Team learning is the fourth discipline evident especially when strengths of group members are applied. One example of a collaborative activity reported was the OpenSim Community Conference held in August 2013, the first ever online conference using an open source platform reliant upon the support of the community.

The values of inclusiveness, reason, and democracy were cited to achieve collaborative outcomes. One respondent said:

> In the best scenario discussion and interaction needs to happen at each level, with the group leaders remembering they are also members. This understanding is hard to come by sometimes. But I understand to keep a group viable and democratic it is a must that the leaders listen to the group and attempt to fulfill needs and desires when possible. They also have to be strong enough to answer with a reasonable explanation to those requesting something when the answer is no.

One respondent cited the nature of collaboration through avatar use illustrating a discipline that emerged in the study:

> … practice more patience, humility, and to gain a deeper understanding of my collaborators. If I can learn enough about them to better understand their motivations/goals/fears/concerns, then that often helps me better understand their behavior so I can help direct the group's efforts to address everyone's needs/concerns.

Finally concerning research question one; a respondent summarized a priority of intent aligned with one of the five disciplines described in (Senge, 1990). When asked how understanding occurred during collaborative experience, the answer provided was, “Establishing a shared vision by which to navigate.” Shared vision is Senge’s (1990) third discipline.

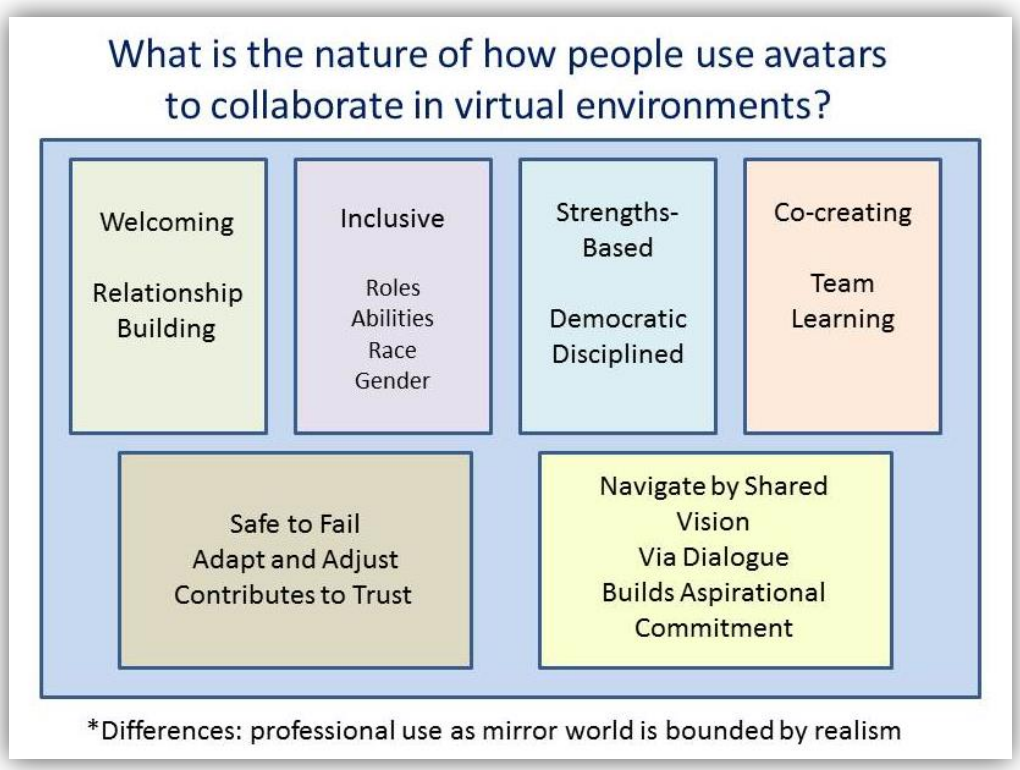

Figure 40. Qualitative Summary of Research Question 1

A difference emerged among respondents who used their avatars for requirements bounded by the need for realism. Mirror world was cited as a necessary requirement where attire suitable to business standards applied. Other professionals in the study used platform affordances to present their identity going beyond realism. Respondents reported their avatars became like a recognizable brand they replicated across platforms when possible, in fact 70% of respondents reused their avatar identity across platforms.

The scope of the study did not ascertain the differences in collaborative dialogue between groups possessing more formal and informal cultures.

Figure 41, *Qualitative Summary of Research Question 2*, illustrates the themes that emerged to describe the nature of how respondents in this study used avatars to engage in dialogue. Image attribution Barbara Truman. The absence of cues was reported to contribute to understanding: “Despite the fact we did not share video or facial expressions - or perhaps because those visual cues did not get in the way. . .we may have listened more carefully to the words.” While not described as an official discipline yet, presencing as described by Senge, Scharmer, Jaworski, & Flowers (2005) requires listening; suspending judgment, becoming open beyond traditional sense making, and letting go of the need to control (p. 13). Another respondent citing the difference in communication cues using avatars, “Maybe because we don't have visual cues in VWs we compensate by increasing our efforts through the tools we do have and those allow for more obvious and accurrate (sic) interpretation than visual cues often do.” Benefit of the doubt became apparent as a theme when trust was cited whether to welcome or promote acceptance. One respondent cited how they achieved understanding, “Having empathy, patience, and being willing to extend trust first (even if the other person didn't trust me yet) helped me come to significant understanding.” Openness to experience, including interacting with others was a theme of study respondents summarized by this individual’s personal development:

> I try to learn from every experience in my life and Second Life really exposed me to an entirely different way of life. I felt as if I was very tolerant of others and that I was not prejudice. However, Second Life taught me to slow down and listen more carefully to what others had to say. I also learned to reflex (sic) on others' thoughts.

The use of programmed gestures was mixed among respondents. Some gestures or animations take over avatar actions and some can be called upon at will, assuming that a user knows how to find and control the gestures. Some respondents programmed their own gestures. Some respondents purchased gestures. Others did not care to use gestures to engage in dialogue and others were too busy to try. Others cited how gestures enabled them to automate some actions required to perform as part of group responsibilities.

The ability to experience pre-programmed (scripted) and spontaneous sensory input enabled some group members to better collaborate through building: "My intention is easily understood by friends because my ideas are visualized in SL [Second Life]. And ideas of friends are also visualized in SL. We don't depended (sic) so much on language, so we can collaborate inter-disciplinary and trans-disciplinary." Others reported struggling with communication challenges. One respondent wished text was used more to provide accessibility for those with hearing impairments. Another respondent said, "Voice is Way better than text. Text is not the best way to communicate."

Humor may be an opportunity and challenge to promote understanding for groups interacting with others internationally. One respondent said, "We cannot have a discussion without puns." A report by Ellis et al. (2008) found surprising results among players regarding when things did not go as planned. They cited game designer, Will Wright's principle to fail funny if failure happens (Walther, 1995, as seen in Ellis etal., 2008, p. 303) Some groups promoted the use of volunteers to transcribe spontaneous comments during meetings to promote inclusiveness. Another respondent cited a means to promote understanding was to ask for feedback often.

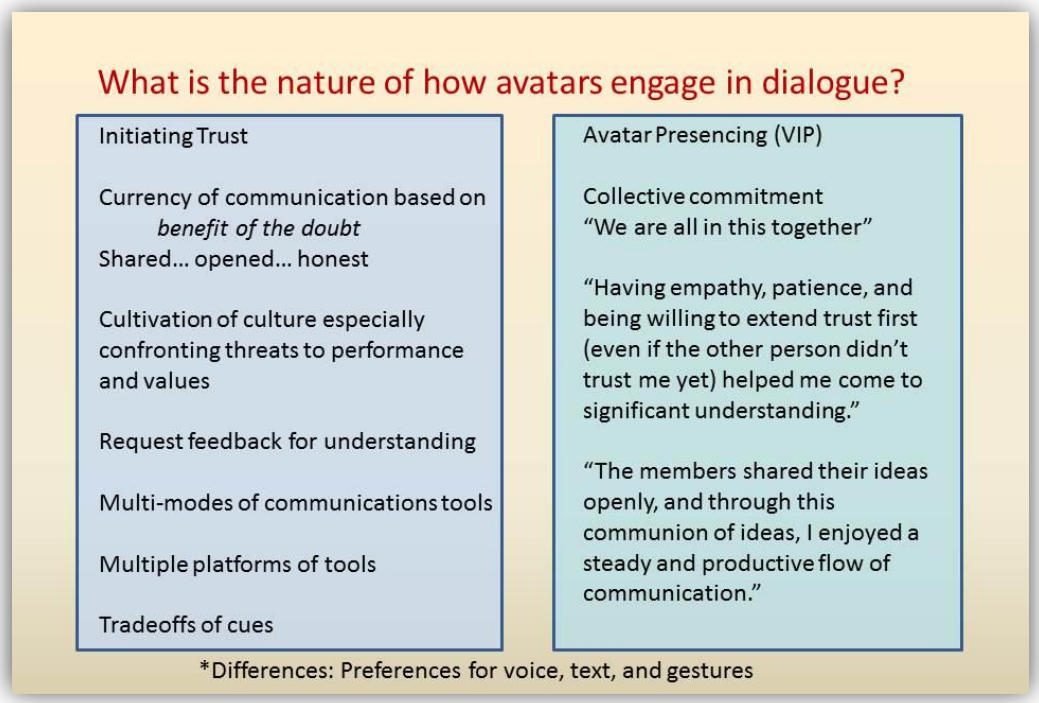

Figure 41. Qualitative Summary of Research Question 2

The three lenses used to explore findings related to respondents' contributions about the nature of reflexive self-awareness in the context of avatar relationship are shown in Figure 42, *Qualitative Summary of Research Question 3*. The first two lenses relate to the nature of using avatars. Ratan (2011) adapted research of neuroscientist Antonio Damasio to explore the virtual self in the context of avatars used though community participation in multiple immersive platforms. Ratan's first level, Proto Self-Presence involved an integration into the body schema representing avatar as an extension. Core Self-Presence created emotional experiences and Extended Self-Presence related to personal identity. Young & Whitty (2011) described progressive embodiment as Supermorphia that involves some degree of body awareness possibly originating and having dominance in either physical or mediated venue (see Chapter Two). The valence of the transformative nature of Supermorphia is considered idiosyncratic to individuals.

One respondent described an empowerment theme by stating, “I can definitely see how an avatar helps one in the physical world. I know that if I can relate to what I write in real life I can also envision my real life as compared to my avatar.” Others appreciated the ability to overcome limitations such as from physical injury. Another respondent cited the ability to generate emotional state through immersion in the virtual environment, “I feel very attached to my avatar. When I am feeling like I need some relaxation, I will sign on and go sit by the waterfall and relax.”

Some respondents did not experience avatar attachment or emotional investment, but they were the minority in this sample. One respondent said their avatar was an alter ego. Avatar as an extension was cited several times. For some respondents beneficial experience came with time, “My avatar changed my perceptions of myself. By using my avatar over many years I could try different behaviors in the virtual world to learn what might work for me in RL [real life] I have adopted some of these behavior changes into my RL.

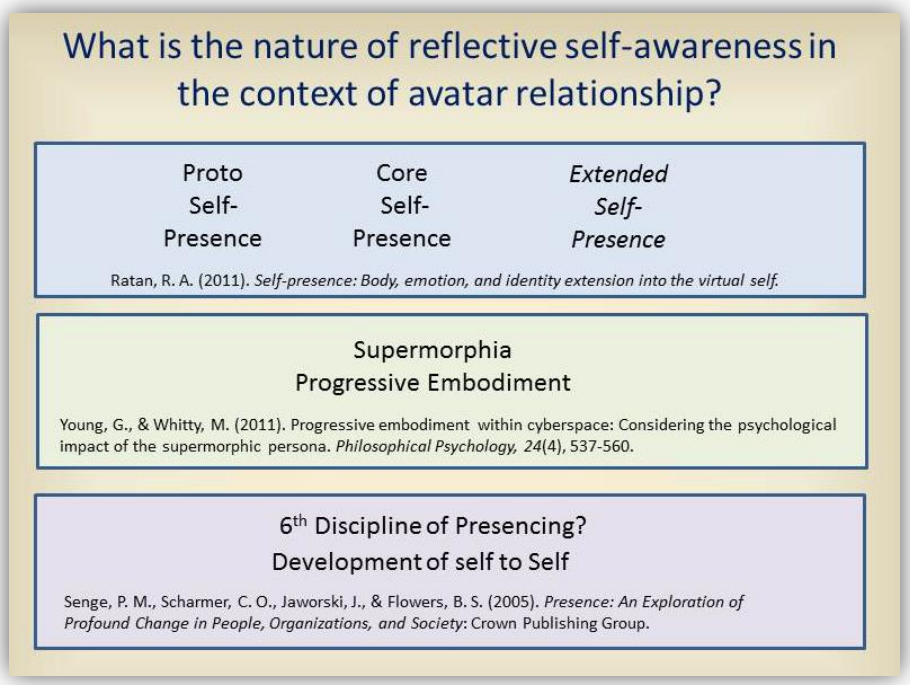

Figure 42. Qualitative Summary of Research Question 3

The third lens addressed the relationship between personal and collective contribution to collaboration. Scharmer (2000) described an intention to develop self to *S*elf to achieve potential inherent within us. It appears that virtual-physioception contributed to the development of avatar and self for most respondents. The question of degree of relationship is not clear. A challenge to determine the degree of relationship exists in the methods of measuring interoception, exteroception, and proprioception meaningfully for each respondent.

Bohm (1996) speculated the proprioception was not restricted to the body and was also affiliated with thinking. He reported that thinking proprioceptively could be spontaneous as a subtle form of self-awareness, possibly the nature of the mind itself (p. 81). Conditioning reflexes that are automatic in thinking is what Bohm asked to suggest

that being aware of thinking's influence aids in developing a greater awareness (p. 83) that allows for deliberate participation in the bodily processes.

A phenomenon was evident practiced by users of avatars in this study intent on self-actualizing. One respondent summarized his or her capability: "Like a chameleon, I like having the ability to evolve, adapt and change quickly, and not solely my avatar's looks, but also, to step outside myself and be more outgoing. I've been able to accomplish far more as my avatar than I did prior to developing an avatar."

Another respondent cited an aspiration to grow, "I try very hard to remain cognizant of multiple views of reality (everyone sees the world and history through their own unique view of reality) and try to see other perspectives by expanding my understanding of them." Other emergent themes were self-monitoring and –awareness. Another respondent cited a spiritual quality reminiscent of the milieu in the environment, "When I know someone in a virtual world it is really more at the soul level than the physical level." The use of an avatar is not mentioned by this respondent, but the milieu and its corresponding interactions has had its impact:

> All my life I have been shy and hesitant to interact with people unless doing so as part of my job. But since becoming involved in virtual worlds, I now have to admit after so many have pointed it out that I am usually now very confident and interactive and comfortable in social environments. I am not sure how interacting in a virtual environment changed this for me - perhaps because it creates a space where interacting with others seems less risky, and the feedback is much quicker and more instructive than what I experience offline when I engage with people.

Guiding Research Question

The guiding research question of the study was summarized:

Do high levels of self-reported *virtual-physioception* correlate to higher levels of self-perceived *virtual intersubjective presencing* in CVEs? Measuring *virtual-physioception* is

a challenge as it is a personal experience requiring meta-awareness for thought, feeling, and action. The construct was deemed critical to explore the phenomenon of how avatars collaborate in virtual environments. For this study one quantitative variable, a rating of avatar inseparability, and its corresponding associated, qualitative question was devised along with an open question about how understanding occurs. Dialogue is exchanged between people, but has a personal activity as well. This degree of mastery of personal agency is considered crucial to effective collaboration.

The second part of the survey on avatar experience was expected to explore the *virtual-physioception* construct by exploring avatar relationship. A relationship existed between the two proposed variables AVIINTE (avatar inseparability) and AVAPRED (predictability perception) was theorized, but a third variable scored higher in association with avatar inseparability, AVICOMM, the variable measuring the degree of agreement with speaking about one's avatar regarding events in life. AVICOMM was reported at 74% in agreement among respondents and 18% disagreed with talking about one's avatar as an extension of life. The distribution was significantly skewed for AVICOMM with a z score of skewness of -3.36, significant at $p < .05$.

Correlation analyses were performed to test for relationship of respondents' perceptions of their inseparability with their avatar (AVIINTE) to their perceptions of how others can predict respondents' behavior and personality traits based on knowing respondents' avatar (AVAPRED). Inseparability was theorized to contribute to virtual-physioception and respondents' perceptions of others' ability to understand were theorized to contribute to virtual intersubjective presencing.

The challenge of answering the guiding research question arose from the lack of respondents qualitative comments referring to a meta-awareness. The confounding inter-relationship between dependent variables, AVI_INTE (Rated relationship of avatar inseparability (Virtual physioception) and AVAPRED (Rating of others' ability to predict physical activities based on knowing avatar, virtual intersubjective presencing) correlated r=.443**, p<.001 and AVI_INTE and AVICOMM (Rating of referral to avatar as extension of self when talking with others) correlated r=591**, p<.001.

AVI_INTE also correlated higher to another variable, MODIFY (Frequency of modifying own work as result of others' input) correlated r=462**, p<.001. AVAPRED correlated with AVI-INTE revealing a relationship suggesting respondents who experienced virtual-physioception had a significant chance of experiencing virtual intersubjective presencing. AVAPRED also correlated with AVICOMM r=.379**, p<.001 and G_SOME (Frequency in using social media to create awareness for the group) r=.296*, p<.05.

Construct Findings

The two proposed constructs were measured by quantitative and qualitative questions. Table 17, *Summary of Constructs and Components*, describes the constructs definitions and the remaining 14 theorized factors associated with components extracted from the principal components analysis. The coding frequencies were obtained by conducting a query in NVivo10 upon the 104 nodes created from open and axial coding analysis.

Table 17 *Summary of Constructs and Components*

Construct	Description	PCA Component	Coding Frequencies
Virtual-physioception	the phenomenological or subjective-awareness of shared self-representation concurrently across virtual and physical spaces arising from meta sensory information from combinatorial interoceptive, proprioceptive, and exteroceptive processing	*Avatar Relationship* *Avatar Empowerment* *Avatar Generativity* *Somatic Awareness* *Avatar Presencing* *Transdisciplinarity*	46 references from open and axial coding
Virtual intersubjective presencing	occurs in a collaborative virtual environment between constellations of identities represented by avatars embodying varying states of human self-consciousness that engage in concerted intention to create the art-of-the-possible	*Group Engagement* *Group Understanding* *Group Collaboration* *Open Listening* *Somatic Awareness*	55 references from open and axial coding

The qualitative analysis using queries enabled viewing concepts from multiple perspectives. Figure 43, *Virtual-Physioception*, represented a word cloud of the analyzed data based on frequency of terms reported in the coded nodes within Nvivo10. The words *group*, *virtual*, and *worlds* were suppressed to reveal underlying concepts. *Virtual-Physioception* had 35 mentions of the term *group*.

Figure 43. Virtual-Physioception

The terms *others*, *try*, *cues*, and *personal* in Figure 43, *Virtual-Physioception*, suggest empathizing to understand other people and avatars. It is not apparent if this sensing applied to the respondent personally. Table 18, *Text Frequencies of Virtual-Physioception Node*, lists the most frequent words that made up the word cloud in Figure 43 representing another view of the same sample of data.

Additional word clouds were created from the most dense nodes analyzed containing references selected from open and axial coding of source material (see APPENDIX G: Qualitative Word Clouds Based on Node Coding). The word cloud, Avatar Presencing had 10 mentions of *group*. Group engagement had 24 mentions of *group*. Group Understanding had 31 mentions of *group*. Leadership had 18 mentions of *group*.

Table 18 *Text Frequencies of Virtual-Physioception Node*

Term	No.	Term	No.	Term	No.	Term	No.
others	21	new	6	help	8	use	5
collaboration	18	see	6	discussion	7	behavior	4
try	14	worlds	6	learned	7	collaborate	4
avatar	12	environments	5	learning	7	cues	4
time	12	interaction	5	members	7	data	4
understanding	12	keep	5	personal	7	easier	4
people	11	listen	5	real	7	everyone	4
able	10	opportunities	5	social	7	facilitate	4
community	10	participate	5	better	6	find	4
felt	10	possible	5	environment	6	human	4
experience	9	productive	5	ideas	6	improve	4
learn	9	tools	5	interactions	6	know	4
understand	9	trust	5				

n=65 No. = number

Considering the small sample size, n=61 and the questions surrounding the ability to reliably measure *virtual-physioception*, the construct is supported theoretically.

Figure 44, *Virtual Intersubjective Presencing*, contained 44 mentions of the term *group*. *Understanding* is related to *collaboration* and is predominant along with dialogue.

Figure 44. Virtual Intersubjective Presencing

Table 19, *Text Frequencies of Virtual Intersubjective Presencing*, contain the most frequent words that made up the word cloud in Figure 44.

Table 19 *Text Frequencies of Virtual Intersubjective Presencing*

Term	No.	Term	No.	Term	No.	Term	No.
collaboration	20	collaborative	8	feel	5	help	6
understanding	18	discussion	8	happens	5	learning	6
others	14	felt	8	improve	5	needs	6
members	13	human	8	interaction	5	personal	6
ideas	12	interactions	8	learned	5	team	6
able	11	level	8	meetings	5	understand	6
people	11	productive	8	performance	5	vision	6
time	11	build	7	possible	5	areas	5
community	10	experience	7	successful	5	best	5
dialogue	9	share	7	trust	5	Conflict	5
environment	9	shared	7	use	5	Daily	5
process	9	everyone	6	work	5	Different	5

n=61 No. = number

The construct of *virtual intersubjective presencing* was supported among respondents within this study. The quantitative measure of how others can predict

respondents' behavior and personality traits based on knowing respondents' avatar (AVAPRED) combined with the frequencies and qualitative comments provided support in this study for the construct.

Emergent Themes

Analysis of the quantitative responses provided confirmatory information that reinforced the qualitative analysis after open and axial coding was completed. The following 18 themes emerged from the qualitative comments discussed in Chapter Five:

- Self-monitoring, awareness
- Embodiment
- Self-actualization
- Aspiration, art-of-the-possible, avatar projection
- Initiate dialogue, trust first
- Avatar reflection for understanding (Presencing discipline, *somatic experience*)
- Benefit of the Doubt, openness
- Empowerment, overcoming limitations
- Acceptance
- Respect, dignity, *honor*
- Communication, feedback, multi-modes, multiple tools, cue tradeoffs
- Cultivate culture, confront conflict
- Building relationships, trust
- Inclusivity, involvement
- Democratic, shared vision
- Co-creating, safe to fail, *techne*
- Strengths-based
- Commitment, personal and collective

Independent T Tests

A series of independent t-tests and Mann-Whitney U tests were used to explore the relationship between the differences of roles in the group and all variables in the survey. Figure 45, *Comparisons of Group Roles*, illustrates the number of differences

between roles obtained from comparing significant differences. Wilcoxin sum ranks were compared for the nonparametric data. Image attribution Barbara Truman.

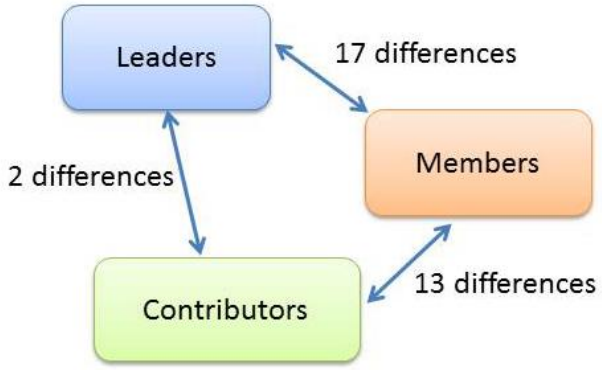

Figure 45. Comparisons of Group Roles

Leadership was theorized to be a factor in the study. The question to what degree leadership was a formal role was explored to seek role and frequency of activities associated with group mission. Respondents had the option on the survey to self-identify as leader, spokesperson, advisor, contributor, and member. Only one respondent self-identified as spokesperson and two reported advisor. On average, leaders (N=32) reported greater frequencies than members (N=13) in the following:

Engage in Networking- The mean rank for leaders was significantly higher than members, p=.000 exact, 1 tailed and p =.001, 2 tailed.

Talking about avatar in life events- The mean rank for leaders was significantly higher than for members, p=.023 exact, 1 tailed and p =.044 exact, 2 tailed.

Use social media- The mean rank for leaders was significantly higher than members, p =.003 exact, 2 tailed.

Provide vision- The mean rank for leaders was significantly higher than for members, p =.000 exact, 2 tailed.

Regulation of feelings- The mean rank for leaders was significantly higher than for members, p =.026 exact, 1 tailed.

Openness of heart and mind- The mean rank for leaders was significantly higher than for members, p =.001 exact, 1 tailed and p =.003 exact, 2 tailed.

Attending meetings outside of field- The mean rank for leaders was significantly higher than for members, p =.024 exact, 1 tailed and p =.046 exact, 2 tailed.

Obtaining insights from others- The mean rank for leaders was significantly higher than for members, p =.046 exact, 1 tailed.

Assist new members- (M=4.8, SE=.22) than members (M=2.2, SE=.34).

Significant difference t(43) = 6.5, $p < .05$, r =85.

Create group resources- (M=4.3, SE=.25) than members (M=2.8, SE=.48).

Significant difference t(43) = 2.9, $p < .05$, r =51.

Conduct events- (M=4.0, SE=.23) than members (M=2.2, SE=.44).

Significant difference t(43) = 4.0, $p < .05$, r =59.

Cultivate group identification- (M=4.3, SE=.28) than members (M=2.6, SE=.46).

Significant difference t(43) = 3.3, $p < .05$, r =54.

Evangelize group activities- (M=4.2, SE=.23) than members (M=2.2, SE=.40).

Significant difference t(43) = 4.7, $p < .05$, r =65.

Avatar inseparability- (M=4.0, SE = .22) than members (M= 2.7, SE= .35).

Significant difference t(43) = 3.2, $p < .05$, r =53.

Overcome educational limitations- (M=3.2, SE=.19) than members (M= 2.4, SE=.33)

Significant difference t(43) = 2.3, $p < .05$, r =48.

Overcome gender limitations- (M=3.1, SE=.19) than members (M= 2.3, SE=.31)

Significant difference t(43) = 2.3, $p < .05$, r =48.

Create linkages for collaboration- (M=3.8, SE=.15) than members (M= 3.2, SE=.30) Significant difference t(43) = 2.0, $p < .05$, r =47.

The differences between leaders and members were not unexpected based on role differences. Activities reported between contributors and members also had 13 differences indicating that actions rather than role provided leadership in support of group mission. The 13 differences were:

Engage in Networking- The mean rank for contributors was significantly higher than for members, p =.004 exact, 1 tailed and p =.009 exact, 2 tailed.

Talking about avatar in life events- The mean rank for contributors was significantly higher than for members, p =.026 exact, 1 tailed.

Use social media- The mean rank for contributors was significantly higher than for members, p =.013 exact, 1 tailed, and p =.025 exact, 2 tailed.

Provide vision- The mean rank for contributors was significantly higher than for members, p =.006 exact, 1 tailed and p =.013 exact, 2 tailed.

Predictability of physical actions based on knowing avatar- The mean rank for contributors was significantly higher than for members, p =.019 exact, 1 tailed and p =.038 exact, 2 tailed.

Attending meetings outside of field- The mean rank for contributors was significantly higher than for members, p =.013 exact, 1 tailed and p =.026 exact, 2 tailed.

Champion cause for resources- for contributors (M=3.5, SE=.51) than members (M=2.1, SE=.43) Significant difference t(43) = -2.2, $p < .05$, r =34.

Assist new members- for contributors (M=3.9, SE=.43) than members (M=2.2, SE=.34). Significant difference t(43) = -3.2, $p < .05$, r =30.

Cultivate group identification- for contributors (M=4.5, SE=.49) than members (M=2.6, SE=.46). Significant difference t(43) = -2.9, $p < .05$, r =31.

Evangelize group activities- for contributors (M=4.1, SE=.47) than members (M=2.2, SE=.39). Significant difference t(43) = -3.1, $p < .05$, r =31.

Avatar inseparability- for contributors (M=4.0, SE = .30) than members (M= 2.7, SE= .35). Significant difference t(43) = -2.9, $p < .05$, r =31.

Modify perspective based on others input for contributors (M=4.0, SE=.25) than members (M= 3.1, SE=.33) Significant difference t(43) = -2.2, $p < .05$, r =34.

Create linkages for collaboration for contributors (M=4.1, SE=.24) than members (M= 3.2, SE=.30) Significant difference t(43) = -2.2, $p < .05$, r =34.

Only two differences were found by directly comparing responses from leaders and contributors. The differences surrounded holding events and providing vision.

Provide vision- The mean rank for leaders was significantly higher than for contributors, p =.032 exact, 1 tailed.

Conduct events- for leaders (M=4.0, SE=.23) than contributors (M=2.8, SE=.42). Significant difference t(43) = 2.5, $p < .05$, r =49.

Gender was also examined across all variables and demographics using independent t-tests and Mann-Whitney U tests. On average, females reported higher ratings on the following ten questions:

Attending meetings outside of field- The mean rank for women was significantly higher than for men, p =.004 exact, 1 tailed and p =.008 exact, 2 tailed.

Openness of heart and mind- The mean rank for women was significantly higher than for men, p =.004 exact, 1 tailed and p =.003 exact, 2 tailed.

Predictability of physical actions based on knowing avatar- The mean rank for women was significantly higher than for men, p =.007 exact, 1 tailed and p =.007 exact, 2 tailed.

Overcome communication limitations through avatar use- The mean rank for women was significantly higher than for men, p =.019 exact, 1 tailed and p =.038 exact, 2 tailed.

Talking about avatar in life events- The mean rank for women was significantly higher than for men, p =.026 exact, 1 tailed.

Engage in Networking- The mean rank for women was significantly higher than for men, p =.000 exact, 1 tailed and p =.001, 2 tailed.

Use social media- The mean rank for women was significantly higher than for men, p =.004 exact, 2 tailed and p =.007 exact, 2 tailed.

Recruitment of new members- for women (M=4.46, SE=.28) than men (M=3.52, SE=.31). Significant difference t(58) = 2.3, $p < .05$, r =63.

Creation of resources for women (M=4.24, SE=.25) than men (M=3.33, SE=.32). Significant difference t(58) = 2.3, $p < .05$, r =63.

Overcome interpersonal limitations for women (M=3.33, SE=.21) than men (M=2.60, SE=.25). Significant difference t(58) = 2.31, $p > .05$, r =63.

Table 11, *Demographic Correlations of Avatar and Respondent*, found in the correlations section in this chapter, report the associations between some activities performed as an avatar within group role and with individual demographics. Social media

use in association with the avatar identity is also reported. As expected, more time with avatar is associated with time in group.

Hypotheses Findings

Respondents were expected to report no experience of *virtual-physioception* while using collaborative virtual environments. Based on the means to measure *virtual-physioception* and the frequency of qualitative coding of text terms and nodes combined with the quantitative frequencies of variable AVIINTE, the null hypothesis is rejected.

Respondents were expected to report no experience of *virtual intersubjective presencing* in collaborative virtual environments. Based on the frequency of qualitative coding of text terms and node combined with the quantitative frequencies of variable AVAPRED indicating experience of virtual-intersubjective presencing, the null hypothesis is rejected.

Summary

This chapter summarized findings from Phases I and II of the study surrounding administration of an online survey. Quantitative descriptive statistics were used in conjunction with qualitative analysis methods to answer three exploratory questions. Two constructs were described and two hypotheses were tested. Correlations and t-Tests were reported across reported group membership. Chapter Five contains interpretation and implications for further study.

CHAPTER FIVE: DISCUSSION AND CONCLUSIONS

This study explored the relationship of how embodied avatars engage in dialogue to collaborate in virtual environments among established groups fostering virtual community. This chapter includes sections describing interpretation, limitations, significance, future directions for study and reflections on research.

Summary of Key Findings

This study offered a glimpse into the collaborative nature of online groups that operate frequently, even daily in CVEs to achieve group aims. The groups represented a diverse, albeit small sample of activists, entrepreneurs, educators, and researchers. The study did not seek detailed information about the nature of the groups to learn about group size, composition, evolution, or aspirations. A case study approach on one active group could provide rich insights. The findings from the study illustrate a spectrum of activity serving multiple domains in society.

The study sought to capture responses from busy people who may spend a great deal of time on computers, especially if their professional jobs involve knowledge work. A total of 84 participants initiated the online survey administered during a five week period from October-November 2013. All participants were able to provide a group name for which they were affiliated and 61 respondents completed the entire three-part survey taking on average between 30 minutes to an hour to complete. Respondents came from seven countries. The United States accounted for 87%. 44 distinct groups were represented of which, females made up 54% with males 44%. Respondents were

predominantly Caucasian (77%). For more details about the demographics breakdown see Chapter Four Profile of Study Participants.

The study managed to attract diverse individuals. All age groups were represented between ages 20 and 70+ with the largest segment representing 50-60 year olds (30%). One respondent noted that age was not asked as a means to overcome interactions similarly to how gender, race, and socio-economic status were. A comment was made how the virtual environment enables groupings of various ages more readily than in physical environments. The theme of acceptance was reported frequently in comments and suggests the precursor to understanding apparent in word clouds found in APPENDIX G: Qualitative Word Clouds Based on Node Coding.

All professional domains were represented from industry, education, government, and military with the largest segment representing university level work (32%). Educational attainment was very high among respondents with the largest segment reporting a doctorate level degree (33%). Qualitative answers reflected the theme of possessing strong communication skills. Leaders made up the largest group role reported (53%) and 70% of respondents reported reusing their avatar identity across grids and platforms. 30% of respondents used their avatar identity with social media such as a blog or Twitter account. A few respondents listed their occupation in one area and they had another primary group attachment such as industry and education. Figure 46, *Group Types Represented in Study*, illustrates the type of groups comprising the 44 groups reported by all survey respondents. Image attribution Barbara Truman. The professional association groups are those using CVEs for conducting business and professional development, not those whose members only engage in CVE use. The Education groups

included universities and groups holding regular meetings. Science education groups are also associated with education. Events include annual conferences such as the Virtual Worlds Best Practices in Education Conference and the OpenSim Community Conference. It does not appear any for-profit businesses were represented in the study, although some individuals listed their professions as contractors and consultants. The non-profits include groups such as Virtual Ability that advocates for accessibility and more therapeutic uses of virtual reality applications. Artistic, musical, and entertainment groups are associated under social.

Figure 46. Group Types Represented in Study

The study was not about platform. Rather, the use of tools were of most interest to see what was important. Second Life, as a platform, was used the most (67%) with OpenSim (25%). The practice to use multiple grids was not directly asked, but it was clear in comments that the communities are bleeding over into other grids when desired or needed. World of Warcraft had representation (8%) and comments added for “other” included social media and open source tools such as open Wonderland. Some

respondents addressed the need for inclusivity to offer meetings notes and learning materials in formats allowing for asynchronous, offline viewing.

The notion to create a survey section for avatar or character arose from Dr. Michael McCreery's (2011) research on the contribution of personality regarding virtual self among World of Warcraft users. Dr. Steven Warburton of King's College in London described a pathway on his blog showing the points of emotional investment involved in the development of relationship with an avatar. Warburton identified a change where an alternative identity may be required to manage in-world complexities (2008).

Concerning avatar demographics, all age ranges of the avatar were represented from < 1 year to 10+ years. The largest segment was 5-6 years (30%). Respondents varied in terms of whether they were able to engage in virtual environments as part of their professional occupation. All time ranges between <1 hour per week to >25 hours per week were reported concerning time spent with respondents' avatars. The largest section reporting as 1-5 hours (25%). Respondents were not asked how long they were engaged in the virtual environment before they became associated and invested in a group. The length of time reported with the invested group in the CVE ranged from < 1 year to 7-8 years. The largest segment was 3-4 years (28%).

Attachment-Engagement Spectrum

Group attachment was evident as respondents reported more than one primary group when asked to list only one (18%). The average number of groups reported by respondents was 2.6. Some respondents also listed two different groups among their primary associated group and the group for which they listed as being emotionally invested (13%). The qualitative comments revealed a spectrum of attachment between

avatar-group, group-community, avatar-group-milieu, virtual community-community (blended activities) and meta-virtual community-society for the greater good. Motivation was a framework in the study as a foundational assumption. It is not clear what drivers promoted the use of CVEs among voluntary members among study respondents. Figure 47, *Attachment-Engagement Spectrum*, illustrates the spectrum of activities respondents reported engaging in using CVEs. Image attribution Barbara Truman. For some individuals, time affords greater attachment to groups and to purposeful activities helping them overcome technological barriers.

The commitment and motivation levels of avatar users span personal and professional reasons for use. In some cases, the virtual community spans a grid, such as Second Life users or residents. The virtual milieu spans grids to involve any or all immersive, avatar-based worlds where communities operate. Perhaps for some respondents, this virtual milieu is reminiscent with a poetic Thoreauvian ideal. Ryan (2011) stated, "For Thoreau, wilderness is a disposition…" and adds, "Using first-person somatic sensuality, Thoreau describes place as electric.." (p. 45). The milieu of virtual environments for some appear to be beyond the notion of third places (Steinkuehler & Williams, 2006, p. 885) and may indicate an empowered desire to act as an agent of positive change.

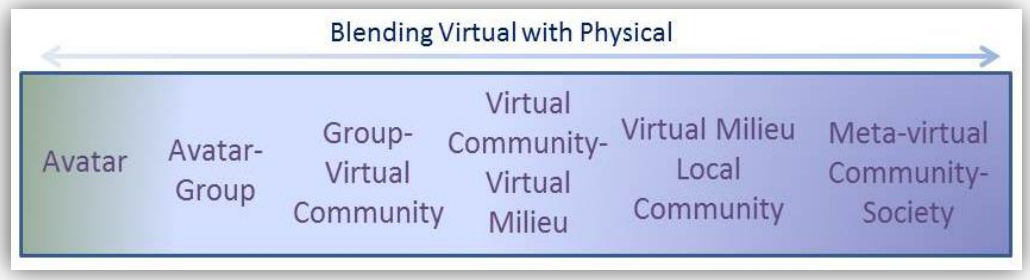

Figure 47. Attachment-Engagement Spectrum

A homebound individual providing care for a loved one said, “Second Life frees me to explore and enjoy people in a very safe and inexpensive environment.” Another respondent cited recovering from illness saying, “During the period of my illness, my avatar behaved with my virtual friends in the same way I behaved with my RL friends. Friends are friends in SL [Second Life] or IRL [in real life], and I needed all the help and support I could get - they were VERY supportive.” One respondent indicated CVEs pose new pathways to connect virtual and physical communities for the greater good of society. The study also involved a small number of respondents indicating they used Second Life, but that a World of Warcraft guild was their primary group. It is unclear based on limitations of the study what game mechanics and powers associated with characters contribute to attachment. Community engagement was a hallmark of one of the World of Warcraft guilds represented in the study involving educators from K-20. The guild strives to enable its members to attain the highest capabilities across races and characters. Family involvement is also permitted. A World of Warcraft insignia made by a guild member’s child was shown at sharing stations during the 2013 national conference for the International Society for Technology in Education (ISTE) in San

Antonio, Texas. Cross generational involvement in CVEs is expected to increase as virtual environments mature and authoring games becomes readily accessible.

Exploratory Findings

Respondents in this study used avatars to collaborate in virtual environments as a generative, social activity where they could experience personal and professional growth. The majority of respondents reported their groups used the strengths of members. Their avatars enabled social networking across groups and grids within the greater virtual world community. The building relationships theme, cited 13 times in source material, increased trust within and across groups. A special issue of the Journal of the Association for Information Systems (2012) cited the findings of Li, Lee, and Lai (2009) who found people desired to connect and trust others outweigh fascination with the technology (as seen in Boughzala, de Vreede & Limayem, 2012, p. 720). Can using an avatar to engage in dialogue within a collaborative virtual environment deliver a small dose of oxytocin that increases social attachment similar to results obtained from a Swiss study? (Kosfeld, Heinrichs, Zak, Fischbacher & Fehr, 2005, p. 673).

Respondents conveyed an aspirational desire to achieve not because they could not do things face to face in the physical world as much as they could do much more in the virtual environment. The majority of respondents embraced multiple tools to bridge social media tools and platforms to connect and collaborate with others. The frequency of engagement suggested an emergent lifestyle spanning personal and professional domains. Some groups orchestrated conferences lasting multiple days across time zones. Such events are expected to increase as expertise coalesces. New forms of virtual communities have taken root and are expanding into the domain of a whole life paradigm. This study

sampled a small fraction of the activity underway in virtual environments. One respondent expressed concern for the unhealthiness of feeling attached to an avatar to the point of inseparability suggesting that a social media addiction may be present. This separate and unattached sentiment was the exception in this study.

The root term ‘collaborate’ and its variations appeared 116 times in the qualitative comments. Some respondents appeared to bridge their physical and virtual activities beyond common practice perhaps in search of harmony between personal and professional aspirations to unite organizations and causes. The study did not attempt to address the learning affordances of the medium of collaborative virtual environments; however, respondents voluntarily expressed how CVES contributed to their personal learning network (PLN). One respondent described their professional engagement, “Learning to use and understand new virtual tech, ongoing personal reflection about how I communicate and share learning in all online environments, attending workshops and presentations in various worlds, reading blogs and social media to keep up with other innovators.”

Some respondents appeared to bridge their physical and virtual identities through inseparability with their avatar. The study did not ask whether respondents felt inseparable from their groups, but it is likely for some respondents the absence of their CVE community resulted in the diaspora phenomenon described in Pearce (2009). One comment summarized the camaraderie a respondent experienced:

> People in the group seemed to be more willing to help and listen to each other. I felt a bit like one of the knights of the round table. . .with each of us able to be heard and to contribute to our team's success.

Respondents reported using dialogue to collaborate in a myriad of ways using embodied avatars. Some preferred the platform affordances of private messaging and others built elaborate gestures and animations to express feelings and behavior across contexts. Expression of communication through avatar customization and appearance was indistinguishable as a function of personality and personal preference or pragmatism. McCreery (2011) conducted recent research on personality using avatars, but there is much more research needed to sort the differences among constructing identities. Empowerment dynamics found in massively online games contribute to identity in ways that are both similar and different from constructive virtual environments where possibilities are greater for expression. One social group represented in the survey had a charter for its variety of members referring to respect similar to that necessary among families.

Emerging technologies did not come up in responses in this study. No mention was made from respondents of tools such as Google Glass, X-box Kinect for gesture-based computing, or the Oculus Rift immersive head display. The dynamics of immersive engagement offer multiple paths for future study. Bolt-on, cyborg-like capabilities will become more common affecting indent formation and group collaboration. The intersection of devices and identity development in a more transparent overlay of immersive reality will impact society rapidly. The straddling of place across devices combined with a constellation of identities may exceed Biocca's three places that add to the sense of presence described as physical, virtual, and imaginal environment (as seen in Mennecke, Triplett, Hassall & Conde, 2010, p. 4). Artificial intelligent cyborgs as described by Blascovich (2002, p. 26) contrast with humans displaying

wearable computing devices that may or may not project or transmit to or from a virtual environment.

The theme of avatar as a means of reflection was illustrated in the prevalence of the term understanding appearing in the qualitative source material 64 times. Dialogue emerged in the study as an aspirational *shiftability* in identity and perspective to better understand. Respondents cited seeking out opportunities to open themselves to people and ideas similar to Yee and Bailenson (2009) increased overlap between *self* and *other* when people experience perspectives of others through avatar use (p. 2). The respondents were collegial as the theme respect appeared multiple times in terms of appreciating diverse viewpoints and conveying respect to everyone. Dialogue is often portrayed as when to speak and how to speak in structured, choreographed forms. The dialogue that emerged among study participants was more spontaneous, yet orchestrated despite the flaws and limitations of the medium. Attachment to the milieu may be an attractor for promoting understanding for some individuals whose associates do not readily relate to experiences afforded by the immersive medium. When asked about whether respondents agreed with how they speak of their avatars' actions as a part of their life, one person said, "I don't end up talking a lot about virtual activities to people I usually associate with because they do not seem to understand."

Reflect also was cited by respondents as an indicator of reflexive self-awareness. One respondent said when asked about agreement to bequeath their avatar for future generations, "I would love for future generations to learn about me through my avatar which reflects my inner self in many ways." Chapter Four described two lenses to interpret the nature of avatar reflexive self-awareness based on the research of Ratan

(2011) and Young and Whitty (2011). The third lense illustrated in Figure 48, *Presencing Institute's Theory U*, corresponds to a process of opening of mind, heart, and will leading to a shift in perspective aiding understanding. The research of the Presencing Institute does not appear to have been applied to collaborative virtual environments yet. Image attribution Creative Commons License 3.0 Presencing Institute http://www.presencing.com

Respondents in this study described a *shiftability* that has an impact on them, but is unclear where the source originates for each individual. The term experience appeared 53 times in the qualitative comments. Shifting perspective to understand was one expression of experience. Another expression involved developing or generating empathy. Time spent developing respondents' avatars had a bearing on development of self-awareness and reflexive relationship. One person described their experience,

> In the beginning I had basic help with the basics of customizing my avatar. Over time and from time to time, I had more 'expert' guidance. I watched my avatar closely. I experience lag as clumsiness, loss of hair as a 'chemo effect.' In general in the early days, developing my avatar gave me ideas about teaching people about the experiences of people who had had strokes. Over still more time, I learned about my sense of style and my body image changed. I lost considerable weight ....

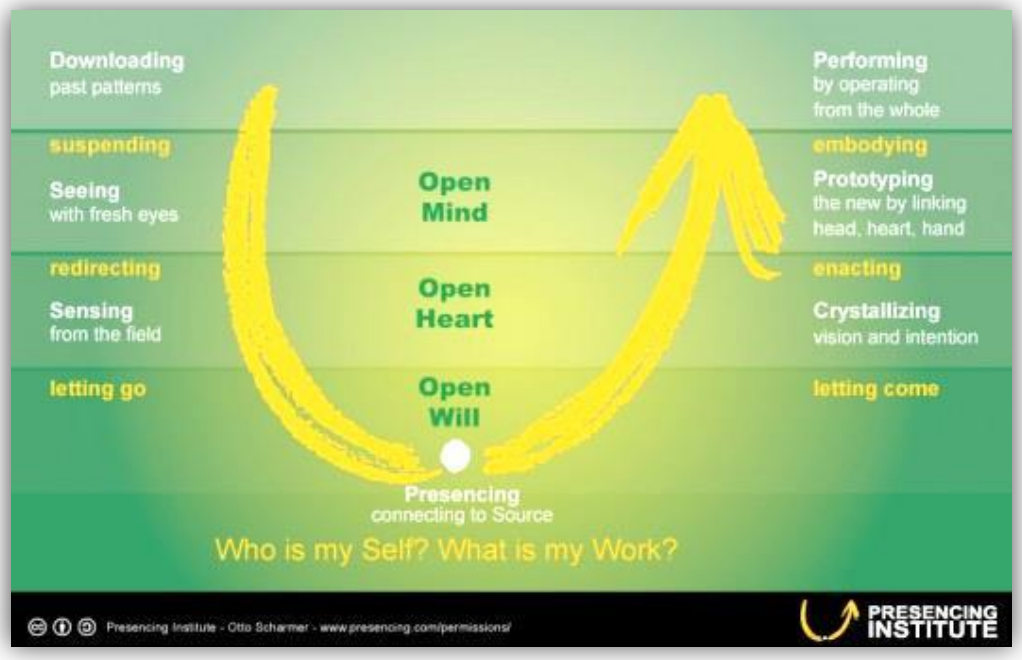

Figure 48. Presencing Institute's Theory U

The relationship of embodiment of avatar and its corresponding impact on change in the physical world is actively researched by Jeremey Bailenson whose Transformed Social Interaction (TSI) framework was one of the influences in this study. To date, much of TSI research is bound by the research laboratory to produce controls for study. As commercial products emerge for personal use in the home, more research may be feasible to explore the relationship between avatar and self. Ratan (2011) focused one study within his dissertation on use of commercially available products that collected bio-sensory data associated with use of virtual environments. Regarding prototyping, Senge et al. (2005) said, "In its essence, prototyping accesses and aligns the wisdom of our head, heart, and hands by forcing us to act before we have figured everything out and

created a plan" (p. 147). Improvements to measure personal somatic awareness may help create new possibilities for collaborative prototyping.

Constructs

As mentioned in the discussion of avatar self-reflexive relationship, an emphasis of empathy may also exist as a form of awareness that some individuals possess and can cultivate. The ability for survey questions to measure interoceptive, exteroception, and awareness of proprioception regarding avatar use was attempted using several quantitative and qualitative variables. The nature of the relationship between the primary variable measuring *virtual-physioception* warrants investigation using improved research methods. Based on the significant relationship between *virtual-physioception, virtual intersubjective presencing* and associated qualitative comments, the constructs are supported theoretically. Both constructs were significantly correlated to how respondents spoke about their avatars in their daily lives. Both constructs were supported theoretically, although virtual intersubjective presencing received stronger support through 44 coded references within the qualitative comments.

Both constructs have been influenced by an implied discipline of presencing that follows the original five disciplines found in The Fifth Discipline (Senge, 1990). The influence of body schema and embodiment require further investigation of these proposed constructs in terms of mental models that can be modeled in a virtual environment. Mennecke, Triplett, Hassall & Conde (2010) suggested in addition to the mental model of three bodies that make meaning in a virtual environment, objective physical body, virtual body, and body schema, a fourth body represents what others understood through interaction (p. 4). Concerted inquiry with this fourth body

representation is consistent with the initiation of the construct *virtual intersubjective presencing*. The interplay of the two constructs imply a need for the fifth discipline outlined by Senge (1990) systems thinking, also cited by Falk-Krzesinski et al. (2011) as most appropriate to address inquiry in involving a span of multiple problems and disciplines (p. 10).

The connected dualism of the two constructs are portrayed in a discussion of social embodiment proposed by Barsalou et al. (as seen in Ziemke, 2003) summarized as four embodiment effects:

> First, perceived social stimuli don't just produce cognitive states, they produce bodily states as well. Second, perceiving bodily states in others produces bodily mimicry in the self. Third, bodily states in the self produce affective states. Fourth, the compatibility of bodily states and cognitive states modulates performance effectiveness (p. 5).

Empowerment and Trans-generative Themes

The positive responses among group members within the study made 17 of 44 quantitative questions negatively skewed requiring transformation for analysis. Respondents reported appreciating diverse disciplinary topics and viewpoints. On average, respondents agreed they understood others (93%) and are understood by others (90%). Respondents also agree that they are aware of their emotions (87%), regulate their feelings (87%), and agree that they have an open mind, heart, and will (87%). A Finnish study published from the US National Academy of Sciences (2013) found that emotional states were culturally universal based upon results of topographical body maps (Nummenmaa, Glerean, Hari & Hietanen 2013, p. 1).

Among the four components extracted from the principal components analysis, the EMPOWER cluster of questions reflected a paradox. Some respondents cited how

their embodied avatar experience in the CVE had helped them overcome shyness and interpersonal communication limitations. Other respondents made it clear that they held an egalitarian stance regarding social status in or outside of the virtual environment. The study did not ascertain the economic status of respondents, but some comments were made to suggest that economic status was not important regardless. Some respondents mentioned enjoying their social, economic and professional status. More than one published author contributed to the study.

The EMPOWER component had the largest Eigenvalue of 11.74 and was positively correlated to the other components, especially to the TRANS component ($r=.385$, $p<.05$). The TRANS component was made up of 11 questions (variables) including six professional interdisciplinary practices adapted from the National Cancer Institute's Team Science Toolkit that were combined with one somatic awareness question, one relationship question, and two generativity questions. Of the 11 questions that made up the TRANS component, four were specifically related to use of an embodied avatar.

Groups represented in the study were high performing. Respondents reported their groups are doing better than average in communicating (82%) as well as creating an impact (82%). The use of strengths within groups was rated better than average (75%). Concerning resolving conflict there was room for improvement despite the high performing nature of groups. Respondents were split. Almost half reported their groups' conflict resolution was average (45%), just over half reported their conflict resolution was above average (54 %). See Chapter Four, Frequency Distributions section for more detail regarding group activities.

Prior Study Barriers Discussed

A qualitative analysis without reporting what did not appear among respondents comments would be remiss. Word queries were run for terms and responses were reviewed once more in Nvivo. The goal was to see if themes appearing in other literature about the downsides of CVE and avatar use were mentioned among respondents. For example, the need for realism in communication has been cited in some studies as a requirement for collaboration. The term realism did not appear in qualitative comments. Fidelity in physical proximity was cited in the study as a mirror world for training requirements using CVEs.

Addiction to mediated technologies have been cited by some studies as a barrier to performance. Managing attention was discussed as part of somatic awareness. One concern was reported as the possibility of a social media addiction when feelings of inseparability from one's avatar exist. Escapism had been cited as a primary means to use CVEs and MMOGs in previous literature. Escapism did not appear among respondents' comments, although relaxation was mentioned in terms of informality of meeting and for obtaining physical benefit.

Social loafing was cited in a previous study as a barrier to team performance, but no mention was made within comments in this study referring to group members willingly not contributing. One reference to multitasking was made suggesting that members exercise the ability to portion attention to other matters behind their avatar. One respondent said they wished to learn to better multitask to keep pace with group activities.

Another previous study discussed the importance to match the technology with the need of the task involved with the collaboration. Respondents in this study were adept

at using collaboration technologies. A greater sense emerged that the needs of the community surpassed the needs of the task i.e. if a member needed assistance using a technology in order to better collaborate, assisting the member surpassed the need of the task(s) required. Some of the respondents' comments mentioned an arsenal of collaboration technologies used in combination to match talent and tasks, simultaneously and adaptively.

Another previous study mentioned issues with griefing where avatars or characters appear and create trouble for others and the environment. Griefing is a form of hacking. No respondents in this study reported any challenges associated with griefing. One respondent specifically mentioned the difference between two groups that led to a greater understanding rather than discrimination. Another previous study cited the concerns for collaboration effectiveness from creative avatar expressions. No respondents cited concerns for being distracted, but one respondent said they did not want to put anyone off or scare anyone away.

Art-of-the-Possible

The literature review in Chapter Two and the nomenclature section preceding it emphasized how some organizations embraced transdisciplinarity to solve wicked problems. The research design of this study employed the framework of Appreciative Inquiry to seek evidence of aspirational endeavors among group members who use virtual worlds to collaborate. Figure 49, *Word Diagram Query of 'Possible'*, depicts search results using Nvivo10 on the source materials from qualitative survey answers using the term possible and its roots. Responses show a variety of notions. Transdisciplinarity is

distinguished from interdisciplinarity as a means to not only go across, but to go beyond disciplines into new possibilities of knowledge and inquiry.

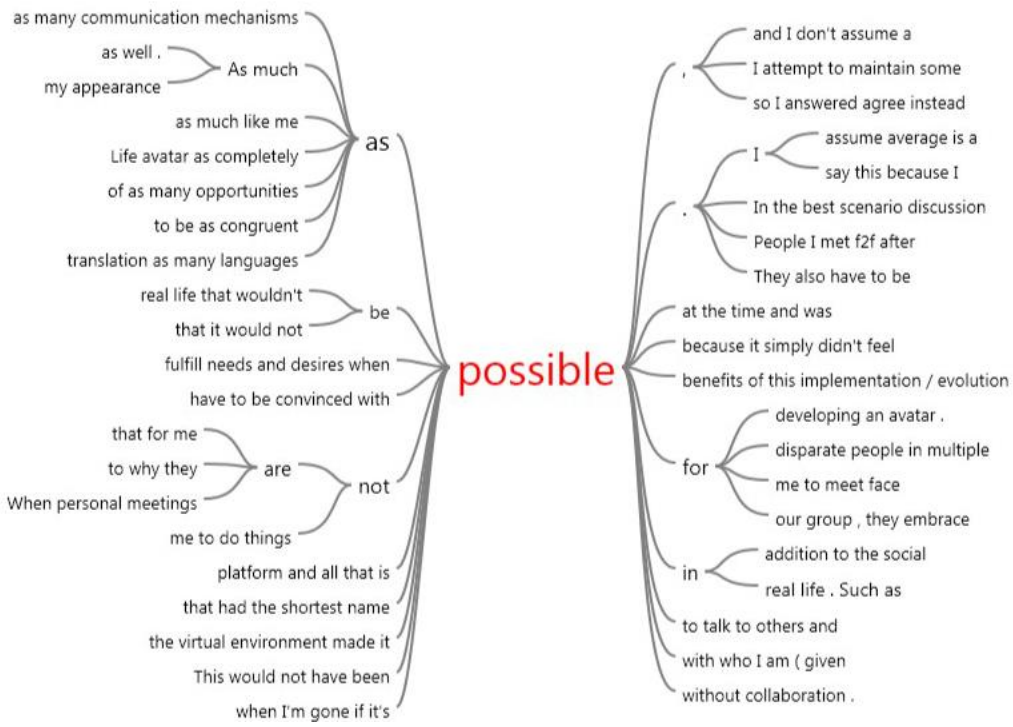

Figure 49. Word Diagram Query of ‘Possible’

The primary quantitative, dependent variable, AVI_INTE, was highly correlated with the question that asked if one’s avatar was referred as an extension of oneself during conversations with others about life events, AVI_COMM ($r=.591^{**}$, $p<.001$). Respondents also agreed they talk about their avatar in conversations (75%). A theme emerged from the qualitative comments involving the notion of art-of-the-possible was going beyond avatar extension to projection. This projection of identity suggests that rather than a hologram-type extension of identity, for some respondents they are going beyond interpolation and way beyond extrapolation of identities. Young and Whitty (2011) describe Supermorphia in similar terms of ideal development of self while relating to authenticity. How CVEs and group collaboration orchestrate conditions for increasing

the likelihood of projecting identity may align with how Senge et. al (2005) described Jungian synchronicity experiences that occur when people connect to their deeper source of intention (p. 159). One respondent described their use of embodied avatars and CVE as part of their toolkit, “I was born a naturalist-scientist and have never deviated from that path” although they cautioned, collaboration was contingent upon shared goals for sustainability.

Self Actualization: Towards Virtual Embodiment of Transdisciplinarity

Maslow (1943) originated a theory of motivation that has experienced differences in interpretation. Motivation was one of the four domains of inquiry required in the study as respondents were expected and did demonstrate motivation to volunteer time and talents within their collaborative groups. Respondents varied in the degree of elaboration of self-exploration, discovery, and cultivation (actualization) such as illustrated in Figure 49, *Maslow’s Heirarchy of Needs towards Transdisciplinarity*. The image on the left in Figure 50 is the widely cited Maslow’s Hierarchy of Needs. Image attribution Creative Commons License 3.0 available at http://en.wikiquote.org/wiki/File:Maslow%27s_Hierarchy_of_Needs.svg

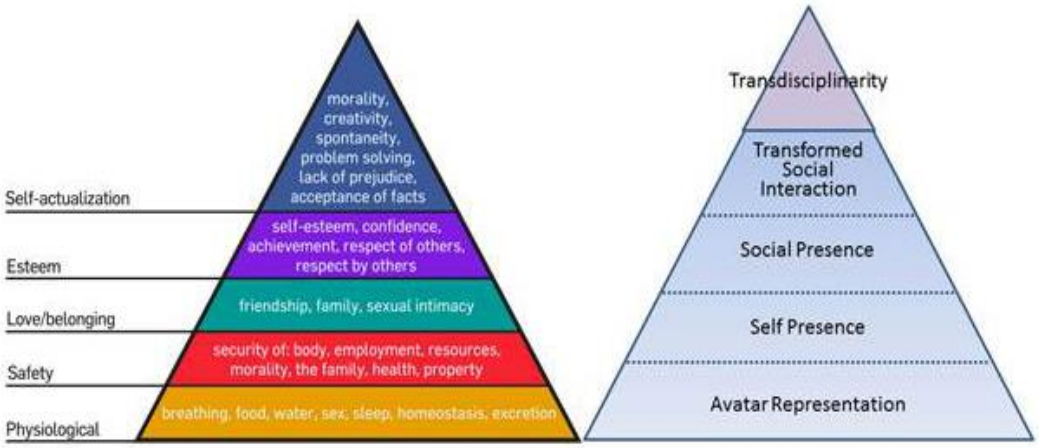

Figure 50. Maslow's Heirarchy of Needs towards Transdisciplinarity

The figure on the right in Figure 50 was produced to illustrate the levels of embodiment progression that appeared as themes from qualitative comments in the study. The volume of comments were not representative of levels, rather the progression aligns with salient comments and the literature review. Digital embodiment has been found to be a unique lever for behavioral change (Yee & Bailenson, 2009, p. 206). Boellstorff (2008) argued for virtual embodiment and cited one Second Life resident's sentiments in the book, *Coming of Age in Second Life*. Boellstorff said, "Virtual embodiment could even be understood as more authentic than actual-world embodiment; as one Second Life resident put it, 'this is how I see myself on the inside'" (p. 134). Maslow's B-cognition was also discussed in a dissertation by nurse educator, Dr. Wendy Mason (2010), who described Maslow's cognition of being in relation to transdisciplinarity (p. 21).

Respondents in the survey had mixed views of the potential for their avatar to become an intelligent aid and friend to them. The rise of persuasive technology to influence voluntary behavioral change for well-being is an area ripe for further research (Ijsselsteijn, de Kort, Midden, Eggen & van den Hoven, 2006, p. 1).

The frequency of engagement respondents reported of interdisciplinary activities in Chapter Four Frequency Distributions suggests that users crossed domains of knowledge and experience. The motivations for such activities are not clear as the study did not seek to discover why people engage is such interdisciplinary activities. They were connected, engaged, and productive, in fact they may be representative of what Montuori (2013) described:

> The networked society, with the amazing power of new technology, gives us access to more information than ever before. The problem now is not access to information. It's how to organize that information, turn it into knowledge, and use that knowledge wisely. This is the challenge of Complexity and Transdisciplinarity (p. 226).

Based on the self-actualized nature of respondents in the study, the question arises of what is possible to achieve if conditions were created to support computationally-rich, collaborative ventures. Hesse (2008) referred to a discovery in 2001 that took many years and combined efforts to create:

> Indeed, completion of the human genome mapping project—one of the most ambitious examples of distributed Team Science in history—may have been made possible only by the collaborative information infrastructures put in place by biomedical informaticians (p. S236).

Heuristics for Practicing Dialogue using Embodied Avatars

The following heuristics were created based on the quantitative and qualitative evidence found in this study combined with the literature review and researcher's personal and professional ethnographic experience. Figure 51, *Heuristics for Practicing Dialogue using Embodied Avatars*, contains three primary activities to practice. Image attribution Barbara Truman. The heuristics are general purpose and do not apply to a specific domain (Gigerenzer, Hoffrage, & Goldstein, 2008, p. 238).

Heuristics		
Discipline	Temporal	Temporal
Model others' perception to cultivate a discipline of shared somatic experience.	Develop a strengths-based awareness of others *after* practicing strengths-based self-awareness.	Assess collaboration *after* employing a strengths-based approach.

Figure 51. Heuristics for Practicing Dialogue using Embodied Avatars

1) Model others' perception to cultivate a discipline of shared somatic experience.

The extension of thinking about modeling ideas presented and heard aligns with the second discipline of creating mental models described by Senge (1990). This heuristic also is framed from research on embodied simulation that asserts we know others' through simulating their goals and feelings (Kerr, 2008, p. 205).

2) Develop a strengths-based awareness of others after practicing constant strengths-based self- awareness

Dialogue with oneself to develop *self* benefits from becoming open and vulnerable in dialogue with others. Opening up to listen deeply based on a discipline of presencing assists with the awareness of strengths that offer potential for development. Increasing personal somatic awareness may assist in identifying strengths in others.

3) Assess collaboration after employing a strengths-based approach

If requirements exist to assess collaboration as part of an initiative, it is recommended that strategies be identified prior to collaboration to assure the assessment/development of strengths.

The question of *shiftability* of place in the environment represents an area of research to explore how a groups' shared vision overcomes the need to attach to place to experience social presence.

Comparison Findings

Independent t-Tests and Mann-Whitney U tests indicated nine significant differences between women (n=33) and men (n=27) in the study. Women reported attending more meetings, more open in heart, mind, and will, more providing assistance for new members, resources created for the group, and more networking. Women also were found to agree more that their avatars helped them overcome interpersonal and communications limitations. Women also agreed more that they were likely to talk about their avatar as an extension of events in their life and have their personality and behavior predicted in physical life based on others knowing the respondent's avatar (see Chapter Four section Independent T Tests).

Not all respondents participated in the same manner within groups, but respondents reported agreement with the use of strengths among members within groups (75%). Volunteer groups have additional challenges to maintain community to achieve common goals again requiring motivation to operate. The study was interested in what types of activities the groups performed. The research questions surrounded the interactions using embodied avatars for creating dialogue to aid understanding used in collaboration.

Independent t-Tests and Mann-Whitney U tests were performed comparing respondents who self-identified as leaders (n=32) compared to those who self-identified as members (n=13). Significant differences were found among responses to 17 questions.

As expected the leaders reported greater frequency in engaging in group activities including performing outreach such as networking, recruiting, cultivating group identification, evangelizing the group, and using social media. Leaders also reported greater frequency of creating resources and conducting events. Leaders also reported higher agreement with having an open mind, heart, and will; regulating feelings, being inseparable from their avatar. Leaders also rated higher frequencies of obtaining insights from discussions with others outside their field and establishing linkages with others from different disciplinary fields. Leaders reported one significant difference between members that related to agreement that use of their avatar improves acceptance of their educational attainment in the physical world. More research is needed to ascertain what this finding means.

A comparison was also made to examine differences in ratings between leaders (n=32) and those who self-identified in the study as contributors (n=13). No definitions were provided to distinguish differences in role. One person said they were a speaker/spokesperson and two people chose the selection of advisor. Fourteen comments were made where respondents described how their roles shifted over time or they shifted roles between groups for which they were invested. Only two significant differences were found between leaders and contributors. Leaders rated greater frequency in providing vision and conducting events. Scharmer stated in the sense [of knowing oneself in the Confucian tradition], ". . . the cultivated self is a leader's greatest tool" (Senge, Scharmer, Jaworski & Flowers, 2005, p. 180).

Differences were also examined between Contributors and members. Similar to the findings of differences between leaders to members, many of the same questions were

significantly different between contributors and members. The distinction appeared indicating contributors reported greater agreement that their physical world behaviors and personality could be predicted compared to members. Contributors did not report the significant differences as leaders did to members regarding frequency of creating resources and of obtaining insights from others who come from different fields. Contributors did not report as much agreement between members as leaders did concerning openness of mind, heart, and will, regulating feelings, acceptance in physical life concerning educational attainment and the ability to have actions and personality predicted in the physical world from avatar use in a virtual environment.

Emergent and Shared Themes

The qualitative findings suggested the emergence of 18 themes, of which six are shared across the two proposed constructs in the study. For individual application, the embodiment theme was referenced earlier in this chapter for suggested levels culminating in transdisciplinarity. *Figure 50.* Maslow's Heirarchy of Needs towards Transdisciplinarity, illustrated a culmination on self-actualization. A discipline of reflective *shiftability* leads to and from somatic experience as suggested in the first proposed heuristic. This somatic experience involves a growing awareness to gather more information obtained from elements of *virtual-physioception*, namely interoception, exteroception, and proprioception. Lindgren (2009) reported, "VEs [virtual environments] can put people in new social contexts that force them to confront the ideas and viewpoints of individuals with different background and experience" (p. 65).

Empowerment was listed as one of the themes under the individual category, although group empowerment resonated from comments. *Collective efficacy* is a term

referred to by Carroll et al (2005) where groups feel empowered resulting in overcoming obstacles such as dealing with the lack of funding (as seen in Olson, Olson & Hofer, 2006, p. 2).

Figure 52, *Emergent and Shared Themes*, illustrates the three groupings of themes based on applied use for an individual, within a group, or across both individuals and groups. Image attribution Barbara Truman.

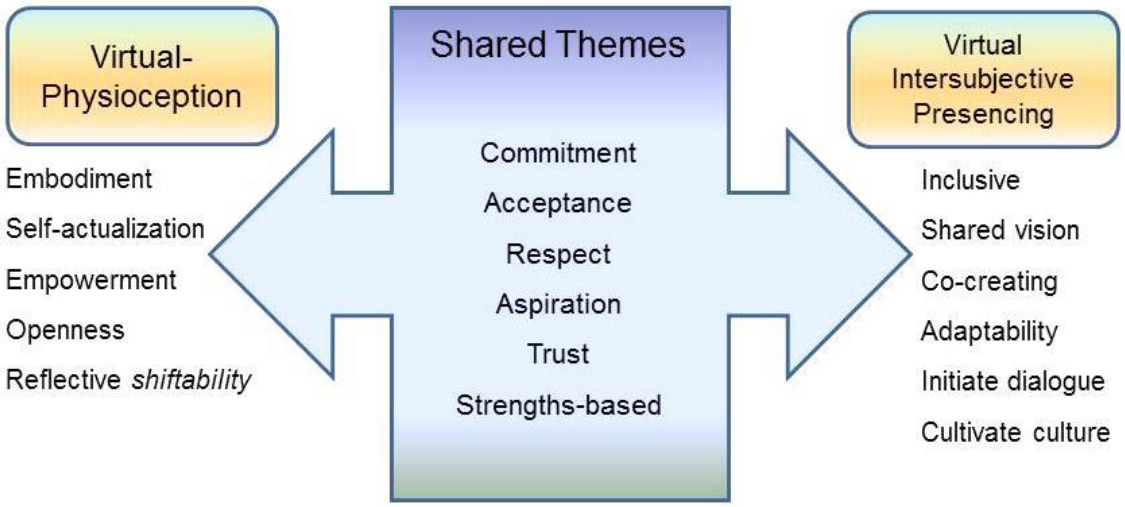

Figure 52. Emergent and Shared Themes

The notion of collaborative virtual environment users producing things was expected, but the level of intention to cultivate identity and collective intention emerged as a theme of co-creation. Strassman (2013) interviewed anthropologist Tom Boellstorff in a video who described *techne*, the original word for craft in early Greek, as how Second Life users demonstrated expressions of creativity for personal growth, liberation, and economics (12:15 and 52:00). Respondents in this study clearly articulated similar themes, although there were not many mentions of selling creative works.

A portion of respondents represented educators. Some described teaching about collaboration and they described student projects. More educators reported engaging in events and sharing their knowledge publicly with regularity as peers. These educators' commitment to finding new approaches to support learners challenged norms and used every available technology across grids reminiscent of Sameshima's (2008) call for grounded learning rooted in wisdom where identity is connected to landscape (p. 39).

The sample of groups involved in this study represented a high degree of intercultural literacy ranging from cross-cultural to intercultural as represented in Heyward's (2002) multidimensional model of development (p. 16). The question remains whether respondents had high levels of cultural literacy prior to engagement with groups in CVEs or whether they acquired these skills through interaction and dialogue.

The combination of themes discovered from respondents' comments bear similarities to Psychologist Howard Gardner's five minds for the future: disciplined, synthesizing, creative, respectful, and ethical (Gardner, 2007). The difference with Gardner's minds, based on comments is that the presencing phenomenon involving personal somatic experience engages more than cognitive states.

Limitations of the Study

This exploratory, pilot study used a mixed methods approach to collect data from a purposeful sample using an online survey reliant upon self-reported data. Care is advised to interpret and generalize findings to other individuals who use avatars and virtual platforms. The study sought experienced users of virtual environments to determine what works for them in their collaborations using embodied avatars.

The challenge in measuring the construct *virtual-physioception* suggests usage of a methodology or more sophisticated tools to determine awareness of interoception and exteroception. Further research involving interviews and focus groups will help explore perceptions of the nature of the construct. The respondents in this study as shown in the Profiles of Study Participants found in Chapter Four and in APPENDIX C: Crosstabs, indicate a high level of experience with virtual environments and a high level of education. More typical users of virtual environments are not represented in this study.

The survey instrument had an overall reliability, but the qualitative responses indicated some degree of misunderstanding on two questions 1) having one's avatar become independent with artificial intelligence to serve as a friend (AVIAIFR) and the ability to bequeath one's avatar for future generations to learn about you (AVIQUEATH). Demographic questions should have been all grouped at the end of the survey to prevent confusion about where the survey ended.

Contributions to the Literature

The literature review contributes toward uniting a holistic paradigm of knowledge and experience involving transdisciplinarity and the use of embodied avatars for collaborative practice and research. The findings of the emerging discipline of avatar presencing offer aspirational leadership development. A survey instrument was created blending prior research into group, avatar, and personal experience. Two constructs, *virtual-physioception* and *virtual intersubjective presencing* were developed and tested to provide a basis for future study. Heuristics for collaborating using embodied avatars in virtual environments were developed based on study findings.

Implications for Practice

The impact of this study implies applicability on multiple levels. Individuals can practice crafting their identity through the use of embodied avatars to explore personal strengths as a personal discipline to build leadership skills. For groups, practicing forays into dialogue to identify how the medium of virtual environments support the exchange of deeper understanding may assist entrepreneurship. As CVEs evolve, users who co-create together may form an aesthetic of language into new shared experience. Ladkin (2008) described a concept of leading beautifully that involved a quality of embodiment exemplifying “the best of human purposes” (p. 29). She cited the research of Taylor (2002) who described an aesthetic muteness in organizations as people do not have the language to share their qualitative experiences (Ladkin, 2008, p. 29).

Leaders communicate informal rules to others influencing the culture of an organization. These informal rules are heuristics whether they were deliberately created or evolved. Gigerenzer’s (2006) research into heuristics suggested developing new rules to shape an organization to become what is desired (p. 58). All participants can create heuristics of their own regardless of formal position. The heuristics developed in this study offer a means of practice for individuals, groups, and organizations to benefit cultivation of culture and community.

The development of dialogic practices originating from embodied avatars within CVEs may capitalize on the distributed use of virtual teams to offer organizations and communities a bridge to physical and virtual spaces. Such collaboration may aid in the development of wisdom, "through generating and sharing knowledge, in part through communal reflection and social dialogue" (Dede, 2009, p. 9). New generations of scholars possessing CVE meta-literacy skills may emerge to partner with university

faculty in research specializations that may accelerate and improve interdisciplinary research using a strengths-based approach.

Implications of the Study

This study was significant for its findings related to personal development using embodied avatars to cultivate identity through dialogue. High performing groups were identified using collaborative virtual environments made up of articulate professionals from multiple domains in society. Stricker, Holm, Calongne, McCrocklin, (2011) cited explorations of emergent qualities of collective intelligence for collaborative problem solving using CVEs (p. 2). Augmentation through cybernetic feedback systems provide a frontier upon which findings from this study may serve. Organizations can harness identities in the physical world as well as embodied avatars acting in virtual environments all acting as sensors to collaborate using collective intelligence. Such actions can seek to create the art-of-the possible and tackle complex challenges of scale. For universities, this study offers evidence to justify as McGonigal (2007) termed, a new form of networked digital literacy based upon massively-scaled collaboration (p. 4).

Collaborative virtual environments will improve rapidly with graphical rendering power and computational power on the petabyte scale. The networking ability for computers exists and will improve. How the gap between what technology can do and how the tools are integrated to offer experiential, in vivo research potential poses a challenge for future leaders to network individuals, organizations, and nations. The platform affordances to allow crowdsourced, collective intelligence using open, big data will attract researchers to practice and research using embodied avatars in CVEs.

Future Research Recommendations

Personal Somatic Awareness

As mentioned earlier in this chapter, commercially available biological devices are available to measure physiological responses to immersive stimuli using avatars. The applicability to capture physiological, emotional, and mental states have potential to improve self-reporting. Such research approaches may have extensible, distributed use outside of a research laboratory into homes serving multiple purposes. Researchers are resourceful to apply commercial gaming equipment for use in psychological and physiological studies. Some serious game applications use personal, biofeedback devices. It is not known how extensively such devices are being researched for use with embodied avatars for identity cultivation and leadership development. Young and Whitty (2011) describe similar research into identity as parity. They add, "…there is evidence to suggest that at the psychological level there is a need to transcend worlds and seek parity and unity between what we are presently considering as different context authenticities (Young & Whitty, 2011, p. 547). Ijsselsteijn, de Kort & Haans' (2006) research into the rubber hand illusion has potential to be combined with other forms of presencing research surrounding the notion of self. They summarized adaptable mapping of body image:

> When we interact with virtual or remote environments using intuitive interaction devices, isomorphic to our sensorimotor abilities, the real-time, reliable, and persistent chain of user action and system feedback will effectively integrate the technology as a phenomenal extension of the self (Ijsselsteijn, de Kort & Haans, 2006, p. 463)

Bridging CVEs and Simulators

Bridging physical and virtual environments is an area of research needed to spur innovation. Just as universities had expensive rooms filled with interactive television equipment requiring place-bound and time-bound use, expensive simulators exist in laboratories that are serving a fraction of the intended population. How are CVEs using embodied avatars connected with such simulators to create a continuum of use maximizing space and place? The temporal aspect of research using such connected devices and environments is a greater challenge. Such blending of devices, software, people, identities, and media may resemble what Coleman (2011) described as X reality. She said, "… X reality describes a world that is no longer distinctly virtual or real, but, instead, representative of the diversity of network combinations" (Coleman, 2011, p. 20). Organizations have made significant investments in place-bound, time-bound simulation equipment are wise to embrace low cost CVE alternatives to integrate in order to obtain greater overall impact. The human dimension must also be investigated for how communities flow across the virtual and physical platforms. Experience design research offered guidelines applied to virtual environments useful for training such as for improving situational awareness (Alston & Schatz, 2013, p. 10). The data need to be managed for interoperability and sustainability for collaboration. This dissertation did not delve into the exciting role for libraries and librarians to make data what Bohle (2013) called actionable intelligence.

Massively Open Virtual Conferences?

Virtual Conferences are another facet of computer-mediated collaboration potentially catalyze virtual community learning organizations similar to how MOOCs

opened academic courseware to the masses. Will virtual conferences become a nexus to incorporate crowdsourcing and perhaps citizen science? Conferences typically are exclusive relying upon paid registrations. Virtual conferences offer the potential to reach out to more participants to engage, which could be a means to market products and create brand loyalty among professional associations.

Bliton, Ely, Jesukiewicz, Norwood & Reyher (2013) cite overreliance on in person conferences that led to the Coburn Amendment 1596 in the United States requiring a 50% reduction in government travel (p. 2). Savings are already occurring, but which organizations are using the mediating technology to further the professional development for an ongoing basis? The use of social media before, during, and after events provides an orbit of activities that also occur within the environment through the use of avatars to build strong relationships. Which technologies will span the occasional virtual meeting with virtual conferences, and virtual collaboration? Seamless use of these technologies will improve adoption and collaboration. Some professional technical groups such as IEEE have discussed the possibility of creating standards for avatars to enable reuse across grids and technologies. If such a capability was possible, the avatar could represent an advanced form of electronic portfolio enabled by interoperability and cloud computing technologies.

Nexus and Praxis

New media leadership is a potential area of research to identify which individuals, groups, and organizations are breaking boundaries to connect disciplinary activities achieving broader impacts through computer-mediated collaboration. Innovation and entrepreneurship served by advanced computational resources are not limited to any one

domain of service. Investigation into how existing organizations within the 'Triple Helix' of academia, industry, and government (Prainsack, 2012, p. 140) commit to use CVES, dialogue, citizen science, and crowdsourcing can serve to build *virtual learning organization communities* (VLOCs). Some groups may be starting new from scratch. Some groups may coordinate existing cyber-infrastructure and personnel and find opportunities to obtain funding similar to the Ohio initiative responsible for expanding broadband access and programs to homes, schools, businesses, and government (One Community, 2013, p. 17). Connecting existing communities and environments may be easier than building new enterprises. The design of advanced cultural signposts that incorporate organizational storytelling may provide a means of mass engagement leading to new forms of collaboration. Raybourn, Kings & Davies (2003) reported the importance of informal social interaction for collaboration,

> The future success of collaborative work in community-based virtual environments requires that designers not only understand the socio-cultural dynamics that manifest in online communication and in virtual communities of practice, but also consider how the design of these environments can support informal communication among strangers (p. 94).

The value of integrating physical-virtual identities to master collaborative agency could lead to work and leisure promoting broader community engagement.

Cynthia Vinson (2013), an employee of the US National Cancer Institute, conducted a concept mapping study for her dissertation on government-sponsored, virtual communities of practice (vCoPs). Vinson adapted Wenger's community of practice framework and created a modified vCoP framework based on community, domain, and practice to investigate stakeholder needs for praxis (p. 123). Vinson's Framework contained three intersecting areas that converged into a Learning Collaborative. The three

areas were *Domains* involving translating research into practice, *Community* involving collaboration, and *Practice* involving usability/design (Vinson, 2013, p. 123). A similar concept frames what we call *virtual learning organization community* or VLOC. Such a community spans multiple domains involving diverse stakeholders using CVEs and disciplines based upon the presencing research of Senge and Scharmer of MIT.

Figure 53, *Virtual Learning Organization Community Framework*, builds upon the notion of participating in CVEs as an embodied avatar to participate in efforts related to activities that span across life. Image attribution Barbara Truman. Such new forms of communities and how they use CVEs to connect people and organizations are a rich area for future study.

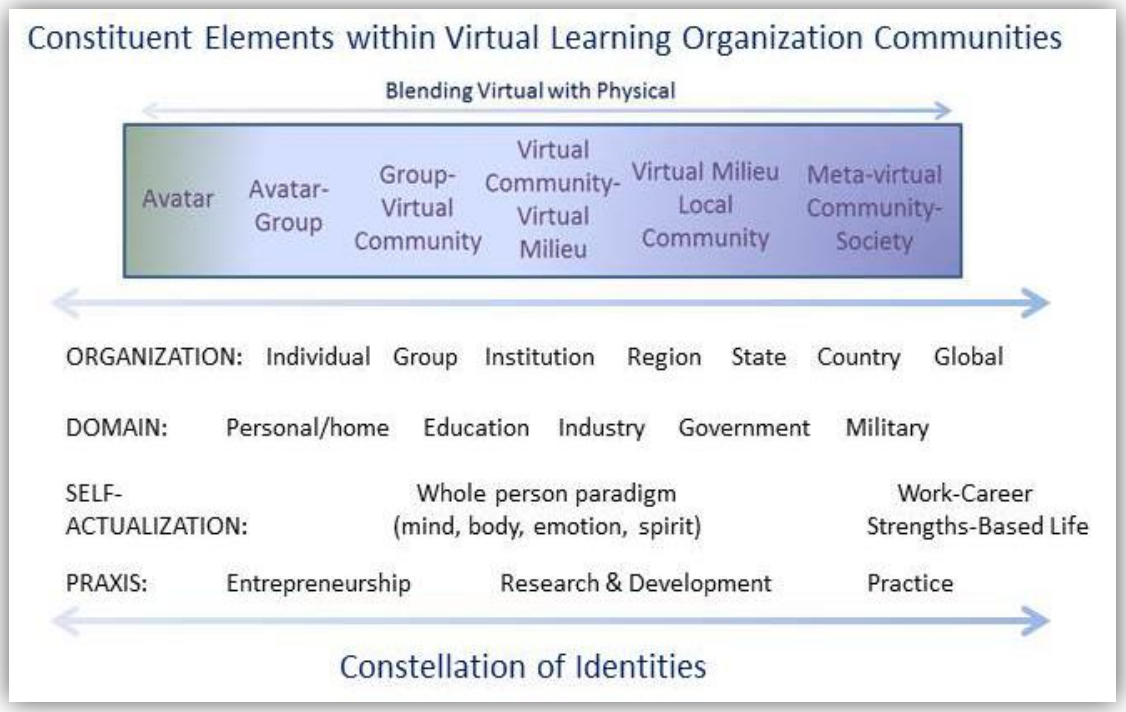

Figure 53. Virtual Learning Organization Community Framework

Likewise, determining when computational approaches trump human, collective intelligence, crowdsourced approaches will lead to better strengths-based combinations

accelerating discovery and innovation. What are the intersections of what Neilsen (2011) describes as shared praxis? He added "Collective intelligence can only be applied within the respective tribes, where there is a shared praxis (p. 81). A prime example of crowdsourced, collective intelligence was the award-winning FoldIt game that enabled anyone to play with folding a representative protein on the Internet (Scacchi, 2012, p. 95). The scientific value of Fold-It provided an avenue of scientific reasoning and a serious game. Raybourn (2007) defined a serious game as "…the use of interactive digital technologies for training and education in private, public, government, and military sectors (p. 207). How can serious games become a nexus of shared praxis for transdisciplinary, collaborative scientific research? Crowdfunded philanthropy may provide examples. A Brookings Institute report found that Internet-based crowd-funding allowed alternatives to making contributions using micro-finance where the giver and recipient is less, costly, less political, and more aligned with taxpayer preference (Desai & Kharas, 2013, p. 3).

McGonigal (2006) described ubiquitous computing and the collective intelligence required to create and participate in Alternate Reality Games (ARGs), "It is clear, then, that the players and designers of ubiquitous games are engaged in an explicit and ongoing utopian discourse of collective intelligence, unified consciousness, and massively collaborative production (p. 440). How can ARGs and Live Action Role Playing games (LARPs), discussed in Chapter One, be used to leverage CVEs as multifaceted, role-playing alternate reality delivery platforms of citizen science in support of transdisciplinary research? Desai Who are the positive deviants who will architect such human-technology multiverse conglomerations?

Compromised hygiene procedures in hospitals are accounted for killing 100,000 people a year in hospital-acquired infections, yet Singhal, (2010) reported some hospitals have dramatically reduced the threat of infections. These hospitals have been attributed to focusing on what works through positive deviance instead of identifying what is wrong and trying to motivate staff to respond (p. 605). Positive deviance is perceived to be accountable for how communities own the solution and through dialogic inquiry, discovers the solution (Singhal, 2010, p. 606).

Canadian hospital president Marie-Dominique Beaulieu cited Berkowitz &McCarthy (2013) as providing a definition of positive deviance as:

> an approach to behavioral and social change based on the observation that in any community, there are people whose uncommon but successful behaviors or strategies enable them to find better solutions to a problem that their peers, despite facing similar challenges and having no extra resources or knowledge than their peers (Beaulieu, 2013, p. 447).

Regardless of role, positive deviants are reported to take initiative and have the emotional intelligence necessary to inspire others to follow (Bloch, 2001, p. 274). Can personal somatic mastery be achieved through practice of the presencing discipline using avatars in CVEs to go beyond emotional intelligence to new literatures of experiential intelligence? Uniting *being* with caring is a function that many nurses are versed in practicing whose jobs require front line caregiving to patients. This dissertation has made a case the collaborative virtual environments provide an emerging platform to promote embodiment of transdisciplinarity. Mason (2010) reported, “Transdisciplinarity provides a vehicle for nurse educators and NP students to bridge the gap between theory and practice” (p. 108).

Reflections: Towards Transdisciplinarity

Two key principles identified in this study resonated with me 1) Strengths-based partnering reminiscent of the work of Donald Clifton, Martin Seligman, Marcus Buckingham and 2) a universal whole-person paradigm based on the work of the late Stephen Covey who performed his dissertation research on leadership. The whole person paradigm advocated by Covey and others combines the cognitive (mind), heart (emotion and feelings), with physical (body) and spiritual (consciousness). These principles have been applied for personal development and professional development. Discovering strengths required considerable exploration and experience. Sharing strengths meaningfully with others benefitted from dialogue that took many forms as found in this study. Can the summed strengths from a *whole* person applied across *all* life activities, including virtual life offer a multiplicity of natural, authentic potential? Whether you are a researcher investigating discoveries, a manager solving wicked problems, or building an organization such as a family, these principles are worthy of further investigation using CVEs, embodied avatars, and a discipline of dialogue. The World Economic Forum (2014) lists as one of its themes to tackle risks as collaborative multistakeholder action (p. 52).

Can we resolve our wicked problems through wise use of embodied avatars and mediated collaboration? Embodied avatars provide a reflection or shadow depending widely on factors that go beyond this study. Coleman stated that new technologies in the form of a Pandora's box can unleash as plague upon our world or be harnessed for good. She adds, "As a networked global culture, we now have the job to negotiate, cajole, charm, and demand what that "good" might look like at the level of the locally situated and the interconnected" (Coleman, 2011, p. 160).

Figure 54, *Doctoral Pandora Project*, depicts a 3D build in Second Life constructed as part of a Greek Mythology project made for Colorado Technical University's Computer Science, Emerging Media Program. Photo credit Barbara Truman. Research required rejecting the common acceptance of the myth's reference to box as the term jar was lost in translation from Greek to Latin. The poet Hesiod was known to say, "Only Hope was left within her unbreakable house" (1999, p.168). The researcher's avatar in Figure 54 on the bridge morphed into a shining star illustrating embodiment of hope through personal transformation as an avatar.

Figure 54. Doctoral Pandora Project

Summary

This chapter summarized findings from a phenomenological study of embodied avatars using dialogue to collaborate in virtual environments. Basarab Nicolescu, the Romanian Physicist whose writings piqued my imagination for this study, stated that transdisciplinarity bears witness to hope and promise hidden in Pandora's box (2002, p.

145). Persistent use of collaborative virtual environments may bridge physical and virtual communities as demonstrated in some groups within this study. Bridging identity across physical and virtual realities appeared to be a function of choice in personal development (leadership) that may provide means for some individuals to project beyond current knowledge and understanding.

Not everyone became attached to avatars and may not be capable of embodiment experience. For leaders in the study, vision drove engagement more easily seen and experienced. Collective vision appeared to fuel the art-of-the-possible. The pursuit of dialogue and collaboration using CVEs generated hope as evidenced in respondents' commitment to their groups and their expectant outlook for the future (Dorcy, 2010, p. 82).

Gabriel Marcel said: "Hope is neither resigned, nor solitary. Hope consists in asserting that there is at the heart of being, beyond all data, beyond all inventories and all calculations, a mysterious principle which is in connivance with me" (1995, p. 28). This study provided hope for transdisciplinary collaboration in virtual environments especially where users deliberately engage in a discipline of dialogue to cultivate his or her ideal, strengths-based identity.

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APPENDICES

APPENDIX A: Survey Instrument

Collaborative Virtual Environment Experience Survey

Purpose: This survey is part of a research study about collaborative experiences occurring primarily within a virtual environment. The survey is expected to take approximately *30 minutes*. There are three sections to complete. Questions surround your experiences and insights. Your thoughtful answers will assist future researchers investigate the potential of collaborative virtual environments.

Definitions:
Collaboration- is different than cooperation. Collaboration frequently requires significant investment in relationship and trust building activities. Collaboration enables the emergence of understanding and realization of shared visions in complex environments or systems. Collaboration does not necessarily require harmony. Mostly, collaboration requires commitment in addition to shared goals, trust and respect.

Dialogue- is different than discussion, conversation, and debate. Dialogue enables one's experience to subtly shift allowing sight through others' eyes. Sustained dialogue often creates empathy. Possibilities open up to new insights as deep listening and understanding emerge. Dialogue builds collaboration. Not all dialogue is formal or structured. Dialogue may include improvisational exchanges with friends, family, colleagues etc.

Directions: For the questions below, please select the one answer that represents your collaboration experience. Please elaborate on your experience in the open questions. There are no right or wrong answers.

Part I. Perception of GROUP Experience in a Collaborative Virtual Environment

1. Please list the *primary* group name (e.g. Global Learning Forum) for which you feel emotionally vested: _____ List any other groups in which you participate and feel vested. _____

For the group in which you are most emotionally vested:
2. Indicate your primary *role* in the group.
   Leader Speaker/spokesperson Advisor Contributor Member Other
   Please describe: _____

For the primary group in which you are emotionally vested:
3. Please assess the frequency with which you typically engage as a member of this group in each of the activities listed below by checking the appropriate box on each line.

Roles:	*Never*	*Less than once a month*	*Monthly*	*2-3 Time a month*	*Weekly*	*Daily*
a. Champion the group to sponsors	☐	☐	☐	☐	☐	☐
b. Provide vision	☐	☐	☐	☐	☐	☐
c. Recruit members	☐	☐	☐	☐	☐	☐

d. Assist new members	☐	☐	☐	☐	☐	☐
e. Use social media to communicate	☐	☐	☐	☐	☐	☐
f. Create group resources	☐	☐	☐	☐	☐	☐
g. Orchestrate events	☐	☐	☐	☐	☐	☐
h. Network with others	☐	☐	☐	☐	☐	☐
i. Cultivate group identity	☐	☐	☐	☐	☐	☐
j. Evangelize the group to others	☐	☐	☐	☐	☐	☐

Think of an occasion in your primary group when you felt the collaborative dialogue contributed to significant understanding.

4. My understanding happened because:

5. My expressed ideas were clear to my collaborators.

Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

6. My collaborators' expressed ideas were clear to me.

Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

When you felt the collaborative dialogue contributed to understanding- .

7. Rate your experience in terms of the quality of the collaborative experience you recalled. The ratings do not necessarily mean that everything went well. Conflict is often productive.

Referring to your group experience:	*Excellent*	*Above average*	*Average*	*Below Average*	*Poor*
a. Communication among collaborators.	☐	☐	☐	☐	☐
b. Ability to capitalize on the strengths of different group members.	☐	☐	☐	☐	☐
c. Resolution of conflicts among collaborators.	☐	☐	☐	☐	☐
d. Productivity of collaboration.	☐	☐	☐	☐	☐
e. Overall perception of the impact of the collaboration.	☐	☐	☐	☐	☐

Please elaborate on your experience:

_____

8. Primary platform you use to collaborate:
   Second Life OpenSim(any) Active Worlds World of Warcraft
   Other please list: _____

9. Length of involvement with the *primary* group that you are most vested:
   < 1 year 1-2 years 3-4 years 5-6 years 7-8 years 9 or more years

Part II. Perception about AVATAR or CHARACTER Collaboration Experience

Directions: Please answer the following questions by selecting the one answer that best represents your typical collaboration experience in a virtual environment.. Please elaborate on your experience in the open questions. There are no right or wrong answers.

1. Describe the development of your primary avatar or character:

2. My avatar or character is inseparable from me.
   Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

Please describe: _____

3. I refer to my avatar or character as an extension of me when I engage in conversations with others about the events in my life.
   Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*
   Please describe:
   _____

4. Please rate your agreement with the statements below as they relate to your *abilities* in the physical world beyond the virtual environment.

My avatar or character helps me in the *physical* world to:	*Not at all*	*Somewhat*	*Moderately*	*Very Much*	*Absolutely*
a. Overcome my social limitations	☐	☐	☐	☐	☐
b. Overcome my physical limitations	☐	☐	☐	☐	☐
c. Overcome my communication limitations	☐	☐	☐	☐	☐
d. Overcome my interpersonal limitations	☐	☐	☐	☐	☐

Please describe: _____

6. Please rate your agreement with the statements below as they relate to the physical world beyond the virtual environment.

The use of my avatar or character improves my acceptance from others related to:	*Not at all*	*Somewhat*	*Moderately*	*Very Much*	*Absolutely*
a. My socio-economic status	☐	☐	☐	☐	☐
b. My educational attainment level	☐	☐	☐	☐	☐
c. My gender	☐	☐	☐	☐	☐
d. My race	☐	☐	☐	☐	☐

Please describe: _____

7. I customized my avatar or character to make it *interact* the way it does. (e.g. emotes in WoW, gestures in Second Life)

Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

Please describe:
_____

8. My avatar or character helps me *express ideas* that contribute to group understanding.

Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

Please describe:
_____

9. Others can accurately predict my physical-life behaviors/personality traits from getting to know me through my primary avatar or character.

Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

10. I am comfortable in having my primary avatar bequeathed for future generations to use for learning about me.

Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

Please describe:
_____

11. I am comfortable having my avatar or character to gradually grow independent, using artificial intelligence, from my persona to become more like a friend to me.

Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

Please describe:
_____

Avatar Demographic Questions

Directions: For the following questions, think specifically of your avatar or character you use in virtual worlds.

12. What is the approximate age (e.g. rez date) of your primary avatar or character?

<1 yr 1-2 yrs 3-4yrs 4-5 yrs 6-7 yrs 8-9 yrs +10 years

13. Approximately how much *average* time per week do you spend with your avatar or character?

<1 hr 1-5 hrs 6-9 hrs 10-15 hrs 16-20 hrs 21-25 hrs > 25 hours

14. Does your primary avatar or character have more than one representation in similar name within other virtual environments? Yes__ No __ , if yes, approximately how many total representations exist? ____

15. Does your primary avatar or character have its own blog or social media sites? Y ___ N ___

Part III. Perception about INDIVIDUAL Collaboration Experience

Directions: Please answer the following questions by selecting the one answer that best represents your typical collaboration experience in a virtual environment. Please elaborate on your experience in the open questions. There are no right or wrong answers.

1. Please describe how you improve yourself to broaden collaborative interactions.

2. I habitually focus my attention on my physiological reactions (i.e. how I think, feel, and physically react).
   Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

3. My emotions are usually clear to me.
   Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

4. I am deliberative in how I express my emotions.
   Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

5. My assumptions are usually clear to me.
   Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

6. I am open (i.e. heart, mind, will) when collaborating with others.
   Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

7. I pride myself on my ability to appreciate varying points of view.
   Strongly Disagree *Disagree* *Neither agree/disagree* *Agree* *Strongly Agree*

8. Approximately how often do you typically engage in the following regarding your professional activities?

Referring to ALL of your professional activities:	*Never*	*Rarely*	*Occasionally*	*Often*	*Very often*
a. Read journals or publications outside of your primary field	☐	☐	☐	☐	☐
b. Attend meetings or conferences outside of your primary field	☐	☐	☐	☐	☐
c. Participate in working groups or committees with the intent to integrate ideas with other participants	☐	☐	☐	☐	☐
d. Obtain new insights into your own work through discussion with colleagues who come from different fields or disciplinary orientations	☐	☐	☐	☐	☐

e. Modify your own work or research agenda as a result of discussions with colleagues who come from different fields or disciplinary orientations	☐	☐	☐	☐	☐
f. Establish links with colleagues from different fields or disciplinary orientations that have led to or may lead to future collaborative work	☐	☐	☐	☐	☐

The following demographic questions refer to you as, opposed to your avatar or character.

9. Age:
<20 20-29 30-39 40-49 50-59 60-69 70+ Prefer not to disclose

10. Gender:
Female Male Transgender Other Prefer not to disclose

11. Ethnicity:
Indigenous (e.g. Native American) Hispanic or Latino African decent or Black
Asian or Pacific Islander Caucasian Multiracial Prefer not to disclose
Not listed: _____

12. Please select your primary professional affiliation.
K12 Community College University Industry Government Military
N/A Prefer not to disclose Other: _____

13. Occupation: _____ Prefer not to disclose

14. Country where you currently reside: (drop down list).

15. Highest level of educational attainment:
Grades 1-8
Some high school
High school graduate
Some college
AA/AS degree (two years of college)
BS/BA degree (four years of college)
MS/MA Masters or graduate level degree
Doctorate degree PhD, EdD, MD, JD, DM, DCS
Prefer not to disclose

Thank you for contributing to this study.

APPENDIX B: Survey Launch Site Example

Serendipitous Synchronicity

Inquiry into imaginary instantiations

Home | About | Becoming Delightful | Research | TransSurvey | Virtual Harmony

TransSurvey

Collaboration in Virtual Environments Survey

Hello!

This page was used in a research study based on collaboration in groups that operate in a virtual environment (CVE) such as Second Life, OpenSim, or World of Warcraft.

Collaboration & Dialogue

This research study was conducted in association with Colorado Technical University's Computer Science, Emerging Media Program. Barbara Truman is the researcher who collected, managed, and analyzed the data under the supervision of Dr. Cynthia Calongne. Privacy was assured.

Purpose: This research study explored collaborative experiences occurring primarily within a virtual environment where effective groups created environments, events, or expertise. Of most interest was perception of experience when interacting using an avatar or character. The study aimed to broaden understanding of the relationship impact of using avatars or characters that may affect collaboration.

Reflect

Definitions:

Collaboration- is different than cooperation. Collaboration frequently requires significant investment in relationship and trust building activities. Collaboration enables the emergence of understanding and realization of shared visions in complex environments or systems. Collaboration does not necessarily require harmony. Mostly, collaboration requires commitment in addition to shared goals, trust and respect.

Dialogue- is different than discussion, conversation, and debate. Dialogue enables one's experience to subtly shift allowing sight through others' eyes. Sustained dialogue often creates empathy. Possibilities open up to new insights as deep listening and understanding emerge. Dialogue builds collaboration. Not all dialogue is formal or structured. Dialogue may include improvisational exchanges with friends, family, colleagues etc.

Tweet This Post

APPENDIX C: Crosstabs

Table 20 *Crosstabs Data Tables in Appendix C*

Primary role in group * Age of avatar Crosstabulation

		Age of avatar						
		<1 year	1-2 years	3-4 years	5-6 years	7-8 years	+10 years	Total
Primary role in group	Leader	0	2	11	10	8	1	32
	Speaker	0	0	0	1	0	0	1
	Advisor	0	0	0	1	0	1	2
	Contributor	1	2	2	2	6	0	13
	Member	3	1	4	4	1	0	13
Total		4	5	17	18	15	2	61

Primary role in group * Reported length of time in primary group Crosstabulation

		Reported length of time in primary group					
		< 1 year	1-2 years	3-4 years	5-6 years	7-8 years	Total
Primary role in group	Leader	2	7	9	9	5	32
	Speaker	0	0	0	1	0	1
	Advisor	0	1	1	0	0	2
	Contributor	3	3	3	2	2	13
	Member	4	5	4	0	0	13
Total		9	16	17	12	7	61

Primary role in group * Average time spent weekly with avatar Crosstabulation

		Average time spent weekly with avatar							
		<1 hour	1-5 hours	6-9 hours	10-15 hours	16-20 hours	21-25 hours	> 25 hours	Total
Primary role in group	Leader	1	6	6	7	3	4	5	32
	Speaker	0	0	0	0	0	1	0	1
	Advisor	0	0	0	0	1	0	1	2
	Contributor	1	2	1	5	1	1	2	13
	Member	4	7	2	0	0	0	0	13
Total		6	15	9	12	5	6	8	61

Gender * Reported length of time in primary group Crosstabulation

		Reported length of time in primary group					
		< 1 year	1-2 years	3-4 years	5-6 years	7-8 years	Total
Gender	Female	6	10	8	6	3	33
	Male	3	5	9	6	4	27
	Prefer not to disclose	0	1	0	0	0	1
Total		9	16	17	12	7	61

Gender * Average time spent weekly with avatar Crosstabulation

		Average time spent weekly with avatar							
		<1 hour	1-5 hours	6-9 hours	10-15 hours	16-20 hours	21-25 hours	> 25 hours	Total
Gender	Female	1	8	5	8	3	3	5	33
	Male	4	7	4	4	2	3	3	27
	Prefer not to disclose	1	0	0	0	0	0	0	1
Total		6	15	9	12	5	6	8	61

Gender * Age of avatar Crosstabulation

		Age of avatar						
		<1 year	1-2 years	3-4 years	5-6 years	7-8 years	+10 years	Total
Gender	Female	3	0	10	12	7	1	33
	Male	1	4	7	6	8	1	27
	Prefer not to disclose	0	1	0	0	0	0	1
Total		4	5	17	18	15	2	61

APPENDIX D: Reliability Analysis and Quantitative Variable Index

Reliability analysis of all items, α = .926

Item question	Variable Name	Cronbach's Alpha if Item Deleted
Frequency in championing the group to stakeholders	G_CHAMP	.926
Frequency in providing vision for direction of group activities	G_VISION	.923
Frequency in recruiting new members	G_RECRUI	.924
Frequency in assisting new members	G_NEWMEM	.923
Frequency in using social media to create awareness for the group	G_SOME	.924
Frequency in creating resources that the group uses	G_RESOUR	.924
Frequency in creating and running events	G_EVENT	.923
Frequency in networking with others and groups on behalf of the group	G_NETWRK	.923
Frequency in cultivating the identification of the group	G_CULTID	.923
Frequency in evangelizing the group to others	G_EVANG	.922
Perception of whether the group understood respondent	GRPCLEAR	.927
Perception of whether respondent understood others	CLEARGRP	.927
Perception of group communication	GRPCOMM	.925
Perception of use of group strengths	GRPSTREN	.925
Perception of the resolution of conflict within the group	GRPCONFL	.926
Perception of the productivity of collaboration	GRPPROD	.924
Perception of the impact of collaboration	GRPIMPAC	.924
Rated relationship of avatar inseparability (Virtual physioception)	AVI_INTE	.923
Reported tendency to speak about avatar as self	AVICOMM	.923
Rating of overcoming social limitations through avatar use	AOVSOLIM	.922
Rating of overcoming physical limitations through avatar use	AOVPHYS	.923
Rating of overcoming communication limitations through avatar use	AOVCOMM	.923
Rating of overcoming interpersonal limitations through avatar use	AOVINTP	.923
Rating of overcoming socio-economic status through avatar use	AVACECON	.923
Rating of overcoming educational status through avatar use	AVAEDU	.922
Rating of overcoming gender through avatar use	AVAGEND	.922
Rating of overcoming ethnicity through avatar use	AVARACE	.922
Rating of avatar customization for interactions	AVIINTER	.925
Rating of avatar's contribution to group understanding VIP	AVIEXPRES	.924
Rating of others' ability to predict physical activities based on knowing avatar	AVAPRED	.925
Rating of comfort to bequeath avatar	AVIQUEAT	.926
Rating of comfort to become friends with artificial intelligent avatar	AVIAIFR	.928
Rating of somatic awareness	SOMATIC	.925
Rating of emotional awareness	EMOTION	.925
Rating of regulation of feelings	TRANSLATE	.925
Rating of awareness of assumptions	ASSUMPT	.925
Rating of openness of heart and mind	OPENWILL	.924
Rating of appreciation for others' viewpoints	IDIFFER	.925
Frequency of reading diverse journals	JOURNALS	.926
Frequency of attending/participating in diverse conferences	CONFEREN	.925
Frequency of attending/participating in diverse meetings	COMMITTEE	.924
Frequency of gaining insights from others for self	INSIGHTS	.924
Frequency of modifying own work as result of others' input	MODIFY	.923
Frequency of establishing links with diverse colleagues	LINKAGES	.924

APPENDIX E: Pattern and Structure Matrix from Principal Component Analysis

	Component			
ITEM	EMPOWER	ENGAGE	COLLAB	TRANS
AOVINTP	.865			
AVAEDU	.848			
AVARACE	.829			
AOVCOMM	.805			
AOVPHYS	.805			
AOVSOLIM	.792			
AVAGEND	.777			
AVACECON	.693			
AVIEXPRES	.580			
AVICOMM				
AVIAIFR				
G_NETWRK		.879		
G_NEWMEM		.828		
G_CULTID		.794		
G_RESOUR		.792		
G_EVANG		.788		
G_VISION		.783		
G_SOME		.757		
G_RECRUI		.668		
G_EVENT		.648		
G_CHAMP		.584		
GRPCOMM			.747	
GRPIMPAC			.702	
GRPCONFL			.689	
CLEARGRP			.653	
GRPPROD			.599	
GRPCLEAR			.594	
GRPSTREN			.590	
IDIFFER			.516	
EMOTION			.417	
INSIGHTS				.828
LINKAGES				.810
COMMITTEE				.734
MODIFY				.719
JOURNALS				.680
AVIQUEAT				.533
TRANSLATE				.533
AVAPRED				.514
AVIINTER				.503
AVI_INTE				.488
CONFEREN				.460
OPENWILL				
ASSUMPT				
SOMATIC				

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Structure matrix from principal component analysis

	Component			
	EMPOWER	ENGAGE	COLLAB	TRANS
AVARACE	.881			.408
AVAEDU	.869			
AOVINTP	.859			
AOVSOLIM	.839			.416
AVAGEND	.831			
AOVPHYS	.816			
AOVCOMM	.796			
AVACECON	.781			.458
AVIEXPRES	.633			
AVICOMM	.539			.418
AVIAIFR				
G_NETWRK		.870		
G_NEWMEM		.845		
G_CULTID		.818		
G_EVANG		.817		
G_VISION		.802		
G_RESOUR		.772		
G_SOME		.740		
G_EVENT		.692		
G_RECRUI		.692		
G_CHAMP		.575		
GRPCOMM			.751	
GRPIMPAC			.738	
GRPCONFL			.680	
GRPPROD			.643	
GRPSTREN			.624	
CLEARGRP			.619	
GRPCLEAR			.562	
IDIFFER			.553	
EMOTION			.452	
INSIGHTS				.849
LINKAGES				.803
MODIFY	.473			.786
COMMITTEE				.724
JOURNALS				.628
AVI_INTE	.424			.607
TRANSLATE				.571
CONFEREN	.466			.558
AVIINTER				.521
OPENWILL				.519
AVIQUEAT				.514
AVAPRED				.482
ASSUMPT				.454
SOMATIC				

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

APPENDIX F: Full Frequency Tables

Table 21 *Full Frequency Results for Survey Questions in Appendix F*

G_CHAMP Frequency in championing the group to stakeholders

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	19	31.1	31.1	31.1
	Less than once a month	9	14.8	14.8	45.9
	Monthly	7	11.5	11.5	57.4
	2-3 Time a month	8	13.1	13.1	70.5
	Weekly	13	21.3	21.3	91.8
	Daily	5	8.2	8.2	100.0
	Total	61	100.0	100.0	

G_VISION Frequency in providing vision for direction of group activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	6	9.8	9.8	9.8
	Less than once a month	8	13.1	13.1	23.0
	Monthly	5	8.2	8.2	31.1
	2-3 Time a month	10	16.4	16.4	47.5
	Weekly	19	31.1	31.1	78.7
	Daily	13	21.3	21.3	100.0
	Total	61	100.0	100.0	

G_RECRUI Frequency in recruiting new members

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	15	24.6	24.6	24.6
	Less than once a month	14	23.0	23.0	47.5
	Monthly	7	11.5	11.5	59.0
	2-3 Time a month	9	14.8	14.8	73.8
	Weekly	10	16.4	16.4	90.2
	Daily	6	9.8	9.8	100.0
	Total	61	100.0	100.0	

G_NEWMEM Frequency in assisting new members

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	6	9.8	9.8	9.8
	Less than once a month	8	13.1	13.1	23.0
	Monthly	6	9.8	9.8	32.8
	2-3 Time a month	12	19.7	19.7	52.5
	Weekly	15	24.6	24.6	77.0
	Daily	14	23.0	23.0	100.0
	Total	61	100.0	100.0	

G_SOME Frequency in using social media to create awareness for the group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	3	4.9	4.9	4.9
	Less than once a month	7	11.5	11.5	16.4
	Monthly	2	3.3	3.3	19.7
	2-3 Time a month	12	19.7	19.7	39.3
	Weekly	20	32.8	32.8	72.1
	Daily	17	27.9	27.9	100.0
	Total	61	100.0	100.0	

G_RESOUR Frequency in creating resources that the group uses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	5	8.2	8.2	8.2
	Less than once a month	11	18.0	18.0	26.2
	Monthly	11	18.0	18.0	44.3
	2-3 Time a month	6	9.8	9.8	54.1
	Weekly	19	31.1	31.1	85.2
	Daily	9	14.8	14.8	100.0
	Total	61	100.0	100.0	

G_EVENT Frequency in creating and running events

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	11	18.0	18.0	18.0
	Less than once a month	12	19.7	19.7	37.7
	Monthly	7	11.5	11.5	49.2
	2-3 Time a month	11	18.0	18.0	67.2
	Weekly	19	31.1	31.1	98.4
	Daily	1	1.6	1.6	100.0
	Total	61	100.0	100.0	

G_NETWRK Frequency in networking with others and groups on behalf of the group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	1.6	1.6	1.6
	Less than once a month	4	6.6	6.6	8.2
	Monthly	6	9.8	9.8	18.0
	2-3 Time a month	10	16.4	16.4	34.4
	Weekly	22	36.1	36.1	70.5
	Daily	18	29.5	29.5	100.0
	Total	61	100.0	100.0	

CLEARGRP Perception of whether respondent understood others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	3.3	3.3	3.3
	Disagree	2	3.3	3.3	6.6
	Neither agree/disagree	2	3.3	3.3	9.8
	Agree	38	62.3	62.3	72.1
	Strongly Agree	17	27.9	27.9	100.0
	Total	61	100.0	100.0	

GRPCOMM Perception of group communication

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below Average	2	3.3	3.3	3.3
	Average	9	14.8	14.8	18.0
	Above average	33	54.1	54.1	72.1
	Excellent	17	27.9	27.9	100.0
	Total	61	100.0	100.0	

GRPSTREN Perception of use of group strengths

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below Average	1	1.6	1.6	1.6
	Average	14	23.0	23.0	24.6
	Above average	23	37.7	37.7	62.3
	Excellent	23	37.7	37.7	100.0
	Total	61	100.0	100.0	

GRPCONFL Perception of the resolution of conflict within the group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	1.6	1.6	1.6
	Average	28	45.9	45.9	47.5
	Above average	18	29.5	29.5	77.0
	Excellent	14	23.0	23.0	100.0
	Total	61	100.0	100.0	

GRPPROD Perception of the productivity of collaboration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below Average	1	1.6	1.6	1.6
	Average	12	19.7	19.7	21.3
	Above average	28	45.9	45.9	67.2
	Excellent	20	32.8	32.8	100.0
	Total	61	100.0	100.0	

G_CULTID Frequency in cultivating the identification of the group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	6	9.8	9.8	9.8
	Less than once a month	13	21.3	21.3	31.1
	Monthly	3	4.9	4.9	36.1
	2-3 Time a month	4	6.6	6.6	42.6
	Weekly	21	34.4	34.4	77.0
	Daily	14	23.0	23.0	100.0
	Total	61	100.0	100.0	

G_EVANG Frequency in evangelizing the group to others

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	9	14.8	14.8	14.8
	Less than once a month	7	11.5	11.5	26.2
	Monthly	6	9.8	9.8	36.1
	2-3 Time a month	14	23.0	23.0	59.0
	Weekly	17	27.9	27.9	86.9
	Daily	8	13.1	13.1	100.0
	Total	61	100.0	100.0	

GRPCLEAR Perception of whether the group understood respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	2	3.3	3.3	3.3
	Neither agree/disagree	4	6.6	6.6	9.8
	Agree	37	60.7	60.7	70.5
	Strongly Agree	18	29.5	29.5	100.0
	Total	61	100.0	100.0	

GRPIMPAC Perception of the impact of collaboration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	1.6	1.6	1.6
	Average	10	16.4	16.4	18.0
	Above average	25	41.0	41.0	59.0
	Excellent	25	41.0	41.0	100.0
	Total	61	100.0	100.0	

AVI_INTE Rated relationship of avatar inseparability (Virtual physioception)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	4.9	4.9	4.9
	Disagree	12	19.7	19.7	24.6
	Neither agree/disagree	8	13.1	13.1	37.7
	Agree	15	24.6	24.6	62.3
	Strongly Agree	23	37.7	37.7	100.0
	Total	61	100.0	100.0	

AVICOMM Reported tendency to speak about avatar as self

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	5	8.2	8.2	8.2
	Disagree	6	9.8	9.8	18.0
	Neither agree/disagree	5	8.2	8.2	26.2
	Agree	27	44.3	44.3	70.5
	Strongly Agree	18	29.5	29.5	100.0
	Total	61	100.0	100.0	

AOVSOLIM Reported of overcoming social limitations through avatar use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	9	14.8	14.8	14.8
	Disagree	6	9.8	9.8	24.6
	Neither agree/disagree	17	27.9	27.9	52.5
	Agree	20	32.8	32.8	85.2
	Strongly Agree	9	14.8	14.8	100.0
	Total	61	100.0	100.0	

AOVPHYS Rating of overcoming physical limitations through avatar use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	13	21.3	21.3	21.3
	Disagree	7	11.5	11.5	32.8
	Neither agree/disagree	19	31.1	31.1	63.9
	Agree	14	23.0	23.0	86.9
	Strongly Agree	8	13.1	13.1	100.0
	Total	61	100.0	100.0	

AOVCOMM Rating of overcoming communication limitations through avatar use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	11	18.0	18.0	18.0
	Disagree	6	9.8	9.8	27.9
	Neither agree/disagree	20	32.8	32.8	60.7
	Agree	16	26.2	26.2	86.9
	Strongly Agree	8	13.1	13.1	100.0
	Total	61	100.0	100.0	

AOVINTP Rating of overcoming interpersonal limitations through avatar use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	12	19.7	19.7	19.7
	Disagree	7	11.5	11.5	31.1
	Neither agree/disagree	21	34.4	34.4	65.6
	Agree	13	21.3	21.3	86.9
	Strongly Agree	8	13.1	13.1	100.0
	Total	61	100.0	100.0	

AVAECON Rating of acceptance of socio-economic status through avatar use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	9	14.8	14.8	14.8
	Disagree	12	19.7	19.7	34.4
	Neither agree/disagree	25	41.0	41.0	75.4
	Agree	10	16.4	16.4	91.8
	Strongly Agree	5	8.2	8.2	100.0
	Total	61	100.0	100.0	

AVAEDU Rating of acceptance of educational status through avatar use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	11.5	11.5	11.5
	Disagree	10	16.4	16.4	27.9
	Neither agree/disagree	26	42.6	42.6	70.5
	Agree	12	19.7	19.7	90.2
	Strongly Agree	6	9.8	9.8	100.0

	Total	61	100.0	100.0	

AVAGEND Rating of acceptance of gender through avatar use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	11.5	11.5	11.5
	Disagree	10	16.4	16.4	27.9
	Neither agree/disagree	34	55.7	55.7	83.6
	Agree	3	4.9	4.9	88.5
	Strongly Agree	7	11.5	11.5	100.0
	Total	61	100.0	100.0	

AVARACE Rating of acceptance of ethnicity through avatar use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	7	11.5	11.5	11.5
	Disagree	10	16.4	16.4	27.9
	Neither agree/disagree	33	54.1	54.1	82.0
	Agree	5	8.2	8.2	90.2
	Strongly Agree	6	9.8	9.8	100.0
	Total	61	100.0	100.0	

AVIINTER Rating of avatar customization for interactions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.6	1.6	1.6
	Disagree	6	9.8	9.8	11.5
	Neither agree/disagree	14	23.0	23.0	34.4
	Agree	29	47.5	47.5	82.0
	Strongly Agree	11	18.0	18.0	100.0
	Total	61	100.0	100.0	

AVIEXPRES Rating of avatar's contribution to group understanding VIP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.6	1.6	1.6
	Disagree	5	8.2	8.2	9.8
	Neither agree/disagree	20	32.8	32.8	42.6
	Agree	28	45.9	45.9	88.5
	Strongly Agree	7	11.5	11.5	100.0
	Total	61	100.0	100.0	

AVAPRED Rating of others' ability to predict physical activities based on knowing avatar

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.6	1.6	1.6
	Disagree	4	6.6	6.6	8.2
	Neither agree/disagree	14	23.0	23.0	31.1
	Agree	28	45.9	45.9	77.0
	Strongly Agree	14	23.0	23.0	100.0
	Total	61	100.0	100.0	

AVIQUEAT Rating of comfort to bequeath avatar

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	3	4.9	4.9	4.9
	Disagree	8	13.1	13.1	18.0
	Neither agree/disagree	18	29.5	29.5	47.5
	Agree	25	41.0	41.0	88.5
	Strongly Agree	7	11.5	11.5	100.0
	Total	61	100.0	100.0	

AVIAIFR Rating of comfort to become friends with artificial intelligent avatar

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	16	26.2	26.2	26.2
	Disagree	12	19.7	19.7	45.9
	Neither agree/disagree	18	29.5	29.5	75.4
	Agree	11	18.0	18.0	93.4
	Strongly Agree	4	6.6	6.6	100.0
	Total	61	100.0	100.0	

SOMATIC Rating of somatic awareness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.6	1.6	1.6
	Disagree	5	8.2	8.2	9.8
	Neither agree/disagree	26	42.6	42.6	52.5
	Agree	22	36.1	36.1	88.5
	Strongly Agree	7	11.5	11.5	100.0
	Total	61	100.0	100.0	

EMOTION Rating of emotional awareness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	3.3	3.3	3.3
	Neither agree/disagree	5	8.2	8.2	11.5
	Agree	42	68.9	68.9	80.3
	Strongly Agree	12	19.7	19.7	100.0
	Total	61	100.0	100.0	

TRANSLATE Rating of regulation of feelings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	4.9	4.9	4.9
	Neither agree/disagree	4	6.6	6.6	11.5
	Agree	42	68.9	68.9	80.3
	Strongly Agree	12	19.7	19.7	100.0
	Total	61	100.0	100.0	

ASSUMPT Rating of awareness of assumptions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	3	4.9	4.9	4.9
	Neither agree/disagree	9	14.8	14.8	19.7
	Agree	39	63.9	63.9	83.6
	Strongly Agree	10	16.4	16.4	100.0
	Total	61	100.0	100.0	

OPENWILL Rating of openness of heart and mind

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	3.3	3.3	3.3
	Neither agree/disagree	6	9.8	9.8	13.1
	Agree	34	55.7	55.7	68.9
	Strongly Agree	19	31.1	31.1	100.0
	Total	61	100.0	100.0	

IDIFFER Rating of appreciation for others' viewpoints

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither agree/disagree	4	6.6	6.6	6.6
	Agree	39	63.9	63.9	70.5
	Strongly Agree	18	29.5	29.5	100.0
	Total	61	100.0	100.0	

JOURNALS Frequency of reading diverse journals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rarely	4	6.6	6.6	6.6
	Occasionally	13	21.3	21.3	27.9
	Often	26	42.6	42.6	70.5
	Very often	18	29.5	29.5	100.0
	Total	61	100.0	100.0	

CONFEREN Frequency of attending/participating in diverse conferences

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	3.3	3.3	3.3
	Rarely	14	23.0	23.0	26.2
	Occasionally	21	34.4	34.4	60.7
	Often	20	32.8	32.8	93.4
	Very often	4	6.6	6.6	100.0
	Total	61	100.0	100.0	

COMMITTEE Frequency of attending/participating in diverse meetings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	1.6	1.6	1.6
	Rarely	4	6.6	6.6	8.2
	Occasionally	10	16.4	16.4	24.6
	Often	33	54.1	54.1	78.7
	Very often	13	21.3	21.3	100.0
	Total	61	100.0	100.0	

INSIGHTS Frequency of gaining insights from others for self

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	1.6	1.6	1.6
	Rarely	2	3.3	3.3	4.9
	Occasionally	15	24.6	24.6	29.5
	Often	26	42.6	42.6	72.1
	Very often	17	27.9	27.9	100.0
	Total	61	100.0	100.0	

MODIFY Frequency of modifying own work as result of others' input

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	1.6	1.6	1.6
	Rarely	8	13.1	13.1	14.8
	Occasionally	18	29.5	29.5	44.3
	Often	20	32.8	32.8	77.0
	Very often	14	23.0	23.0	100.0
	Total	61	100.0	100.0	

LINKAGES Frequency of establishing links with diverse colleagues

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	1.6	1.6	1.6
	Rarely	4	6.6	6.6	8.2
	Occasionally	17	27.9	27.9	36.1
	Often	25	41.0	41.0	77.0
	Very often	14	23.0	23.0	100.0
	Total	61	100.0	100.0	

APPENDIX G: Qualitative Word Clouds Based on Node Coding

Avatar Relationship:

Figure 55. Additional Word Clouds

Avatar Expression:

Avatar Empowerment:

Avatar Generativity:

Avatar Presencing:

Group Engagement:

Group Understanding:

Leadership:

Platform Affordances:

Towards Transdisciplinarity:

APPENDIX H: Curriculum Vitae

Barbara E. Truman

http://barbaratruman.com http://barbaratruman.blogspot.com

Summary of Experience

Eighteen years' experience as a leader and faculty administrator in online learning within higher education and corporate sectors. Architect of award winning, faculty development programs built on research and collaboration at one of the fastest growing, metropolitan research universities in the United States. Background within Instructional Systems Design and Human Performance Technology. Current researcher of collaborative virtual environments (CVEs) that span K-20, government, military and industry domains for simulation and game-based learning innovation including STEM.

Education

Colorado Technical University, Doctorate in Computer Science, Emerging Media
December 2013
Dissertation Title: Transformative Interactions using Embodied Avatars within Collaborative Virtual Environments: Towards Transdisciplinarity.

University of West Florida
Human Performance Technology, Graduate Certificate Aug. 2010

University of Central Florida, Orlando Florida
Doctoral courses, Curriculum and Instruction. Specialization: Instructional Technology July 2001
Masters of Arts, Instructional Technology: Instructional Systems Aug. 1996
Bachelors of Arts, Advertising and Public Relations May 1994
Clarita Garcia Communications Scholarship
Who's Who of American Universities
Omicron Delta Kappa National Leadership Honor Society
Seminole Community College, Sanford, FL
Associate of Arts, Magma Cum Laude, Who's Who American Junior Colleges May 1992
Awarded 30 credits from CLEP examinations
Operation Bootstrap HUD Scholarship, Orange County, Florida

Detailed Experience:

Fusion Unlimited Networks, LLC
Simulation Strategist October 2013-present
Conduct research and development into avatar-based collaboration in virtual environments for training, simulation, and education across industries for physical and virtual communities.

Academic Partnerships, LLC, Dallas, TX
Vice President of Learning Technologies Feb. 2013 – July 2013
Provide leadership and research support for innovative applications of learning systems, strategies, and technologies across a network of State Universities developing online learning. Liaison with professional associations, educational, government, and military research laboratories to advanced tested educational innovations. Develop effective, research-based practices to provide immersive learning experiences for medical simulations including nursing clinicals. Research massively open online courses (MOOC) for the MOOC2Degree Initiative.

University of Central Florida, Orlando, FL
Director, Course Development, Center for Distributed Learning July 2009 – January 2013
(Reorganization) Lead and oversee New Media, Learning Systems and Technologies, Techrangers™ and media teams for production of online programs and special initiatives. Forge new collaborative, interdisciplinary capabilities with online academic services across the institution including online Science, Technology, Engineering, and Mathematics (STEM) initiatives.

Director, Course Development & Web Services Feb. 1998-July 2009
Led, managed, and developed a learning organization to create fully-online, blended, and enhanced learning environments to support UCF's academic programs. Collaborated with diverse campus leaders to plan strategy, emerging technologies, and building capabilities to provide enterprise programs for effective faculty and course development. Created facilities, recruited and developed talented staff to produce cost-effective programs and multimedia productions. Provided analysis and evaluation to exceed accreditation requirements. Served on campus committees for accreditation, continuity of operations, security, and searches. Presented and published findings. Participated in regional, state, and national associations for university representation and professional development.

Coordinator of Course Development July 1997-Feb. 1998
Reported to the Vice Provost and Chief Information Officer to develop a department around a specially-funded pilot program. Recruited staff and created faculty development offerings, work flow processes, and systems of support for scalability. Planned, renovated, and designed facilities. Created models of service, evaluated learning technology tools and approaches to develop and diffuse best practice.

Course Developer June 1996-July1997
Reported to the Vice Provost of Academic Affairs to create UCF's first faculty development program to build inaugural online programs. Assisted in the creation of policies and procedures to institutionalize planning, development, and assessment. Performed analysis to recommend platform, tools, and approach to online learning.

Service to the Profession
Invited evaluator for the Sloan-C 2013 International Conference, Emerging Technology Track
Evaluator, Serious Games Challenge for the IITSEC Conference 2012, 2011

Advisory Board Member, GamesMooc hosted by Front Range Community College, Colorado, 2012, 2013
Participant, VWBPE MOOC and GamesMooc, 2012, 2013
Participant, Networked Seminar in New Media MOOC. Dr. Gardner Campbell, Virginia Tech, 2011
Journal Reviewer, International Review of Research in Open and Distance Learning
Journal Reviewer, EDUCAUSE Quarterly 2010
Reviewed proposals and volunteered for the Virtual Worlds Best Practices in Education annual conference
held in Second Life – 2011.
Reviewed grant proposals for Hewlett Packard's Innovations in Education Grant Program in 2010
Reviewed Effective Teaching with Technology in Higher Education: Foundations for Success by Tony Bates and Gary Poole. Jossey-Bass in 2002
Reviewer, Learning Anytime Anywhere Partnership (LAAP) Grants, U.S. Department of Education, Miami, FL 2001

Teaching Experience
IDL6543 Faculty Development Course
EDUCAUSE Learning Technologies Leadership Institute 2005-2007

Grant Involvement
2011 $250,000 EDUCAUSE Next Generation Learning Challenges Grant – Blended Learning
2008 $800,000 Sloan-C Regional Campus Blended Delivery
1999 $100,000 Florida Department of Education, Course Development, WebCT Training, Co-PI
1997 $40,000 UCF Pegasus Disc, Co-PI
1995 $800,000 Florida Distance Learning Demonstration Grant

UCF-Unit Recognition
2012 Sloan Consortium, Excellence in Institution-wide Online Education
2011 Sloan Consortium, Effective Practice in Online Education Award
2008 Sloan Consortium, Gomery Award for Quality Online Education
2006, 2009, 2011 Telly Awards for Video Productions
2005 EDUCAUSE national award, Systemic Teaching and Learning Award shared with Virginia Tech
2004-2011 State of Florida Davis Productivity Awards (multiple)
2003 Sloan Consortium, Excellence in Distance Learning Program Award
2000 United States Distance Learning Association, Best Program in Higher Education Award
1998 Benchmarking best practice award for teaching with technology, American Productivity and Quality Center (APQC) and State Higher Education Executive Officers (SHEEO)

Peer-Reviewed Publications

Moskal, P., Dziuban, C.D., Upchurch, R., Hartman, J., Truman, B. Assessing Online Learning: What One University Learned about Student Success, Persistence, and Satisfaction. (2006) *Peer Review: Emerging trends and key debates in undergraduate education: Learning & Technology*, *8*(4), 26-29.

Dziuban, C., Hartman, J., Moskal, P., Sorg, S., & Truman, B. (2004). Three ALN modalities: An institutional perspective. In J. Bourne & J. C. Moore (Eds.), *Elements of Quality Online*

Education: Into the Mainstream (pp. 127-148). Needham, MA: Sloan Center for OnLine Education.

Truman, B. (2004). UCF's Exemplary Faculty Support: An Institutionalized Ecosystem. *Journal of Asynchronous Learning Networks*, 8(3). Available: http://sloanconsortium.org/jaln/v8n3/ucf%E2%80%99s-exemplary-faculty-support-institutionalized-ecosystem

Dziuban, C.D., Moskal, P.D., Juge, F., Truman, B., Sorg, S. & Hartman, J. (2003). Developing a web-based instructional program in a metropolitan university. In B. Geibert & S. H. Harvey (Eds.), *Web-wise learning: Wisdom from the field* (pp. 47-81). Philadelphia, PA: Xlibris Publications.

Hartman, J. L., & Truman-Davis, B. (2001). The holy grail: Developing scalable and sustainable support solutions. *C. Barone & P. Hagner (Vol. Eds.), EDUCAUSE leadership strategies, 5*, 45-56.

Hartman, J. L., & Truman-Davis, B. (2001). Institutionalizing support for faculty use of technology at the University of Central Florida. *Teaching faculty how to use technology: Best practices from leading institutions*, 39-58.

Truman-Davis, B., Futch, L., Thompson, K., & Yonekura, F. (2000). Support for Online Teaching and Learning. EDUCAUSE Quarterly. 23 (2), 45-51. Available: http://www.educause.edu/ir/library/pdf/eq/a002/eqm0023.pdf

Sorg, S. Truman-Davis, B., Dziuban, C., Moskal, P., Hartman, J., & Juge, F. (1999). Faculty Development, Learner Support, and Evaluation in Web-based Programs. *Journal of Interactive Learning Environments*, *7*(2-3), 137-155.

Morse, L. & Truman, B. (1996). A Distance Education Infrastructure, *The Journal of Academic Media Librarianship, 4*, 1.

Presentations since 2005

Truman, B. (2013, November 15). Community is Key: Realizing the Potential of Collaboration in Virtual Environments. FantasTech Virtual Confernence. J. Reynolds Community College, VA., AvayaLive.

Truman, B. & Yonekura, F. (2013, August 14). Harnessing Edtech Innovation Requires a Cross (Fun)ctional Guild. Society for Applied Learning Technologies Conference, Reston, Virginia.

Truman, B. & Yonekura, F. (2013, May 20). Learning Design for use of Learner-Centered Authentic Tasks and Instructional Overlays. Invited session for the Loire Integrated Live-Virtual-Constructive (LVC) Learning Environments MOOC. Open Simulation-Moodle Platform.

Calongne, C., Novak, K., Luchs, C., & Truman, B. (2013, April 17). GamesMooc Lurkers Welcome. TCC Online Conference.

Brandman, R., Truman, B., Andersen, M., & Petersen, R. (2013, April 4). MOOC Provider Panel: Coursera, Academic Partnerships, Instructure, and EdX. EDUCAUSE Learning Initiative Spring Focus Session.

Truman, B., Yonekura, F., & Martin, T. (2013, January 28). GamesMooc Experiential Engagement and Transformation. Florida Educational Technology Conference, Orlando, FL.

Pickett, A., Truman, B., & Shaw-Nelson, C. (2012, October 10). Invited, feature session- Best Faculty Strategies. 18th Annual Sloan Consortium International Conference on Online Learning, Orlando, FL

Cavanagh, T., Truman, B., & Futch, L. (2012, August 29). Invited session for online learning to senior administrators at the Federal Law Enforcement Training Center (FLETC), Glenco, GA

Truman, B. (2012, May 3). First Stop: Cyberspace Immersive Learning for Study Abroad Orientation. Invited session for UCF's Summer Conference, Orlando, FL

Calongne, C., Yonekura, F., Truman, B., & Stricker, A. (2012, June). The Alchemy and Intimacy of the Learning Genome. New Media Consortium Annual Conference hosted by MIT, Boston, MA

Truman, B., Campbell, G., Dorland, L., Yonekura, F., Haymes, T. & Heyden, R. (2012, June). The Past, Present, and the Future of the Networked Seminar in New Media. New Media Consortium Annual Conference hosted by MIT, Boston, MA

Truman, B. (2012, March 7). Must Play to Learn: Can Digital Game-Based Learning Help Us Unlock Optimal Learning Outcomes? Invited session within SUNY Learning Network Online Learning Summit 2012, State University of New York, New York, NY

Truman, B. (2011, December). What's in it for Everyone? Innovative Applications of Game-Based Learning. Webinar delivered to the Colorado Community College System.

Truman, B. (2011, November). Growth with Quality: Building a Culture of Online Learning Through Strategic Educational Technology Collaboration. invited speaker for the Universitas21 Conference on Teaching and Learning held at the University of British Columbia, Vancouver, Canada

Yonekura, F., & Truman, B. (2011, June). Everybody Wins: DIY Open Gamification 4All. Presentation made at the New Media Consortium Annual Conference, Madison, WI

Yonekura, F. & Truman, B. (2011, June). Who's In? UCF's Gamemaker System for Learning, Research, and Institutional Engagement. Poster presented at the Games, Learning, and Society Conference, Madison, WI

Truman, B. & Futch, L. (2011, February). Optimal Contact: Opportunities for Course Redesign Using Blended Learning. American Association for State Colleges and Universities (AASCU) Winter Meeting "Innovation and Collaboration: Mapping the Journey to 21st Century Institutions, Orlando, FL

Truman, B. & Yonekura, F. (2010, November, 4). Demonstration of UCF's Obojobo learning content-management system presented at the University of West Florida, Pensacola, FL

Keene, A., Resmer, M. & Truman, B. (2010, September). Rich Media: The Future Learning Environment is Here Now. NUTN Summit Leading the New Normal, Colorado Springs, CO

Yonekura, F. & Truman, B. (2010, June). Institutional implementations of new media -beyond ad-hoc interventions. New Media Consortium Summer Conference. Anaheim, CA

Keene, A., Resmer, M., & Truman, B. (2010, March). Future of Learning Platforms. Campus2015 Rich Media Conclave, Trinidad

Ko, S., Ragan, L., & Truman, B. (2009, July). Preparing for Success: Faculty Development for Online Instruction. Department of Defense Worldwide Education Symposium, Atlanta, GA

Green, K., St. Arnaud, B., Truman, B., Yu, A. (2009, May 5). The Future of Technology and Education. Invited panel discussant, Collaboration and Engaging the Campus Conference, Case Western Reserve University, Cleveland, OH

Truman, B. & Adler, S. (2009, May 5). Designing, Building, and Evaluating Electronic Portfolios- Perspectives from the Campus and Silicon Valley. Invited session, Collaboration and Engaging the Campus Conference, Case Western Reserve University, Cleveland, OH

Ko, S., Ragan, L. & Truman, B. (2008, October). Increasing Impact: Best Practices for Faculty Development in Distance Learning. 14th Sloan Consortium International Conference on Online Learning, Orlando, FL

Truman, B. & Brown, M. (2007, July 11). Leading from Who You Are. Workshop for the EDUCAUSE Learning Technologies Leadership Institute, University of Wisconsin-Madison, WI

Brown, M. & Truman, B. (2007, July 11). Mentoring: Looking Outward and Inward. Workshop for the EDUCAUSE Learning Technologies Leadership Institute, University of Wisconsin-Madison, WI

Hansen, P. & Truman, B. (2007, July 10). Communication Strategies. Workshop for the EDUCAUSE Learning Technologies Leadership Institute, University of Wisconsin-Madison, WI

Juge, F., Truman, B., Futch, L., & Bauer, S. (2007, May 7). Old Wine in New Media, presentation for the Society of Wine Educators annual conference, Monterey, CA

Truman, B. (2006, June 10). One Leader's Path: Leading from Where You Are. Workshop for the EDUCAUSE Learning Technologies Leadership Institute, Pennsylvania State University, State College, PA

Williams, D., Truman, B. & Morrison-Shetlar, A. (2006, October 26). The Exploding Intersection of Faculty Development and Instructional Technology. Professional Organizational Development annual conference, Portland, OR

Hartman, J., Sorg, S., Dziuban, C., & Truman, B. (2005, October). Institutional Leadership for Online Learning Award. Annual EDUCAUSE Conference, Orlando, FL

Truman, B. (2005, July). Life is a Circus and the Show Must Go On: Managing Projects from the View of the Ringmaster. Workshop presented at the EDUCAUSE Instructional Technology Leadership Institute. Pennsylvania State University, State College, PA

Recent Professional Memberships - Representation
2013 International Society for Technology in Education (ISTE) Member of SIGVE
2013 IEEE Computer Society
2013 Association for Computing Machinery (ACM)
2013 Society for Simulation in Health Care
2012, 2013 Horizon Retreat Member, New Media Consortium, Austin, Texas
2010 Rich Media Conclave, Trinidad
2009 EDUCAUSE Annual Conference Program Committee and Chair, Teaching and Learning Track
2009 EDUCAUSE Search Committee for Associate Director, Learning Initiative
2009 EDUCAUSE Alternate Reality Game Planning Group for annual Learning Initiative Conference
2005-2007 EDUCAUSE inaugural faculty member, Learning Technologies Leadership Institute
2006 EDUCAUSE Learning Initiative Annual Program Committee Member
2006 EDUCAUSE Seminars in Academic Computing Annual Program Committee Member
2004-2011 conference planner with the American Association for State Colleges and Universities (AASCU) and

Previous memberships: Society Applied Learning Technology, United States Distance Learning Association,
American Society Training and Development, Project Management Institute, Society of Wine Educators, International Game Developers Association and the World Future Society.