2014

Facing Experience: A Painter's Canvas in Virtual Reality

Dolinsky, Margaret

http://hdl.handle.net/10026.1/3204

http://dx.doi.org/10.24382/3620
Plymouth University

FACING EXPERIENCE:

A PAINTER'S CANVAS IN VIRTUAL REALITY

by

MARGARET DOLINSKY

A thesis submitted to the University
of Plymouth in partial fulfillment for
the degree of

DOCTOR OF PHILOSOPHY

School of Art & Media
Faculty of Arts

In collaboration
with Indiana
University,
Bloomington USA

September 2014

Facing Experience: a painter's canvas in virtual reality
Margaret Dolinsky

Question: How can drawings and paintings created through a stream of consciousness methodology become a VR experience?

Abstract

This research investigate how shifts in perception might be brought about through the development of visual imagery created by the use of virtual environment technology.

Through a discussion of historical uses of immersion in art, this thesis will explore how immersion functions and why immersion has been a goal for artists throughout history. It begins with a discussion of ancient cave drawings and the relevance of Plato’s Allegory of the Cave. Next it examines the biological origins of “making special.” The research will discuss how this concept, combined with the ideas of “action” and “reaction,” has reinforced the view that art is fundamentally experiential rather than static. The research emphasizes how present-day virtual environment art, in providing a space that engages visitors in computer graphics, expands on previous immersive artistic practices.

The thesis examines the technical context in which the research occurs by briefly describing the use of computer science technologies, the fundamentals of visual arts practices, and the importance of aesthetics in new media and provides a description of my artistic practice. The aim is to investigate how combining these approaches can enhance virtual environments as artworks. The computer science of virtual environments includes both hardware and software programming. The resultant virtual environment experiences are technologically dependent on the types of visual displays being used, including screens and monitors, and their subsequent viewing affordances. Virtual environments fill the field of view and can be experienced with a head mounted display (HMD) or a large screen display. The sense of immersion gained through the experience depends on how tracking devices and related peripheral devices are used to facilitate interaction.

The thesis discusses visual arts practices with a focus on how illusions shift our cognition and perception in the visual modalities. This discussion includes how perceptual thinking is the foundation of art experiences, how analogies are the foundation of cognitive experiences and how the two intertwine in art experiences for virtual environments. An examination of the aesthetic strategies used by artists and new media critics are presented to discuss new media art. This thesis investigates the visual elements used in virtual environments and prescribes strategies for creating art for virtual environments. Methods constituting a unique virtual environment practice that focuses on visual analogies are discussed. The artistic practice that is discussed as the basis for this research also concentrates on experiential moments and shifts in perception and cognition and references Douglas Hofstadter, Rudolf Arnheim and John Dewey.

Virtual environments provide for experiences in which the imagery generated updates in real time. Following an analysis of existing artwork and critical writing relative to the field, the process of inquiry has required the creation of artworks that involve tracking systems, projection displays, sound work, and an understanding of the importance of the visitor. In practice, the research has shown that the visitor should be seen as an interlocutor, interacting from a first-person perspective with virtual environment events, where avatars or other instrumental intermediaries, such as guns, vehicles, or menu systems, do not to occlude the view. The aesthetic outcomes of this research are the result of combining visual analogies, real time interactive animation, and operatic performance in immersive space.

The environments designed in this research were informed initially by paintings created with imagery generated in a hypnopompic state or during the moments of transitioning from sleeping to waking. The drawings often emphasize emotional moments as caricatures and/or elements of the face as seen from a number of perspectives simultaneously, in the way of some cartoons, primitive artwork or Cubist imagery. In the imagery, the faces indicate situations, emotions and confrontations which can offer moments of humour and reflective exploration. At times, the faces usurp the space and stand in representation as both face and figure. The power of the placement of the caricatures in the paintings become apparent as the imagery stages the expressive moment. The placement of faces sets the scene, establishes relationships and promotes the honesty and emotions that develop over time as the paintings are scrutinized.

The development process of creating virtual environment imagery starts with hand drawn sketches of characters, develops further as paintings on “digital canvas”, are built as animated, three-dimensional models and finally incorporated into a virtual environment. The imagery is generated while drawing, typically with paper and pencil, in a stream of consciousness during the hypnopompic state. This method became an aesthetic strategy for producing a snappy straightforward sketch. The sketches are explored further as they are worked up as paintings. During the painting process, the figures become fleshed out and their placement on the page, in essence brings them to life. These characters inhabit a world that I explore even further by building them into three dimensional models and placing them in computer generated virtual environments. The methodology of developing and placing the faces/figures became an operational strategy for building virtual environments. In order to open up the range of art virtual environments, and develop operational strategies for visitors’ experience, the characters and their facial features are used as navigational strategies, signposts and methods of wayfinding in order to sustain a stream of consciousness type of navigation.

Faces and characters were designed to represent those intimate moments of self-reflection and confrontation that occur daily within ourselves and with others. They sought to reflect moments of wonderment, hurt, curiosity and humour that could subsequently be relinquished for more practical or purposeful endeavours. They were intended to create conditions in which visitors might reflect upon their emotional state, enabling their understanding and trust of their personal space, in which decisions are made and the nature of world is determined.

In order to extend the split-second, frozen moment of recognition that a painting affords, the caricatures and their scenes are given new dimensions as they become characters in a performative virtual reality. Emotables, distinct from avatars, are characters confronting visitors in the virtual environment to engage them in an interactive, stream of consciousness, non-linear dialogue.

Visitors are also situated with a role in a virtual world, where they were required to adapt to the language of the environment in order to progress through the dynamics of a drama. The research showed that imagery created in a context of whimsy and fantasy could bring ontological meaning and aesthetic experience into the interactive environment, such that emotables or facially expressive computer graphic characters could be seen as another brushstroke in painting a world of virtual reality.

Margaret Dolinsky

Facing experience: A painter's canvas in virtual reality

Chapter 2: Research Review

Chapter 3: Creative Activity Review

Chapter Six: Apogee

References

Illustrations

Chapter One: Introduction

Chapter 2: Research Review

Chapter 3: Creative Activity Review

Chapter Four: Methodology

Figure 4.13 "*Figuratively Speaking*" M. Dolinsky 2012. Virtual Environment Still. VR offers the ability to swap boundaries from reality to virtuality and to see unfamiliar objects as environments. This can be exploited even further when the visitor can see the virtual world from various vantage points that are easily traveled compared to the real world.

Figure 4.14 "*Blue Window Pane II*" M. Dolinsky 1999. Virtual Environment Still. Here the 'Stairwell scene' is made up of staring emotables and stairwells. The visitor can follow the spiral stairwell or jump off the stairs which enables flying. We can move internal boundaries from one method of travel to an alternate method of travel.

Figure 4.15 "*Beat Box*" M. Dolinsky 2004. Photo. Here a CAVE visitor is placing sound selections represented by necklaces on an interval of the audio sequencer, represented by an emotable.

Figure 4.16 "*Blue Window Pane II*" M. Dolinsky 1999. Virtual Environment Still. The '*Living Room*' has the emotables watching a projection screen with different frequencies selected by pressing a navigation button that corresponds to a small head below the screen.

Figure 4.17 "COLOR" in all three instances is the same color but it loses visual uniformity with different backgrounds.

Figure 4.18 The image contains hues that appear as multiple shades.

Figure 4.19 The color squares are the same in all images, yet their appearance is altered by the background color. This provides four different types of interpretation of the original squares.

world and when the globe of heads is approached, the scene transitions to "*Dream Grrrls*". Installed at the Ars Electronica Center in 1996.

Figure 5.47 "*Blue Window Pane II*" M. Dolinsky. VR Still. When the visitor approaches the windows, they shatter and a spray of colorful computer graphics temporarily and metaphorically "blinds" the visitor with surprise. Then suddenly the scene changes and the visitor is in another environment.

Figure 5.48 "*Figuratively Speaking*" M. Dolinsky. VR Still. The faces are talking at once in a small grouping. As the visitor approaches the heads their voices become more audible. We can generalize that because all the emotables are in one place that is a significant place to be. Indeed, travel to that area reveals new sound perceptions.

Figure 5.49 "*Figuratively Speaking*" M. Dolinsky. VR Still. The emotable acts as a guard to prevent anyone from continuing further. If the visitor continues, the guards will gesticulate and wave their arms in protest, often calling out a sound to further their expressions. If the visitor overcomes the guard and continues past, the environment will change in some way to reflect a new consciousness a new stance in that space and a new location.

Figure 5.50 "*Figuratively Speaking*" M. Dolinsky. VR Still. "*Figuratively Speaking*" is completely created with emotables and the smaller elements that make up the emotables become the larger elements of the environment. Here one nose of an emotable becomes a tree. Inside the trees are two figures in conversation. The space is called the "*Forest of Knowses.*"

Figure 5.51 "*Blue Window Pane II*" M. Dolinsky. Photograph in the CAVE. The emotable appears as a mask that has its eyes closed until it is approached and it stops its repetitive chant of OM. When the visitor comes eye to eye with the emotable, the scene will transition to a rotating tunnel that represents the turnings of the unconscious. The emotable as a mask is generalized as a doorway to another environment as well as doorway to perception.

Figure 5.52 "*Blue Window Pane II*" M. Dolinsky. VR Still. Many faces and stairwells make up the scene. The stairs are representative of travel in the environment as well as gaining a height towards a deeper psychic level or deeper contemplation. Here the scene also "stares" back.

Figure 5.53 "*Beat Box*" M. Dolinsky VR Still. An audio sequencer is made up of a series of emotables with long necks that hold necklaces. Each necklace represents a sound sample that the visitor has placed at an interval on the sequencer.

Figure 5.54 This chart outlines artistic elements that guide the navigation in Dolinsky's virtual environments. The 3D objects are circumstances or point so interest to help the visitor find their way. The analogies enhance the emotional landscape of the environment.

Figure 5.55 "*Beat Box*" M. Dolinsky. Sound activated graphics provides visual cues for the visitor to know which interval on the sequencer is active. When the head enlarges it plays a unique sound and appears to have a unique voice.

Figure 5.56 "*Dream Grrrls*" M. Dolinsky, Grit Sehmisch 1996. The environment becomes very dark and the navigation wand becomes a flash light. This is analogous to discovering new ways of traveling in the dark and ideas of self-discovery.

Figure 5.57 "*Figuratively Speaking*" M. Dolinsky. The visitor climbs a mountain to the "Land of Sees" where the blue water and sky offers an expanse of color where we can generalize that the world can be filled with objects or not filled with objects but contains us all the same. We have the ability to see it in many ways depending on our state of consciousness and what we connect with.

Figure 5.58 "*Dream Grrrls*" M. Dolinsky, Grit Sehmisch 1996. In the "See-Saw World," the spheres of emotables act as a see-saw to carry the visitor and the emotable in a sea of clouds high in the air.

Figures 5.59 "*Blue Window Pane II*" M. Dolinsky. In the "*Stair scene*" a sense of height is gained by climbing the central spiral staircase and jumping off the stairs. The height is a generalization of how height is experienced in the real world and is a metaphor for a new lease on life and gaining a new perspective.

Figures 5.60 "*Figuratively Speaking*" M. Dolinsky In the "*Land of the Sees*" a mountain is climbed and a sculpture reconfigures itself to reveal an expansive viewpoint. The concept of travel and height is generalized to be able to travel up into the mountains in the virtual world.

Figure 5.61 "*Figuratively Speaking*" M. Dolinsky. VR still. Interior and exterior spaces allows boundaries to shift and substructures to break apart or merge. Here the windows frame the outside world.

Figure 5.62 "*Blue Window Pane II*" M. Dolinsky. VR Still. The inner sanctum of the environment is texture laden in order to indicate somewhere novel yet the structure is reminiscent of real world walls and windows in order to set up a challenge to explore.

Figure 5.63 "*Strait Dope*" M. Dolinsky. VR Still. The texture rich environment is an imaginary hallucinatory scene that occurs when we are sober. Confrontation with the emotables provide a level of conversation in the form of animated exchanges. Although the scene is not familiar, it has a landscape and characters that we can explore in a manner similar to the real world.

Figure 5.64 "*Strait Dope*" M. Dolinsky. The emotables are swapping components and shifting from one level to another when they move from being quiet to becoming animated and demand things of the visitor who is originally there to be entertained.

Figure 5.65 "*Dream Grrrls*" M. Dolinsky, Grit Sehmisch. VR Still. The labyrinth is the main room with emotables that are portals to other dream worlds. The Labyrinth is the place of return from the dreams and when the visuals transition to this scene, it is a metaphor for waking up from the dream.

Figure 5.66 "*Blue Window Pane II*" M. Dolinsky 1999. A gold skeleton key is found in each room and the key points the way in or out of an environment.

Figure 5.67 "*Figuratively Speaking*" M. Dolinsky 2012. VR Still. The landscape is made from components of the emotables faces to symbolize that the land is intrinsic to who they are.

Figure 5.68 This chart artistic elements that guide the navigation in Dolinsky's virtual environments. The 3D objects are circumstances or points of interest to help the visitor find their way. The analogies enhance the emotional landscape of the environment.

Figure 5.69 "*Cabinet of Dreams*" M. Dolinsky 2005. The main room has the possible selections for the non-linear movement by way of the cabinets that act as portals to take the visitor to other worlds.

Figure 5.70 "*Cabinet of Dreams*" M. Dolinsky 2005. The main room has all the possible selections for non-linear, non-hierarchical travel. The work unfolds for the visitor without prescribed paths because the work is created in order to enhance a self-directed flow.

Figure 5.71 This chart outlines artistic elements that incorporate animations to guide the visitor in Dolinsky's virtual environments. The 3D objects are circumstances or points of interest to help the visitor find their way. The analogies enhance the emotional landscape of the environment.

Figure 5.72 "*Blue Window Pane*" M. Dolinsky 1999. VR Still. The Living Room has a projection screen with buttons that correspond to the navigation wand.

Acknowledgements

Many Thanks to Roy Ascott, Director of Supervision of my research at the University of Plymouth, for his insight and inspiration during my supervision. Thank you to Michael Punt and Mike Phillips for their supervision support.

Thanks to my network of Planetary Collegium colleagues. I enjoyed our adventures as members of the Centre for the Advanced Inquiry in the Interactive Arts.

Very Special Thanks to Ed Dambik and Vera Kapur, who provided both technical support and humor so that I could achieve a wonderful and wonder filled research trajectory.

AUTHOR’S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

The tuition was a self-financed. Technical support for the research was provided by the Advanced Visualization Lab at Indiana University (IU) Bloomington, USA. The research was supported by the IU President’s Initiative, IU College of Arts & Humanities Institute, the Pervasive Technology Institute D2I Grant, IU New Frontiers Grants, IU UITS Software Support Grant, and the Indianapolis Museum of Art.

All of the written thesis and artwork had been instigation of the candidate, unless otherwise noted.

Relevant seminars and conferences were regularly attended at which work was often presented; external institutions were visited for consultation purposes and several papers prepared for publication.

Presentation of creative and performing work:

2013 Supercomputing 13. Denver CO. Nov 17-22. The Living Canvas digital canvas and IQ Tables.

IEEE Cluster 2013. Indianapolis, IN. Sept 23-27. The Living Canvas digital canvas.

Grunwald Gallery of Art, Aug 30- Oct 11. The Living Canvas digital canvas and IQ Tables.

Bushwick AR Intervention, Thin Air Gallery, Bushwick, NY. May 31- June 2. Augmented Reality.

2012 Supercomputing 2012 Salt Lake City,UT. Poke holes into your Thoughts interactive installation.

Smithsonian Folklore Festival Emotable Portraits installation, Washington DC.

Ecclesiastical Art Exhibit, Emotable Portraits installation Indianapolis Convention Center

Adler Planetarium "Moon Lust" Chicago, IL

Bushwick Studios, New York Augmented Reality Exhibition June

Manifest AR Shanghai Augmented Reality Exhibition. June

Manifest AR Bloomington Augmented Reality Exhibition. May

Out of the Box, San Francisco, CA. Augmented Reality Exhibition. Jan 23-25. Strait Dope.

IU SoFA Faculty Exhibition, Grunwald Gallery, Indiana University, Jan 13-28. Figuratively Speaking.

2011 Cyberinfrastructure Building (CIB) Dedication October 12, 2011

Inter:Facing, Grunwald Gallery, Indiana University, Sept 9-28. Solo exhibition of interactive animations.

Passion with Tropes, Opera with IU Jacobs School of Music, Dept of Theater&Drama, Halls Theater, May.

Telematic Collective Concert & VR Exhibit. IUPUI Informatics & Communications Tech Complex. Apr 21.

Big Robot, University of Illinois at Urbana-Champaign. Separation in concert. Apr 14.

Zerospace Conference on Distance & Interaction in Music. Univ Wisconsin-Milwaukee. Feb 18. Fig Speaking.

PVE: Performance Video Event, University of the Streets, NYC. Separation animation. Feb 12

30 Second Spot, School of Visual Arts, NYC. Separation animation. Feb 9.

2010 IEEE Cloud Computing. Indianapolis, IN. Dec 1-3. Emotable Portraits, animations. Separation-concert premier.

Intermedia Festival Marion Cnty Public Library Central Branch, Indianapolis. Apr 23-27.Emotable Portraits.
Intermedia Festival IUPUI VR Theater, Indianapolis. April Six Friends VR.
IEEE VR 2010 March 20-26, 2010 in Waltham, Massachusetts, USA Six Friends VR.
Simon Fraser School of Interactive Arts and Technologies March. Emotable Portraits.
Bloomington Faculty from IU's Hope School of Fine Arts. IU Art Museum. Emotable Portraits Jan 22-Mar 7.
Art in Virtual Reality. IS&T SPIE Electronic Imaging: Science & Technology. San Jose, CA. Jan. 18-21. SixFriends.

2009 Beihang University, Beijing, China. Nov. Emotable Portraits.
Indiana University Kokomo Art Gallery. Kokomo, IN. Jan. Hello World large screen installation.
Annuncaition+Visitation: operatic projections of her sexual insight. Buskirk Chumley Theater Oct 9-10. Projections. In collaboration with American Opera Theater and IU Jacobs School of Music.
Celestial Reflections. Indiana University Kokomo Oct 1-Nov12. Solo. Emotable Portraits&projections.
International Association for the Study of Dreams Art Exhibition. Chicago IL.Jun 25-30. 2D Prints.
Dreamtime. Dean Johnson Gallery. Indianapolis, IN. May1-Jun18. Emotable Portraits, Painting, Videos.
Concentus. In collaboration with the Early Music Institute at IU Jacobs School of Music Recital Hall. Mar 29. Emotable Portraits interactive installation and projections.
AXIOM Center for New and Experimental Media. MG Fest09, Motion Graphics Festival. Boston MA. Mar 7-14. Emotables Portraits animation.
MASHITUDE. MG Fest09, Motion Graphics Festival. Chicago IL. Jan 24. Emotables P. animation.
VR Works! IS&T SPIE's Electronic Imaging: Science & Technology. San Jose, CA. Jan. 18-21. VR Portraits.

2008 Supercomputing 2008. Austin, TX. Nov. Emotable Portraits interactive installation.
Towards a Science of Consciousness. Tucson, AZ. Apr. Hello World screen installation.

Sponsae Christi.. In collaboration with the Early Music Institute, IU Jacobs School of Music, IU Dept of Theater and Drama. Indiana University Art Museum. Bloomington. Feb 24. Drama.

MG Fest08, Motion Graphics Festival, Society for the Arts. Chicago IL. Jan 15-21. Hello World screen installation. www.mgFest.com

Indiana University Kokomo Art Gallery. Kokomo, IN. Jan. Hello World large screen installation.

2007 Glitches, Bits, & Switches. Alogon Gallery. Chicago, IL Dec 1-31. Hello World large screen installation.

INtransit V.2: Fast Women. 119 Gallery. Lowell, MA. Oct 13. Video collaboration with Bebe Beard.

DART Gallery. IV07 Information Visualization. Zurich, Switzerland. Hello World (Illuminated Script), July 3-6. DART gallery online and poster.

ACM SIGCHI Creativity & Cognition Conference. Washington, DC. June 14-15. Interfectio Puerorum : Digital Projections and the12th Century Fleurys. Demonstrations.

Fleury: Massacre of the Innocents. Trinity Congregational Church, Bloomington. Mar 31. Drama in collaboration with the Early Music Institute, IU Jacobs School of Music.

The Bloomington Biennial 2007: Faculty Artists from IU's Hope School of Fine Arts. Indiana University Art Museum. Hello World (Illuminated Script) Jan 27-Mar 11.

Cinewomen NY presents Animation, Avant-Garde, and Experimental Films. Two Boots Pioneer Theater. Experimental: interactive movies for CAVEs. NY, NY. Jan 23.

Fleury: Massacre of the Innocents. In collaboration with the Early Music Institute, IU Jacobs School of Music. Indiana University Art Museum. Bloomington. Jan 13. Drama.

2006 IU Research Works. SuperComputing 06. Tampa FL. Nov 13-16. Cabinet of Dreams Poster.

Cabinet of Dreams. Indianapolis Museum of Art. Asian Galleries. Nov 06-. Permanent Collection.

Buffalo Infringement Festival VR Subfest. Haywalls Arts Center. Buffalo, NY. Beat Box. Aug 4-6.

Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T SPIE's 17th Annual International Symposium: Electronic Imaging: Science and Technology. The

Engineering Reality of Virtual Reality. Cabinet of Dreams VR exhibition, San Jose, CA. Jan 20.

2005 ResearchWorks. SuperComputing 05, Seattle Washington. Nov 12-18. Cabinet of Dreams. John-e-box.

IGRID, International GRID, San Diego CA. Sep 26-29. Cabinet of Dreams. CAVE-to-CAVE.

I-Light, IN Univ. Purdue Univ., Indianapolis. Sep 21- 25. Cabinet of Dreams. CAVE-to-CAVE to IUB.

Ingenuity Festival. Cleveland Museum of Art, OH Sep 1-4. Cabinet of Dreams. CAVE wall.

X Room. Indianapolis Museum of Art. May 5-Nov 2006. Cabinet of Dreams- Permanent Collection.

American Association of Museums Conference. May 3. Cabinet of Dreams.

Bloomington Biennial 2005: Faculty Artists from IU's Hope School of Fine Arts. Indiana University Art Museum, IU Bloomington. Mar 25-Apr 30. Journey 405. Plasma Display.

VR Works Panel and Demonstration. Society of Imaging Sciences and Technology International Society of Optical Engineering IS&T/SPIE's 16th Annual International Symposium: Electronic Imaging: Science & Technology. The Engineering Reality of Virtual Reality Conference Exhibition. San Jose, CA. Jan 17-21. Beat Box. CAVE-to-CAVE to Univ. of Illinois Chicago, SUNY Buffalo, IU.

2004 Red Gate Gallery, Dongbianmen Watchtower, Chongwenmen, Beijing, China. Nov 24-27. Vintage ImmersaGrams.

CAVE to CAVE Network Art Exhibition. SVR 2004 Seventh Symposium on Virtual Reality. In Sao Paulo, Brazil. Oct 21. Collaboration between Brazil, SUNY Buffalo, EVL-UIC Chicago, Royal Institute of Technology [Kungliga Tekniska högskolan], Stockholm Sweden and IU.

The Lounge. School of Fine Arts Gallery, IU Bloomington. Oct 8. Activations No. 2. John-e-box.

Networks and Collaboration. SUNY Buffalo Conference Apr 24-25. CAVE-to-CAVE. Beat Box.

IEEE Virtual Reality Annual International Symposium. VRAIS '04. Chicago, IL. Mar 29. Network CAVEs from IU to Chicago and Sweden. Beat Box.

DART Exhibition. SoFA Gallery, IU Bloomington. Feb 9-21. Activations. John-e-box.

VR Works. Society of Imaging Sciences and Technology International Society of Optical Engineering IS&T/SPIE's 15th Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality Conference. In San Jose, CA. Jan 18-22. Beat Box. Networked at Univ of Illinois at Chicago, SUNY Buffalo and IU.

2003 The Lounge. School of Fine Arts Gallery, Indiana University, Bloomington. Oct 10. John-e-box.

Immedia. University of Michigan Media Union. Ann Arbor, Jan 31 Feb 8. Beat Box CAVE.

Bloomington Biennial 2003: Faculty Artists from Indiana University Hope School of Fine Arts. Indiana University Art Museum, Bloomington. Jan 25-Mar 9. Beat Box. John-e-box.

2002 I-Light. IUPUI, Indianapolis. Dec 4. Indiana test-bed CAVE Exhibit over the Indiana Fiber Optic Net.

International Grid applications-driven high bandwidth testbed. IGrid 2002, Amsterdam, Holland. Sep 24-26. Beat Box–CAVE environment was networked simultaneously between CAVEs in Indiana, Univ of Illinois at Chicago, NCSA Champaign IL, SUNY Buffalo and Amsterdam.

digitalwind. Museum of Contemporary Art Chicago Version 2.0. Apr 18. Dream Grrrls and Beat Box.

The WHO? Show. Murphy Art Center, Indianapolis, IN. Mar 16-22. Vintage ImmersaGrams: signed interleaved CAVE Epson prints and Kodalith films mounted on Plexiglas, framed in a metal light box.

Immedia Digital Arts. University of Michigan Media Union, Ann Arbor. Beat Box. Feb 8-17. CAVE.

Margaret Dolinsky. Space version 2.1 [Online Gallery] Curator: Ryan Gibson.

2001 Research@Indiana. SC01, SuperComputing, Denver, CO, Beat Box Networked CAVE. Nov 10-16.

Digital Frontier–The Buffalo Summit. University of Buffalo. Nov 2-3. Beat Box–ImmersaDesk.

Digital Innovations in Printmaking. Drexel University Arts Gallery, Philadelphia, PA. Oct 31- Dec 7.

New Media Aesthetic. Alternate Currents. Chicago IL. Oct 27. Beat Box CAVE-to-CAVE.

Alive on the GRID. Ars Electronica Festival 2001 Linz, Austria. Sep. Beat Box collaboration with UIC Chicago, SUNY Buffalo, Umea, Sweden, C3 Budapest, Amsterdam and IU. Permanent Collection.

Blue Window Pane II. NTT InterCommunication Center. Tokyo, Japan. June 24. CAVE Exhibit.

CAVE-to-CAVE Artspeak: Visual Metaphors for Collaborative Navigation. and LVis - A Smart Virtual Reality Interface to Digital Libraries. Collapsing Time & Space: A High Performance Network Application Program Symposium, IUPUI Indianapolis. Apr 6. Poster.

Bloomington Biennial 2001: Faculty Artists from IU's Hope SoFA. IN Univ. Art Museum. Mar-Apr.

2000 Wired Women: On the Verge of a Digital Renaissance. The Gallery at the Three Arts Club, Chicago, IL. Dec 8 - Jan 22. ImmersaGrams exhibition.

Research@Indiana. SC2K SuperComputing 2000. Dallas TX. Nov 6-10. Blue Window Pane II–Networked CAVE to ImmersaDesk Exhibition. LVis–ImmersaDesk exhibition, & Virtual Poster.

Alberto Casiraghi. IU School of Fine Arts Gallery, Bloomington. Sep 15 - Oct 6. "Sanctum" book collaboration with Casiraghi.

International Grid Research Infrastructure Exhibition. INET Global Research Summit. IGrid 2000, Yokohama, Japan. July 16-21. Blue Window Pane II–CAVE-to-CAVE.

ImmersaGrams Virtual Reality Snapshots. (art)^{n} Laboratory, Chicago, IL. May 8-13.

1999 After Hours, Walker Art Center, Minneapolis, Nov. Artist in Residence. Dream Grrrls ImmersaDesk.

CAVE Exhibition. Ars Electronica Center Festival 1999. Linz, Austria. Sep. Blue Window Pane–Permanent Collection.

SigKids. SIGGRAPH '99. ACM Special Interest Group on Graphics, Los Angeles CA. July. Blue Window Pane, Panorama Screen Stereo Display.

Second Nature: A Show of New Media for the New Millennium Ukrainian Institute of Modern Art, Chicago IL. May 9-June 27. ImmersaDesk and ImmersaGrams Exhibition. Color catalogue.

Immedia 99. University of Michigan Media Union, Ann Arbor. Dream Grrrls–CAVE. Jan 27-Feb 6.

Margaret Dolinsky–Electronic Fields. Illinois Art Gallery, Chicago. Feb 26-Apr 9. Curator: Jane Stevens. Sponsored by the Sony Gallery of Consumer Electronics. Individual Exhibition.

Digital Tools and Output Media: Deleting the Discord between Art and Technology. Dorothy Uber Bryan Gallery, Bowling Green State University, OH. Dream Grrrls. Dec 5- Feb 5.

6th NY Digital Salon. Center de Cultura Contemporania de Barcelona, Spain. Mar 22-Apr18. [Traveling]

6th Annual NY Digital Salon. Triennale di Milano, Italy. Feb 15 – Mar 15, 1999. [Traveling exhibition.]

6th Annual New York Digital Salon. Circulo de Bellas Artes, Madrid. Jan 8 - Feb 7. [Traveling exhibition.]

Publications

2014 Dolinsky, M.," Facing Experience: A Painter's Canvas on Virtual Reality" forthcoming

Dolinsky, M.," Shifting Perceptions - Shifting Realities" in Geroimenko, V., (Editor) Augmented Reality Art: From an Emerging Technology to a Novel Creative Medium Publisher: Springer

Dolinsky, M in Cox, D., Sandor, E., et al., New Media Women Artists: Prairie Style forthcoming book.

Dolinsky, M., McDowall, I., Eds., Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T SPIE's 25th Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality (Conference Proceedings). San Francisco, CA. Feb.

2013 Craig, Alan. 2013 Understanding Augmented Reality, 1st Edition. Morgan Kaufmann.

Dolinsky, M., "Emoting Virtual Worlds" Intelligent Agent

Dolinsky, M., "Art and Virtual Environments" Media-N Journal Sum 2013: V.09 N.02 CAA Conference Edition.

Dolinsky, M., McDowall, I., Eds., Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T SPIE's 24th Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality (Conference Proceedings). San Francisco, CA. Jan.

2012 Dolinsky M, Sherman W, Wernert E, Chi Y, Reordering Virtual Reality: Recording and Recreating Real-Time Experiences. The Engineering Reality of Virtual Reality (Conference Proceedings). San Francisco, CA. Jan.

McDowall, I., Dolinsky, M. Eds., Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T

SPIE's 23rd Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality (Conference Proceedings). San Francisco, CA. Jan.

Dolinsky M. Emoting Virtual Worlds *Intelligent Agent*. Eds. Patrick Lichty and Christiane Paul.

2011 Dolinsky M. Facing Perceptual Shifts in Proceedings International Society of Electronic Arts, ISEA Istanbul.

McDowall, I., Dolinsky, M. Eds., Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T SPIE's 22nd Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality (Conference Proceedings). San Francisco, CA. Jan.

2010 Woods, A. et al Stereoscopic Displays and Applications 1990-2009: A Complete 20-Year Retrospective and The Engineering Reality of Virtual Reality 1994-2009 (Special Collection) SPIE Volume: CDP51. Co-Editor. Sept.

McDowall, I., Dolinsky, M. Eds., Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T SPIE's 21st Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality (Proceedings). San Jose, CA. Jan.

2009 Dolinsky M, Transformative navigation: energizing imagery for perceptual shifts. Chinese Translation.

Dolinsky M, Transformative navigation: energizing imagery for perceptual shifts. In Technoetic Arts. Vol 7 Issue 1 Jun. Ed.: Roy Ascott. Bristol: Intellect. pp.49-64 w/3 pps. full color images.

McDowall, I., Dolinsky, M. Eds., Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T SPIE's 20th Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality (Proceedings).. San Jose, CA. Jan.

2008 Dolinsky M, Imaging technological structures for organization of biological consciousness and aesthetic experience. Ed.: Roy Ascott. New Realities: Being Syncretic: IXth Consciousness Reframed Conference Vienna 2008 (Edition Angewandte) by Roy Ascott, Gerald Bast, Wolfgang Fiel, and Margarete Jahrmann. Vienna: Springer.

McDowall, I., Dolinsky, M. Eds., Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T

SPIE's 19th Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality (Conference Proceedings).. San Jose, CA. Jan.

2007 Astrodime Transit Authority. Fast Women. Boston, MA. DVD series.

Dolinsky M, Hello World (Illuminated Script). IV07 Information Visualization. Zurich, CH. July 3-6.

Dolinsky M, Nelson T, Interfectio Puerorum: Digital Projections and the 12th Century Fleury's Massacre. ACM SIGCHI Creativity & Cognition Proceedings. Washington, DC. June.

Dolinsky M, CAVEs Projecting Imagination into Reality across High Speed Networks. *Art Inquiry.* (Contemporary arts journal) Ed.: Ryszard W. Kluszczynski. Lodz: Scientific Society Press, Poland.

2006 Dolinsky M, Inverse Perspective in Proceedings of International Society of Optical Engineering's Electronic Imaging Science & Technology Technical Conference: *Engineering Reality of Virtual Reality*.

Dolinsky M, Sharing Virtual Reality Environments across the International Grid (iGrid) in Ascott R, Ed., *Engineering Nature: Art and consciousness in the post-biological era*. Bristol: Intellect.

Tsoupikova D, Dolinsky M, Hill, A, Kostis H, Hmeljak D, Zhizhiin M, Medvedev D, Ygdrasil - framework improvements empower artists with rendering and creative control. In *Future Generation Computer Systems.* Publication pending.

2005 Dolinsky M, A Ballad of Historical Dependency. Emerging Technologies Panel: New Media Art: research at the forward edge. *Visual Proceedings of ACM SIGGRAPH '05.* L.A. CA. Aug 1.

Dolinsky M, Experiential: becoming a part of the history of projections. in *Proceedings of Altered States: transformations of perception, place, & performance.* University of Plymouth, UK. July 22–24.

Dolinsky M, Anstey J, Pape D, Aguilera J, Kostis H, Tsoupikova D, Collaborative Virtual Environments Art Exhibition. Proceedings of International Society of Optical Engineering's Electronic Imaging Science and Technology Technical Conference: *The Engineering Reality of Virtual Reality 2005*.

2004 Dolinsky M, Aligning Projections: Painting and the CAVE. *Ciber@rt Bilbao.* Spain, Apr 26-29.

Dolinsky M, Visual navigation structures in collaborative virtual environments. in Proceedings of International Society of Optical Engineering's Electronic Imaging Science and Technology Technical Conference: *The Engineering Reality of Virtual Reality 2004*.

2003 Dolinsky M, Immersive Projection and Virtual Environments. in Katia Maciel, ed. *Redes Sensoriais: arte ciência, technologia*. Rio de Janeiro: Contra Capa Livaria. ISBN 85-86011-74-6. Translation: *Sensorial Net: Art, Science and Technology.* Published in Portuguese. Nov.

Dolinsky M, Arranging Things: A Rhetoric of Object Placement by Leonard Koren. *Leonardo Digital Reviews.* Nov. [Book Review].

Dolinsky M, Gromala D, Sharir Y, The function of art in restructuring experience in virtual environments *Proc. of Virtual Systems and Multimedia: Hybrid Realities*. Montreal, Canada. Oct.

Dolinsky M, Action and Reaction: The Life and Adventure of a Couple by Jean Starobinski, Translated by Sophie Hawkes with Jeff Fort. *Leonardo Digital Reviews*. Oct.[Book Review].

Pape D, Anstey J, Dolinsky M, Dambik, EJ, Ygdrasil—a framework for composing shared virtual worlds In *Future Generation Computer Systems* Vol 19, Issue 6, Aug 2003. Pages 1041-1049. 3rd biennial Internat'l Grid applications-driven testbed event, Amsterdam, Netherlands. Sep 23-26.

Dolinsky M, Audio Sequencers and Sound Activated Graphics in Networking CAVE™s. *Intelligent Agent.* Vol. 3, No. 2. Editor: Patrick Lichty. Director and Publisher: Christiane Paul.

Dolinsky M, Dambik EJ, Beat Box. *iGrid 2002.* National Science Foundation video produced at SARA, Stichting Academisch Rekencentrum Amsterdam. Holland.

2002 Dolinsky M, ≥2 Hearts Beat as One: CAVE Collaborations and Sound Machines. 4th International CAiiA-STAR Research Conference: Consciousness Reframed Non-local, Non-linear, Non-ordinary. *Biennale for Electronic Arts Perth.* John Curtin University. Perth, Australia. Aug 1-4.

2001 Dolinsky M, Blue Window Pane II. *Bloomington: Kennedy & Sons.* Artist commerative book. NTT InterCommunication Center. Tokyo, Japan.

Dolinsky M, CAVE-to-CAVE Artspeak: Visual Metaphors for Collaborative Navigation. *Bloomington: Kennedy & Sons.* Artist book. Collapsing Time & Space: High Performance Network Application Program Symposium. IUPUI Indianapolis Apr 6.

Dolinsky M, Blue Window Pane II. *C@T: The Connecticut College Center for Arts and Technology. The 8th Biennial Symposium on Arts and Technology.* New London, Connecticut. Mar 1-3.

Dolinsky M, Teaching Virtual Reality as an Artistic Medium. *Computer Education* 97. Feb 3-6. With cover image.

2000 Dolinsky M, Blue Window Pane: Seeing Into CAVE Virtual Environment Art in Griffin RE, Ed., The *2001 International Visual Literacy Association (IVLA) Selected Readings*. IVLA 2000, Exploring the Visual Future: Art, Design, Science & Technology, 32nd Annual IVLA Conference, Ames, Iowa. Oct.

Dolinsky M, The Energy of Projections in Virtual Environment Arts. in Proc. 3rd Intl Consciousness Reframed, Res. Conf. Univ Wales College,Newport, Ctr Advanced Inquiry Interactive Arts. UK. Aug.

Borner K, Dillon A, Dolinsky M, LVis—Library Visualization. *Proceedings of the IEEE International Conference on Information Visualization 2000*. London, England. July.

Dolinsky M, Virtual Environment as Rebus in Ascott, Roy, *Reframing Consciousness: Art Mind and Technology*, pp. 201-205. Intellect Books Publisher, UK. Nov.

1999 Dolinsky M, Ed., Facing Reality in *Artists Using Science and Technology, YLEM Newsletter* San Francisco California.July/Aug.

Dolinsky M, Blue Window Pane in *Artists Using Science and Technology, YLEM Newsletter* San Francisco California.July/Aug.

Sandor E, Fron J, Greiber K, Orellana F, Meyers S, Plepys D, Dolinsky M, Ali MD, Collaborative Visualization: New Advances in Documenting Virtual Reality with IGrams *Proceedings of the IEEE International Conference Information Visualization London 1999*. July 14-16.

Word count of main body of thesis: 92154

Margaret Dolinsky

September 14, 2014

Margaret Dolinsky
Facing experience: A painter's canvas in virtual reality

Chapter One: Introduction

1.0.0.0 Introduction

1.1.0.0 Problem: How to situate imagery from drawings and paintings as interactive virtual environments?

1.2.0.0 Purpose: To situate drawings as affective experience within virtual environment arts

1.3.0.0 Research Question: How can drawings and paintings created through a stream of consciousness methodology become a VR experience?

1.4.0.0 Significance: The activity of engaging with virtual environments demands an attention to experience, which is integral to immersion in virtual environments.

1.5.0.0 Delimitations: Focus on visual dynamics in interactive virtual environments

1.6.0.0 Assumptions: Virtual environments are a scientific technology, and yet it is unique visual medium

1.7.0.0 Terminology

1.8.0.0 Organization of Study

1.9.0.0 Summary of key points made in this chapter

1.0.0.0 **Introduction**

There has been a historical tradition in art towards altering perception, promoting what I call a “perceptual shift” for the viewer. I define a perceptual shift as the cognitive recognition of having experienced something extra-marginal, on the boundaries of normal awareness, outside of conditioned attenuation. Perceptual shifts are often provoked by artwork such as trompe l’oeil, Cubism, Cornell boxes, labyrinth gardens, and Brecht’s political theater. These devices for wonderment have a magical quality that requires a specific interaction unique to the particular device and its functions. Once the participant realizes his or her role within that interaction relationship, possibilities open for cognitive and perceptual shifts. In my own work, I am not necessarily attempting to shape emotion in particular, but I do hope to shape perceptual possibilities within virtual environments, interactive animation and augmented reality. Action is key. The action enhances the sense of immersion and the efficacy of the graphics (Rosen, Bricken et al 1994).

Virtual environment art is a predominantly visual and kinesthetic form of 3D computer graphics that reacts to the viewer-participant as she manipulates her head, hand and body movements. It offers a psychological proximity whereby the participant is physically located inside the art, completing the art with her active engagement, which forms and shapes it. The virtual environment exploits perception to promote sensory awareness in an effort for the senses to establish a state of presence through immersion. By igniting multiple sensory modalities at once, significant cross modal effects occur where the sensory streams interact. When these sensory streams are significant, a sudden and fleeting moment of extra experience – a perceptual shift – can occur within the participant. For the visitor, the boundaries begin to blur between the self, the virtual environment and the limits of the real world. Virtual reality is determined in unison through the visitor's actions and the computer's updates of the environment. Together they establish an art performance regulated by software.

1.1.0.0 **Problem:** How to situate imagery from drawings and paintings as interactive virtual environments?

The research problem is how to transform a stream of consciousness methodology for creating drawings and paintings into a practice for creating virtual environments. Strategies for technologies for these environments are developed in computer science and engineering laboratories for researchers in scientific, mathematical and medical visualization, and are commonly used for training purposes such as flight simulation, surgical procedures and scientific visualization. The challenge was to create aesthetic experiences that did not resemble typical computer graphics as seen in video games, cinema and websites, etc. The artwork allowed an exploration into the question of how analogies, stream of consciousness and shifts in perception might be useful in the development of visual imagery created for virtual environment technology.

The research began when, in the context of my painting practice, I first considered developing arts for virtual environments and asked myself 'why should anyone want to be immersed?' I shifted from working in a painting studio to working in a computer science laboratory where there were very few artists. Most computer science laboratories must carefully weigh their desire to support artists, who use resources and can potentially slow the laboratory's primary research. Given the scientific and rather rational atmosphere in which the virtual environment technologies are housed, the art developed in comparison can be regarded as having its unconventional directions. So it became important for this thesis to delve into the history of immersion, to understand the technologies and how they work, to uncover the artists using them and investigate what types of perceptual possibilities virtual art as a medium could offer.

The history of immersion may be situated as beginning in the musings of an early person's thoughts and in how those thoughts became the act of markings on cave walls. Regardless, in an effort to share these past times, people came together and began to explore the potential for artistic immersive spaces to strengthen bonds that facilitate the building of a cohesive society. The idea of caves comes in to play in this discussion in two ways.

One is that prehistoric markings symbolize the use of an alternate form of communication—the media for the Paleolithic era. The possibilities for how and why marks are made, how we are biologically driven to produce them and to share them is a part of the larger aesthetic exploration of this thesis. I follow the prehistoric trajectory of marking cave walls with a parallel desire to mark on CAVE Automated Virtual Environment or CAVE walls. CAVE is a recursive acronym for a specific type of projection system virtual reality theater that resembles a room made up of projection screens and the graphics appear in 3D stereo in the theater with its visitors. This investigation is a result of my desire to understand how a medium like a virtual environment can have an impact on the arts, on artists and on the visitors experiencing it. This impact occurs in an action/reaction equation where the virtual environment is navigated in real time, updating according to the visitors' engagement and displaying according to the navigator's perspective.

The second reason for beginning the discussion of the history of immersion with cave paintings is that the immersive practices represented in caves is indicative of a biological drive to create or “make special” (Dissanayake 1980:404) and a tendency that continues in the present-day: it is a place for the reflection of and scaffolding of thoughts through visual, verbal, aural and social platforms. Plato's “*Allegory of the Cave*” (Cornford 1965:227-235) became another starting point for discussing the history of philosophies relevant to immersion and projection for ancient man and moreover, the contemporary arts, psychology, painting, theater and comedy. The use of art, psychology and theater can subvert our attention to expose otherwise taken-for-granted ideas and reveal insights. A virtual environment theater positions visitors for action in order to experience art. This thesis considers the potential of art in virtual environments to situate the viewer in uncommon situations in order to produce shifts in perception. Moreover, an investigation into analogies, stream of consciousness and conceptual metaphors are vital to inform creative thinking.

There are many different types of virtual environments, including theatrical projection spaces, single screens, head mounted displays, panoramic displays and domes which are described in terms of their different types of projection systems which offer unique viewing experiences. The terms virtual reality and virtual environment have varied meanings and it is important to define as many interpretations as possible within the limits of 3D stereo viewing and its sometimes 2D display options. Equally important is to recognize that the technologies are used in many fields in unique ways. The main developers of the hardware systems infrastructures and their corresponding displays are computer scientists and other developers who create environments for science, education, medicine and business.

Virtual environments technology became available in the 1980s with artists contributing from all over the globe. Working in mixed reality scenarios since 1987, Monika Fleischmann and Wolfgang Strauss are among the first to create for this medium (Fleishmann, Strauss 2014). They command a philosophical and artistic vision that continues to influence virtual environment development today. Their work is sophisticated and complex, both in graphics and in content. Their 1992 “*Home of the Brain*” explores philosophical texts while the visitor is exploring a virtual world (Fleishmann, Strauss 1992).

Daria Tsoupikova, Tim Portlock and Wille Mäkelä are painters whose VR artwork manifests with very different results. Tsoupikova retells Russian folktales (Tsoupikova 2007). Portlock reconstructs cities he lives in and historical sites (Pape, Anstey et al. 2001). Mäkelä paints in real-time inside the virtual theater making images of skiers moving down a mountain and other figures in motion (Keefe, Feliz et al. 2001).

Artists like Rita Addison (1995), Char Davies (2004) and Maurice Benayoun (2012) have taken serious topics such as brain injuries, nature and ecology and war, respectively, and allowed us to experience them through virtual immersion. Rita Addison uses her photographs as visual devices in her work about memories of a car accident. Her voice is the first person narrative allowing others to empathize with her experience of a car accident where she suffered from brain damage. The results are cinematic, much like Sandin's latest work, which ports video to the CAVE walls (Ainsworth, Sandin et al. 2011). Sandin is a co-inventor of CAVE technology, (Cruz, Sandin et al. 1993:135-142) and his CAVE artwork consists of mathematical abstractions, fractal rendering (Hart, Kauffman et al. 1990:209-218) and high-resolution video playback.

Char Davies' work reflects her interests in nature, ecology and scuba diving. Her HMD, or head mounted display artwork uses a breathing vest to control navigation through virtual environments themed around trees and nature (Davies 2008). Maurice Benayoun uses a camera as a navigation device to roam a war zone that allows visitors to frame the environment and capture images as if they were taking actual photos (Benayoun 2012). When a photo is captured, the environment loses its color in that direction and appears to be dying. These environments expand the discussions surrounding their topics by situating a subversive confrontation that causes people to think about social issues.

Another category of CAVE art that influenced my own practice was the collaborative or CAVE-to-CAVE pieces. This discussion is important because these are not well documented and some have only been seen on the test beds of research networks. The networked CAVE artworks laid down the foundations for my ideas about faces in virtual environments that do not represent actual people. This phenomenon I have named emotables.

I differentiate two types of characters occupying the environments. One is the avatar representing a real person and the other is the emotable, representing characters that emanate from a virtual space and represent aspects of the virtual environment through their ability to emote. Initially the emotables were referred to as avatars because in some fashion they do represent people. During the writing of this dissertation, the differentiation expanded and the emotables now represent the characters intrinsic to the environment and/or the people that are created through my drawings. Thus the emotables have a separate origin and purpose apart from the avatar as a representation of an actual person. These instances of graphical characters comprise what I term an emotional landscape where the emotables are an inherent part of the environment to support the visitor in their navigation. This phenomenon of emotables underscored my belief in the power of metaphors and experience in virtual environments.

Metaphors are a fundamental building block of thought and according to Lakoff and Johnson, the “metaphor is not a figure of speech, but a mode of thought” (Lakoff 1993:210). By its visual nature, moving through a virtual environment is a type of action that is heavily dependent on the visual mode of thought for communication and decision making. In line with this thinking, the thesis began to investigate Douglas Hofstadter’s statement that “analogy is the core of cognition” (Hoftstadter 2000). The research into Hofstadter's use of analogies and Rudolf Arnheim's (1969, 1974) studies of art fundamentals were coupled with a discussion of contemporary virtual aesthetics in order to discover how I might approach creating artwork in an active virtual environment. As a result, the following observations were formulated about the relationship between artist, visitor and virtual environment.

The artist designs a virtual environment knowing that she must relinquish some artistic control. The art will ultimately be navigated by visitors who will decide their path through the piece. Rather than offering a fixed frame with one point of view, the art is dependent on a person interacting and exploring the world. A fundamental moment of perceptual shift occurs during the communication exchange between art, artist and interactors.

Meeting someone in person or meeting him or her in an artwork requires effort and some psychological control. When we project our thoughts on to our world, we presume that the reactions and perceptions of others are similar to our own. We imagine that others are seeing and thinking the same thing or something similar to how we are. However, being centered inside a virtual environment, projection is part desirable and part unconscious because it is an important mechanism in our development as beings in virtual worlds. Visitors project their thoughts inside the virtual environment—fusing thought and world to establish a reality through negotiation and reckoning. Fostering these projections became my design goal when I created the virtual environments that are detailed in the thesis. Projections not only occur in human thought but also through the computer processing the code on to the screen. As a result, the computer and the human being are taking part in generating the virtual environment imagery. The artist must develop the environment while keeping in mind that the visitor will be an element in the virtual world's palette of colors, shapes and tools. In Arnheim's terms, the visitor is part of the gestalt of the piece, composing one of its fundamental visual elements. By making choices available, the artist sanctions visitors to make their mark on the environment as they discover and uncover the art work. The work is revealed through a series of navigation choices, environmental negotiations and triggered events. It is during this dynamic engagement that the existence of the work is realized because the work cannot fully represent itself in an idle state. In other words, no digital image of the environment effectively represents the CAVE to indicate the reactive experience of being in the CAVE and discovering the artwork.

Rather than offering a fixed frame with one point of view as in a painting, virtual environment art is dependent on a person interacting and exploring the world to discover choices and variations. In the creative process, the CAVE artist recognizes the visitor by relinquishing some control in how the work unfolds to reveal its story. The artist can design the structure with varying degrees of linearity and hierarchy by providing tools and triggers for strategic manipulations within the art environment. A tool may give the viewer the ability to design audio environments by manipulating machines dedicated to percussion, ambient or bass sounds. A tool can allow the visitor to paint images and sculpt shapes in mid-air. A trigger may be a button press to enable flying or a proximity sensor that opens a curtain or door to reveal a pathway. The combination of art, psyche, tools and triggers expands the projection of energies in the virtual environment.

Unlike a painting hung on the wall, the virtual environment is a nontraditional artwork that holds its position in a stable and familiar style but remains ephemeral. CAVE visitors know that the projection will soon be gone. However all VR works are unique and navigated in different ways which can cause visitors to be uncertain of their direction in the environment or to have anxiety about their performance. They may consider that they are positioned inside the theater to perform on stage or feel as if they were part of a magic act.

The visitor negotiates the images and combines projective thoughts with projection energies to conceive of the screen presentation in a unique immersive experience. In a traditional theater, the performers and the members of the audience are typically separated. In a CAVE theater, multiple persons share the stage and the house to become simultaneously performers and audience. The CAVE reconfigures the relationship between the performers on stage, the people in the audience and the dynamic that occurs between the two. Instead of looking at the scenario, listening to the script and feeling along with the actors, CAVE visitors are gathering images and events to engage in a real-time story.

The nonlinear, non-hierarchical CAVE art experience has the potential to remain elusive as it depends on both the mechanical and the psychological projections that are shared uniquely in a certain time and space with a particular set of visitors and circumstances. The experience is a reflection of particular frames of mind and the active physical interaction. Because of this, the CAVE virtual environment mimics the dynamics of awareness and attention in our real environments. See Figure 1.1.

Figure 1.1 Moving through CAVE projections where projections are both technological and psychological.

The CAVE artist must be aware that her role is to create a space for exploration and play where visitors perform; however, unlike a traditional director, the artist works with actors who have not read the script and are unfamiliar with the story, setting, characters, and props. For the visitor, the experience is not unlike real-life situations where we are in unfamiliar settings or performing tasks for the first time. There may be some performance anxiety with the unfamiliar script or joy in discovering new possibilities. It can be compared to a blind date at a coffee shop: strangers talking, laughing, and animating their lives for one another while creating a new scenario and a fresh performance.

The goal of VR art is a shared sense of being. In the CAVE as well as in the real world, we search for a sense of unity and a sense of place. In the CAVE, interaction fosters a sense of unity with the space, the art, the artists and other visitors. Ultimately, it is a sense of unity that is vital to our lives.

Mediation occurs between the projector light as an energy source and the images on the screen as a potential placement for the light. The visitor negotiates the image on the screen and combines projective thoughts with projection energies to conceive their unique immersive experience. The energy of hardware systems, projection lights, and a theater space is mediated with the energy of images, imaginations and thoughts to combine and recombine towards a continual replenishing of the active art experience. Projection systems draw on the energy of light and its reflections (bouncing off the mirrors) to comprise a major component of CAVEs. Once a visitor enters the theater, they contribute another form of energy—from their person. The visitor contributes a psychological projection system and their personal reflections bouncing in the midst of the environment. In the CAVE, machine and human projection systems interact, reflect and emit from one to the other in action and reaction amalgams.

The actions and reactions occurring in the energies between the psyche and CAVE art projections correspond to the scientific premise that energy is neither created nor destroyed but rather transfers from one state to another. In effect, projection system art feeds the light bulb in our heads. An effective virtual environment experience is one in which the art dynamically envelops the visitor and her thought processes so that she becomes engrossed in what is said to be “immersion.” Philosophically, the light of the projected environment and all the components that make it visible are neither object nor subject because object and subject are inseparable. What is outside of the self cannot be separated from what is inside the self.

The energies of projection, psyche and engagement within virtual art environments make them a critical forum for the investigation of the importance of artistic, scientific and aesthetic fusions in all of our environments.

My method for creating imagery occurs during the hypnopompic state, while transitioning from being asleep to being awake. There are sketchbooks of various sizes and various drawing implements and digital tablets next to my pillow. When I wake up, I do not use an alarm or radio, I simply reach for a drawing instrument. Through the course of this writing, I have discovered that the process is similar to what is referred to as active imagination or “generating images from the unconscious” (Jung 1936:102). See Figure 1.2.

Figure 1.2. Spontaneous drawing by Margaret Dolinsky 2012.

The execution and development of virtual environments uses the same type of intuitive process. It unfolds gradually in the 3D modeling software from the creation of the first models, the emotables. Once the emotables are constructed, they are textured with imagery from digital paintings to give a unique appearance. See Figure 1.3.

Figure 1.3. “Roots Family Portrait” Dolinsky 2013.
Digital painting created from the previous drawing.

The emotables are then transferred to a virtual environment 3D space that is navigable. Here the emotables begin to give me ideas for the landscape and the development of an environment begins. Once they are in the environment they live in, they begin to suggest how to move and interact in the space. Interactions between the emotables is determined by how they move on the paper in 2D space, how they appear in 3D space and understanding their characteristics by interacting with them inside a virtual environment technology display.

The process weaves together the emotables, the environment and the visitor's interaction for an immersive experience. This creates subversive confrontations and interactions that involve some type of psychic dilemma. For example, in my work "*Dream Grrrls*" is about dreams and nightmares, "*Figuratively Speaking*" is about people's postures and reactions they emote when approached. See Figure 1.4.

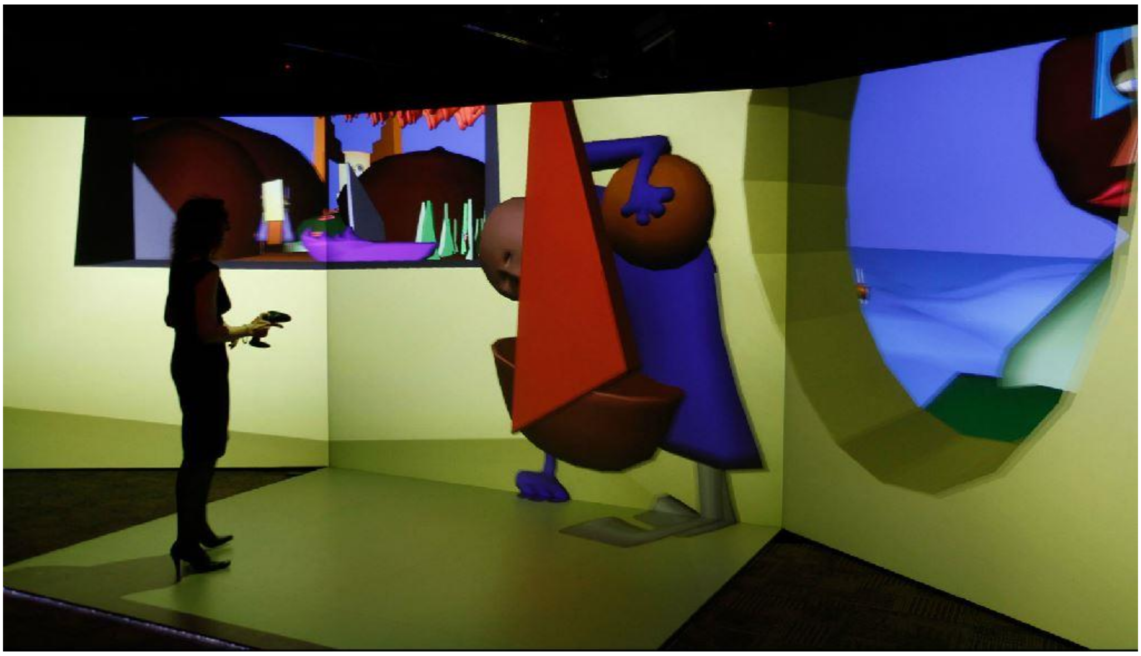


Figure 1.4. "*Figuratively Speaking,*" M. Dolinsky 2012, plays with people's postures and reactions they emote when approached.

“*Blue Window Pane”* is filled with dilemmas about which direction to turn, how to manage hitting a brick wall, and spiritual release.

The majority of the work included in the thesis is virtual environments, and it includes musical and theater performances and art installations. Two early paintings are based on themes of morning rituals and perceptions of the heart. These paintings symbolize the themes that are critical to my work. It is important to understand the drawings and paintings and the process of their manifestation so several facets of the drawing painting process are illustrated. The stream of consciousness method for producing the imagery situates the imagery and reveals the style behind the virtual environments.

1.2.0.0 **Purpose:** To situate drawings as affective experience within virtual environment arts

This research investigates how shifts in perception might be brought about through the development of visual imagery created for the use of virtual environment technology by examining the history of immersion, virtual environment technologies, virtual environments as art, how analogies work and how they work in virtual environments and how artists might document their work.

1.3.0.0 **Research Question:** How can drawings and paintings created through a stream of consciuosness methodology become a VR experience?

The main question of this investigation is how can drawings and paintings created through a stream of consciuosness methodology become a VR experience? This thesis analyzes the progression of my explorations from drawings and paintings to fully immersive virtual environments.

1.4.0.0 **Significance:** The activity of engaging with virtual environments demands an attention to experience, which is integral to immersion in virtual environments.

The significance of this thesis is that a stream of consciousness strategy for creating drawings and paintings is used to inspire and to create virtual environments that situate visitors in an aesthetic experience as an emotional landscape.

I investigate the first person experience in virtual reality and interactive arts by considering the possibilities of guiding the visitor through the art and its visual, cognitive and aesthetic aspects.

One of the environments I use for a virtual reality display theater is the CAVE Automated Virtual Environment, or CAVE. The technology, typically located in science and research laboratories, is becoming integral to design and media centers. An emerging field in the arts, the community of virtual reality and techno-artists is an international one. This worldwide foundation is integral to my research as I design and create environments to experience in CAVEs that are connected via high-speed, high-bandwidth research networks (iLight, Internet2, iGrid collaborative events) using the tools for a graphical computer, audio and video conferencing experience.

My thesis describes how I develop visual imagery for my paintings and interactive artworks. I investigate how stream of consciousness helps facilitate my visual imagery through spontaneous drawings and how that imagery is extended to the virtual environment. Moreover I investigate a process of active imagination that continues throughout the aesthetic realization of the work both in the process of making the work and in the process of the visitor helping to realize the art with their interactions.

Critical to solving the computer aesthetics problem are strategies for creating unique artwork and strategies for integrating unusual combinations of software packages and hardware technologies.

We share experiences using computer generated interactive worlds such as projection-based virtual environments, online gaming, video games and mobile applications, which are challenging to create and provide various levels of engagements.

Some artists have explored a multi-modal sensory system for computer graphics experiences called virtual reality to build virtual environment experiences. The virtual environments that this research focuses on use large projection screens, stereo audio, 3D visual displays and a tracking system. Artists Char Davies (Canada), Maurice Benayoun (France) and Jeffrey Shaw (Australia/Germany) create virtual reality environments that involve nature, war and architecture, respectively. This research does something unique in the history of virtual environment research; it establishes a strategy whereby drawings that are seemingly spontaneous random marks created from a stream of conscious thought process develop into 3D immersive environments. In so doing, it chronicles an unrecognized potential for virtual environment art.

My research investigates how art experiences and interactions in 3D computer graphics displays such as the CAVE change perceptual cognition as well as have social and political implications for groups working collaboratively over the network.

This research is important because combining arts with communication technology creates an environment that encourages innovation and change, fosters inter-disciplinary work and drives digital art practices in ways that are new and challenging which enables investigators, artists and students to consider their research from alternative experiential vantage points that opens up a dialogue for alternate directions and considerations. The research is also important for the humanities and the social sciences in order to study how groups in divergent disciplines living in remote locales interact with one another via human-centered integration of information and telecommunications technologies.

The major focal point that my research will address is how shifts in perception might be brought about through the development of visual imagery created by the use of virtual environment technology. The current literature on CAVEs and virtual reality focuses on technology, how it relates to therapeutic experiences, or the potential that 3D visualization provides for science, education and medicine. This thesis concentrates on the intersection between art and computer technology and focuses on art.

1.5.0.0 **Delimitations:** Focus on visual dynamics in interactive virtual environments

The focus of the research is on an artistic strategy that uses an active imagination technique to generate imagery for creating paintings and virtual environment art.

The cognitive processes of making analogies and the fundamentals of perceptual thinking are discussed in the methodology for understanding the artistic process. The research is not a dissertation on the cognitive science of creative processes or perceptual cognition.

The research discusses how virtual environments are immersive and aesthetic experiences and discusses artists who use the medium. It is not an exhaustive study on virtual reality artwork. It concentrates on a strategy for creating immersive environments and how that strategy is informed by virtual environment technology.

Immersion is discussed as the perception of being within an emotional landscape and giving oneself to the circumstances of the environment. Presence, often referred to as a sense of being there is very much an element of the virtual environment but the semantics of immersion and presence as concepts is not discussed because that is beyond the scope of the research. It would also be beyond the scope of the research to discuss the idea of presence using avatars. Rather, there is a focus on immersion as a sense of being there.

The research will not focus on user studies of the virtual environment in regards to aesthetic experiences. This is because the virtual environment experience is subjective and it would be difficult to understand what answers are needed to articulate the existence and absence of an aesthetic experience. In the same light, how those questions would be constructed could be construed as problematic. This may be an area for further research.

Archiving virtual environments is important and that information has been collected by Jacquelyn Ford-Morie (Morie 2007).

This dissertation addresses a need to create immersive art using a unique strategy and then provides examples of the creation of such work.

1.6.0.0 **Assumptions:** Virtual environments are a scientific technology, and yet it is a unique visual medium

It is assumed here that art methodologies enhance the science of virtual environments through collaboration, interaction design and aesthetic experiences. Artists and scientists work alongside one another to expand scientific research and artistic expression and are motivated by exhibiting collaborative virtual environments. Looking toward the arts, such as painting and sculpture, screen-based computer graphics capture a visual tradition. Virtual reality expands this tradition to not only what we face, but to what surrounds us and even what responds to our body and its gestures. Art making that once was isolated to the static frame and a single point of view is now out and about, in fully immersive mode within CAVEs. Art knowledge is a guide to how the aesthetics of 2D and 3D worlds affect, transform, and influence the social, intellectual and physical condition of the human body through attention to psychology, spiritual thinking, education, and cognition. The psychological interacts with the physical in the virtual world in such a way that each facilitates, enhances and extends the other, culminating in a “go together” world. Attention to sharing art experience across high-speed networks introduces a dimension of dynamism and vitality when we “become virtual” in real time with others.

1.7.0.0 **Terminology**

In this thesis specific terms are used in order to explore art making and virtual environments (VEs) in terms of their relationships in order to create art using VEs as an aesthetic medium and to employ psychology using VEs as an emotional and performative medium.

My drawings typically consist of a large amount of portraiture and subsequently the faces became integral in my VE art. I developed what I term an 'emotable.' An emotable is a digital character that represents ability, motion, emotion, motive, and voice—their construction and placement enhances aesthetics and helps guide visitors through an environment. This is opposed to an avatar that represents a person whereas the emotable represents an affective entity. An emotable can have facial expressions, with an animated face and a unique voice but it does not represent any person in particular. It acts as its own entity and may act as a mirror to a receptive visitor.

My imagery is derived through a stream of consciousness drawing technique which I employ almost daily by using a sketchbook to capture a hypnopompic moment. Hypnopompic hallucinations are altered states of consciousness that may occur while waking up from sleep that causes one to perceive reality along with dream like experiences (Revonsuo 2009). During the day, this automatic drawing is similarly as fluid as the morning ritual and maintains a level of emotional spontaneity. This is important because my technique is an active and honest drawing process that seemingly compels itself to realization. Similar automated techniques were used by artists who developed Surrealism, Cubism and Dadaism in order to gain a primacy in their work that rejected copying the natural world verbatim. Andre Breton, father of Surrealism, sought to capture spontaneous outbursts of the imagination through poetry and pass around drawing games known as *exquisite corpse* (Browder 1967:74).

This thesis uses the term virtual environments liberally for all the art works that include screen-based immersive interaction and realizes that even web pages can be called virtual environments therefore it is important to make a distinction. For the most part, when the term virtual environments, virtual reality or VR are used here, they refer to interactive that utilize computer technologies with 3D computer graphics, projection screens, tracking, audio and stereo displays.

The term ‘virtual environment’ is used interchangeably with ‘virtual reality' although the term ‘virtual reality’ has had negative connotations of not delivering what was promised (Dixon 2007, p 394). More recently, VR as a term is having a resurgence with the development of new 3D goggles and viewing devices such as the Oculus Rift, http://www.oculusvr.com/, Sony Project Morpheus http://www.sony.com/SCA/company-news/press-releases/sony-computer-entertainment-america-inc/2014/sony-computer-entertainment-announces-project-morp.shtml , Google Glass http://www.google.com/glass, and with other companies such as Samsung announcing that they will join in the development as well http://www.engadget.com/2014/05/30/samsung-oculus-partnership/ .

Virtual reality is an immersive computer technology where 3D visuals are seen through stereo projection screens that fill the field of view and are enhanced by stereo audio with related hardware devices for interaction. The screens can be wall sized to create a theatrical configuration that resembles a stage or a room or the screens can be so small that they can be installed inside eye goggles. In a room size display, typically referred to as a CAVE, (DeFanti, Sandin et al. 1993) the projection screens comprise three walls and a floor. The projection on the floor is a significant device for immersion because it allows the visitor to stand in the environment and move forward towards the images on the walls (Cruz-Neira, Sandin et al. 1993:141). CAVEs are also built using six walls in a full cube configuration, such as those housed at the University of Illinois, Duke University, and Iowa State University. The first person interaction establishes the visitor/navigator as integral for the responses in order to realize the environment. This action-reaction process offers the visitors agency through the multi-sensory visual, audio, and bodily kinesthetic stimulations that help to establish the aesthetics in the virtual world in terms of the interface, content, environment, perception, performance and plasticity. (Sandin 1998, Gigliotti 1995). When the environment is created in a theatrical context, VEs act as a stage for the suspension of disbelief which offers the possibility to gain an emotional reaction. (Rheingold 1994). A virtual environment becomes an aesthetic experience when the visitor gains, even for a moment, a heightened sense of perception.

Virtual environments are typically seen in a CAVE, or CAVE Automated Virtual environment or in a HMD where the technical apparatus delivers artwork that can be either realistic or abstract. Realistic environments can be persuasive and rigorous and stand in for reality which tends to recontextualize the actual locations (Bull 2005).

My thesis contends that more abstract or metaphorical environments are dependent on the use of analogy where the interpretation of the environment is based on a visual communication that establishes the essence of things in the virtual world based on the knowledge of our relationship to things in the real world. Navigating the environment allows the visitor to ascertain the virtual objects in terms of familiar structures. For example, a hallway becomes a passage to another location or a different room despite that hallway appearing in an unfamiliar way when it resembles a cavernous eye socket and becomes a tunnel that functions in a familiar way and invites the visitor to follow its confines. When objects function this way they allow the visitor to perceive the environment with a heightened sense of perception conducive to an aesthetic experience.

Virtual environments offer visitors a large proportion of their sensory input as coming from the virtual world in order to establish a sense of 'immersion' and facilitates the feeling of 'presence' – of being in the virtual world. The feeling of immersion and sense of presence aids the suspension of disbelief that a visitor needs in order to interact naturally with the virtual world.

In terms of creating my art as virtual environments, I try to build an 'emotional landscape' that conveys an affective experience. In order to do this, I am cognizant of the fundamental art principles of color, shape, size and design.

1.8.0.0 **Organization of Study**

The dissertation is organized in six chapters:

1. Introduction
2. Research Review which discusses the history of Immersion and immersive experiences in virtual environments and their documentation.
3. Creative Activity Review which discusses virtual environments as art, How analogies work and how they work in virtual environments
4. Methodology discusses how VR is created and how VR art is created.
5. Analysis and presentation of results discusses my artwork.

6. Conclusion discusses how the artwork is read.

1.9.0.0 **Summary of key points made in this chapter**

This thesis investigates art for virtual environment technology and explores a personal type of interactive art that is created using a stream of consciousness mode for creating drawings and paintings.

The drawings are a foundation to a technique that employs the active imagination to situate artistic, experiential installation. The drawings are reminiscent of artistic styles of expressionistic art such as Cubism, Surrealism and Formalism and tend to be spontaneous, honest, and whimsical. The freshness of the process opens up a dialogue to inner thoughts and stream of consciousness thinking. Oftentimes the images are faces and people in intimate conversations with themselves or others. When the faces are formed in 3D virtual reality they form a part of the landscape that provides an emotive quality to the environment and so the graphical characters have been termed “emotables.” The virtual environment technology used includes CAVE Automated Virtual Environments, projection systems, domes and head mounted displays. Virtual reality simulates real world action and interaction whereby graphical objects situate us in a landscape for play. The thesis investigates the technology for this aesthetic type of play and the artists creating interactive arts such as Char Davies, Maurice Benayoun, Jeffrey Shaw and many others. The need for immersion in art has a historical precedent predicated on a biological drive for creating things and as Dissanayake terms it “making special” and begins with a discussion of early man’s markings in prehistoric cave settings. The biological drive to create is an aspect of the active imagination which is the unconscious drive to express ourselves. We form expressions and make connections by scaffolding our thinking through conceptual analogies, metaphors and generalizations, which is the foundation for some expressive arts. The thesis demonstrates how an automatic form of drawing and investigating shifts in cognition and perception that occur in visual modalities can act as a dialogue to guide us through the navigation of a virtual world and frame consciousness for aesthetic exploration.

Chapter 2: Research Review

2.1.0.0 **History of immersion**

2.1.1.0 **Introduction**

Inside the ancient caves of Lascaux, the crackle of the fire animates the drawings on the walls, which cradle their inhabitants with mystery and drama, creating an alternate space both mentally and physically. This is perhaps the earliest gathering of images and light projections to facilitate an immersive shift in perception. The cave has been “made special” for this purpose, a phenomenon that has parallels in, for example, the Roman amphitheater, the Greek stage, liturgical drama, opera, cinema, video games, and contemporary virtual environment art.

Through a discussion of historical uses of immersion in art, this section will explore how immersion functions and why immersion has been a goal for artists throughout history. It begins with a discussion of ancient cave drawings and the relevance of Plato’s “*Allegory of the Cave*.” Next it will examine the biological origins of “making special” and the human inclination to create objects of significance. The research will discuss how art as a process substantiates cognitive awareness and that in combination with the drives for “action” and “reaction,” we can refer to art as fundamentally experiential rather than static. There is a historical precedent towards a need for immersion and various artists are discussed in terms of their psychological drive to create. Moreover, virtual environment art, in providing a space that engages visitors in computer graphics, expands on previous immersive artistic practices. Types of virtual environment technologies and their application domains are discussed in an effort to establish art as a relevant domain in the creation of virtual environments.

2.1.2.0 **Why do we want to be immersed in art?**

The term immersive

> "refers to the degree to which a virtual environment submerges the perceptual system of the user in computer generated stimuli. The more the system captivates the senses and blocks out stimuli from the physical world, the more the system is considered immersive" (Biocca, Delaney 1995: 57).

In virtual environment art, both the image making process and the image appreciation process are methods of immersion. They captivate the senses by titillating perceptions and motivating ideas. This research considers how immersive art is part of a trajectory that begins with a mark-making process in Paleolithic caves and how a parable of an ancient cave continues to influence our thinking of modern day virtual environment devices. These devices are both computer driven and visitor driven in an interdependent relationship. Given that this dynamic is integral to immersion, the research briefly discusses how the terms 'action' and 'reaction' were appropriated from science by thinkers reflecting on the creative process. The research investigates how an analogy manifests cognitively in order to consider how the use of analogy might influence immersion. It looks at how the push and pull during analogical reasoning strengthens our conceptual understanding between seemingly separate circumstances (like navigating in a virtual world).

Much of the research has focused on creating virtual environments using an interactive, 3D stereoscopic device or virtual reality theater called the CAVE or CAVE Automatic Virtual Environment (Cruz-Neira et al. 1993). The CAVE consist of computers, multiple projectors, walls made of projection screen material, and tracking systems that allow for 3D stereo viewing and tracking of visitors' movements through a graphical and sound environment.

The CAVE derives its name from "The Allegory of the Cave" from *The Republic of Plato*. (Cornford 1965:227-235) In the allegory, Plato contemplates a reality that is formed solely by shadows of people, animals and objects. Prisoners, chained to rocks, observe only the shadows and do not witness the objects creating the shadows. (Cornford 1965:228) Those objects are in constant flux, passing behind the prisoners and out of their actual viewing range. It is as if the objects do not actually exist since only their shadows are seen. The projection of the shadows onto a wall creates the prisoners' world. Knowledge of that world is gained over time by observing the shadows and their animation. (Cornford 1965:229) If one were to break free and view the objects casting the shadows, it would be imperative to share the discovery, though it would be difficult for the prisoners, having only ever experienced the world of shadows, to believe the freed prisoner. (Cornford 1965:231) Plato argues that people need to see something literally or figuratively to understand it for themselves: "the soul of every man does possess the power of learning the truth and the organ to see it with; and that, just as one might have to turn the whole body round in order that the eye should see light instead of darkness, so the entire soul must be turned away from this changing world, until its eye can bear to contemplate reality and that supreme splendor which we called the Good. “ (Cornford 1965:232) The allegory illustrates how perceptions change depending on the frame of consciousness: where we are sitting, what the lighting is, who we are with and how far we can journey both physically and mentally. The allegory points to psychological states in terms of metaphors of light including the firelight, the sunlight and the radiance of light becoming a vehicle for knowledge. The final burden would be for the man to share that knowledge when he returns to the others in the cave.

From the beginning, there has been the desire for communication in order to enhance kinship, marriage, partnership and relevance. The processes that have changed humans from an unorganized state to a form a complex, heterogeneous society have allowed for aggregation, socialization, organization, cooperation and communication. Ultimately, the ability to assist one another in survival and to socialize has provided us with a level of security needed to explore the distances that our thoughts and minds can extend to us. With a focus on the mind with its extensibility of thought and art with its transmission of expression, this research is interested in how art experiences shift consciousness. Specifically, the research focuses on how immersive experiences enhance communication. It explores how immersion within virtual environments enhances aesthetic communication and creates meaning in both interpersonal and intrapersonal relationships.

2.1.3.0 **Paleolithic caves and "Making Special"**

Paleolithic caves show evidence of having been prepared for intimate gatherings. These spaces seem as far away as possible from the security of the land, with its natural sunlight and fresh air. Both remote and sacred, these secure spaces provided a place for experiences that were separate from those of the everyday experience of the natural world. Below ground, the inhabitants entered a zone outside of their normal life - a world with walls. The walls of the passages into the lower reaches of the earth included drawings and markings that compelled the travelers to prepare for the transition to an alternative atmosphere and towards significant new knowledge bases, altered memories, or the invocation of dream-like events.

The use of fire was required to create and to see the drawings and to enhance their appreciation, adding significance to the imagery itself. The light flickering against the walls animated the drawings. The animations created an illusion of an imaginary dreamtime, an alternate mental state invoking primal knowledge and causing otherworldly spirits to come alive. The caves can be compared to present-day churches, theaters and congressional rooms. Altars, stages, and televisions provide modern-day versions of the Paleolithic walls. Gathering spaces like theaters, sports bars and stadiums allow us to watch contemporary, technologically enhanced versions of the flickering firelight of the caves. The sparkling animations appeal to some primal part of our being, affording a satiation of our impulse to gather and to immerse ourselves in shared space. The shared space provides a method to transport ourselves to a world that will challenge our experiences, stimulate our thoughts and motivate our energies.

It has been argued that the circumstances of the caves psychologically prepared the initiates and others for the reception of crucial information about social customs and cultural norms (Barton 1994; Pfeiffer 1982; Mithen 1988). David Lewis-Williams writes in 'The Mind in the Cave,'

> "Shifting emphasis from the content of the message to its form and the reasons for it, some researchers have linked the startling topographical contexts of many images to 'information transmission' and have drawn on recent developments in 'information theory'"(Lewis-Williams 2002: 67).

Some believe that the 'information' contained in Paleolithic cave drawings is linked to the relationships between scattered tribes who congregated in an effort to form communities referred to as alliance networks (Gamble 1980; 1982; 1999; Jochim 1983).

Antonio Gilman developed a Marxist approach to the alliance networks theory and argued that the tensions within the alliance networks facilitated the transition between the Middle and Upper Palaeolithic eras, asserting that art was a response to a need for symbols of identity (Gilman, Thornes 1985).

Lewis-Williams dismisses these arguments because the capacity of images to store or convey information is limited, unlike the hard drives of modern computers. He writes that "these information theory explanations in some ways state the obvious (pictures mean something) and, at the same time, accept the disputable proposition that pictures carry enormous loads of information, more than words." He argues that, as art historian Ernst Gombrich has pointed out, pictures have the power to move, but they in fact carry little information because people read pictures in different ways. He emphasizes that "the best that can be said for pictures is that they trigger memories of information that has been absorbed in different ways, that is, by experience and verbally" (Lewis-Williams 2002: 67).

Thus, the cave drawings do not transmit a fixed meaning but rather their meaning derives from the way in which, in relationship to the visitor and to their surroundings, they facilitate an active experience of remembering and relating. Ellen Dissanayake, in her pivotal work "Art as Human Behavior: Toward an Ethological View of Art," elaborates this view of art as experience. She argues that humans have a proclivity toward refining our experience in order to create something of greater value. Ordinary life is incoherent, but "when it is shaped and embellished or transformed as in ritual or play or art it takes on a greater or more significant reality so that when we find something to have coherence it seems to be "aesthetic" (Dissanayake 1980:404). This aesthetic ability of “making special” creates a level of experience separate from practical life but fundamental to human existence.

In order to achieve this experience of another plane, apart from the everyday world, art must produce an awareness and acknowledgement of the way in which it has been created. Dissanayake writes that this awareness is universal:

> "Appreciating "how," the way something is done, demands cognitive awareness - a more or less self-conscious discriminating, relating, recognizing and following manipulations within an acquired code. This type of awareness is of course biologically useful in human communication and in the processes of cognition and perception generally" (Dissanayake 1980:402).

In effect, art is behavior, not simply content or an object; it is a process of “making special”. This is why virtual art environments are so effective for image making. In incorporating the viewer as an active part of the work, virtual environments emphasize the work’s ongoing nature—the “how” of the work. They depend on an active behavioral process of making special and satisfy the biological need for aesthetic communication.

According to poet and philosopher Frederick Turner, mark making is an inherent sign in the search for beauty from which we all derive a natural pleasure. In his biopoetic explanation of the relationship between aesthetics and ecology he writes,

> "The special evolutionary truth is that our capacity to perceive and create beauty is a characteristic of an animal that evolved. Beauty is thus in some way a biological adaptation and physiological reality: the experience of beauty can be connected with the activity of actual neurotransmitters in the brain, endorphins and enkephalins. . .What is this awareness that is to perception what perception is to sensation, and sensation to reaction? The answer is: aesthetic experience. Aesthetic experience is as much more constructive, as much more generous to the outside world, as much more holistic, and as much more exact and particularizing than ordinary perception, as ordinary perception is than mere sensation. Thus by rations we may ascend from the known to the very essence of the knower. Aesthetic perception is not vague and "touchy feeley" relative to ordinary perception; quite the reverse. This is why, given an infinite number of theories that will logically explain the facts, scientists will sensibly always choose the most beautiful theory. For good reason: this is the way the world works." (Turner 1999:119-125).

Well-designed virtual environments, by emphasizing the “feedback loop” between the visitor’s actions and the responding changes to the space, pique the drive for coherence through interaction. They facilitate an aesthetic experience that transcends ordinary perception. Visitors are in a sense *making marks* as they navigate the virtual world. They facilitate the making of the world through their head and hand actions. The visitor becomes meaning in that they are integral to the vitality of the world of computer graphical immersion. In order for the immersion to be effective, an element of aesthetic desire--what Turner calls beauty--must be maintained. He states that

> "Beauty in this view is the highest integrative level of understanding and the most comprehensive capacity for effective action. It enables us to go with, rather than against, the deepest tendency or theme of the universe, to be able to model what will happen and adapt to or change it" (Turner 1999:125).

2.1.4.0 **Action and Reaction**

Dissayanake's and Turner's conceptions of art as process rather than object are paralleled in the historical development of the concepts of action and reaction. The actions and reactions occurring in the energies projected between the psyche and virtual environment art correspond to the scientific premise that energy is neither created nor destroyed but rather transfers from one state to another. An effective virtual environment experience is one in which art dynamically envelops the visitor and her thought processes so that she becomes "immersed."

Philosophically, the art, including the projection lights and all the components that make it visible, is neither object nor subject because object and subject are inseparable. What is outside the self cannot be separated from what is inside the self. The elements of hardware and human influence one another in an action/reaction loop.

Jean Starobinski's book *Action and Reaction: The Life and Adventure of a Couple* eruditely pays homage to the word pair "action and reaction" by examining the dynamics of their semantic relationship, exploring their etymology and, as the title suggests, their "life and adventures" within linguistics, physics, chemistry, literature and politics. In Latin and Greek, the original antonym of 'action' was 'passion,' suggesting such concepts as physical/mental and motion/emotion. 'Reaction' as a word was instituted later, partly through Aristotelian physics which states "opposition between qualities enable the elements to act upon each other." For example, in medicine "to live is to react" therefore semen represents action and menstrual fluid reaction because fertilization was understood as transmitting motion.

The four kinds of motion or kineseis imagined by Aristotelian physics were

- Phora
- Auxesis and phthisis,
- Alloiosis
- Phthora

Phora is locomotion or the local motion that is the first motion produced. Phora, also denoting place, is situated in the cosmos. The other three categories are descriptors of phora: increase and diminution (*auxesis* and *phthisis*), alteration (*alloiosis*) and generation and destruction (*genesis* and *phthora*).

Humans are active entities: beings in motion that are complex and self-maintaining wholes. Aristotle re-characterizes the question “what is being?” when he shifts 'being' from a question of “what?” to a question of “how?” He bridges the gap between *ousia* (being) and *kinesis* (motion*)* by using *energeia* or *entelecheia* (being-at-work). He describes being not as a static matter or situation, nor in its pure eternal form, but rather *entelecheia* (being at-work-staying-itself). He points to a “dynamic equilibrium” rather than a static substance, where “the highest level of material and the form are one and the same thing” (Metaphysics). It is in being-at-work that human beings remain themselves. Our human identity is a matter of being, not a matter of sheer substances.

Remi Brague, in his article, “Aristotle’s Definition of Motion and its Ontological Implications” (1990) stresses the importance of Aristotle's shift from “what?” to “how?” Brague argues that since at least the time of Parmenides, there has been an overriding temptation to define being with the static and inert. Motion either “has been” or “will be,” implying that “that which is [presently]…can only be immobile” (Brague 1990:3). Brague argues that Aristotle’s contention in the *Physics* that being has motion and that that motion can be characterized deserves significant consideration. He states that “the consequence of this ontological rehabilitation of motion is an undisputed fact . . . it is Aristotle’s concern for the elaboration of a *knowledge* of the sensible” (Brague 1990:4). That is, we cannot have knowledge of the sensible, natural world - a world that is constantly in motion- if motion has no being. If motion has no being, the natural world becomes, as Parmenides asserted, “The Way of Seeming.” The stakes regarding our understanding of motion - what I posit here, as action and reaction- are high. As Brague asserts, “if that which is in motion, or, its fundamental feature, motion, is not, then there is no knowledge of nature” (Brague 1990:4).

This brings the discussion to Newton's *Principia Mathematica* (1687) and his third Law of Motion. Newton’s use of metaphor to describe his scientific principles makes his ideas clear in a way that mathematics cannot. The third law of motion states that

> "To every action there is always opposed an equal reaction: or the mutual actions of two bodies upon each other are always equal, and directed to contrary parts. — Whatever draws or presses another is as much drawn or pressed by that other. If you press a stone with your finger, the finger is also pressed by the stone. If a horse draws a stone tied to a rope, the horse (if I may so say) will be equally drawn back towards the stone: for the distended rope, by the same endeavour to relax or unbend itself, will draw the horse as much towards the stone, as it does the stone towards the horse, and will obstruct the progress of the one as much as it advances that of the other. If a body impinges upon another, and by its force changes the motion of the other, that body also (because of the equality of the mutual pressure) will undergo an equal change, in its own motion, toward the contrary part. The changes made by these actions are equal, not in the velocities but in the motions of the bodies; that is to say, if the bodies are not hindered by any other impediments. For, as the motions are equally changed, the changes of the velocities made toward contrary parts are reciprocally proportional to the bodies. This law takes place also in attractions, as will be proved in the next scholium" (Newton 1729:20).

John Turberville Needham, (British biologist 1713-1781) believed that matter is not the primary elementary principle. It is composed of two simple driving forces without any additional components: a principle of motion and a principle of resistance, which act upon each other. Needham explains, “All the effects produced in the Universe are but the result of action and reaction… Any sensible point in Nature (that is, any point accessible to our senses) is essentially active and reactive…, the life of the Universe counterbalanced action” (Needham 1750:322). Not only is “my body … a complete system of action and reaction,” (Needham 1750:381) but “the actual order of our knowledge is such that we cannot conceive of the resisting agent as resisting without the motor agent, not the motor agent as motor without the resisting one” (Needham 1750:389-90). Starobinski concludes, "Thus the immaterial is the secret insider of all matter" (Starobinski 2003:52).

In this period, the words ‘action and reaction’ shift from science into society not only through art but through political discourse as well. This led to the inclusion of ‘reaction’ as the antonym of ‘revolution’ and ‘progress’ (Starobinski 2003:318) for Montesquieu, the French social commentator and political thinker of the early eighteenth century. For him, the play of action and reaction is no longer descriptive or purely explanatory but a goal to pursue and a value to assert (Starobinski 2003:305). As a reaction to scientific thought, the nineteenth century poets Poe, Claudel, and Valéry attempted to appropriate the terms 'action and reaction' to reestablish passion and philosophy in the action of life. They sought a literature and art that challenged the omnipotence of scientific thought over passion, emotion and basic experience. Artists such as the Impressionists or Paul Klee could not settle for objects at their face value. Rather, they stressed the importance of the creative search because it reminds us that nature and life are always changing.

The environment is a changing system of flow, continually altering in response to changes in human consciousness. As we experience the world from moment to moment, transformations in the physical space around us influence our mental energies. This is particularly evident in such environmental elements as architecture, labyrinths, interiors, theme parks, gardens, and grottoes. What we consciously see and hear, feel, smell and think is based on material that has only reached consciousness after passing through a series of filters and censors.

Some spaces allow us to negotiate meaning in new ways by igniting our energy and emotional status. I will discuss examples of transformations in spaces that influence our mental energies in the real world. I argue that virtual environments restructure the landscape around us and encourage dynamism and perceptual shifts. Examples of such spaces include transformative architecture, mazes and labyrinths, modern Interiors, Disneyland, Renaissance and Gothic architecture, landscape gardening, and Italian grottoes.

This relates to the ideas of Charles Darwin, who suggested in his seminal work "*On the Origin of Species*" that the species that survives best is the one most adaptable to change (Darwin 1864). That is, the ability to adapt or change with the circumstances of our environment is more critical than intelligence and strength. This might explain the artist's fascination with creation and why experiencing the change in the progression of an artwork can be more important than other vital tasks, such as getting something to eat. Hence, the term 'starving artist' only applies to food when it refers to generating an aesthetic process.

With the dedicated artist on one hand and the visitor to the artwork on the other, it underscores the need to enjoy beauty as biologically driven. Visitors flock to museums, galleries and shopping malls as well as the far reaches of nature in order to enjoy art and to seek out beauty. This quest for beauty is a vehicle for giving ourselves the opportunity to be immersed in the nature of aesthetic experiences.

2.1.5.0 **Towards immersion in VR art**

In his book *Virtual Art from Illusion to Immersion*, art historian Oliver Grau chronicles art history in its movement from illusion to immersion. (Grau 2003) He lays the foundation for the history of immersion and integrates virtual environments in his taxonomy of types of immersive artworks.

Grau insists that the panorama is the highest form of illusion that uses traditional methods of painting and deserves special consideration for two reasons. One is its application of technological, physiological and psychological knowledge. The other is that its illusion space addresses the observer as directly as possible. The panorama and the virtual environment reveal strategies for removing boundaries and psychological distances between the visitor and the image (Grau 2003:6). The illusion works on two levels. The first being the playful appearance that allows visitors to succumb to the aesthetic joy of illusion and the second being that the visitors can be temporarily overwhelmed in their perception of the difference between the image and reality. (Grau 2003:17)

Grau lists several instances where the panoramic illusion can be described as immersive environments, focusing on von Werner's *The Battle of Sedan* which was a visualization of the battlefield that established itself as an "instance of the first importance for "molding political and social history according to the opinions of official and state circles of the time." (Grau 2003:91)

Grau includes virtual reality in the history of immersion and lists the features of the panoramic view of VR:

- Sensorimotor exploration of image space
- Impression of a living environment
- Image becomes multisensory interactive space of experience with a time frame
- Parameters of time and space can be modified at will

- Space can be used for modeling and experiment
- Worldwide access via data networks
- Telepresence
- Images of the natural world are merged with artificial images in “mixed realities, where it is often impossible to distinguish between original and simulacrum (Grau 2003:7)

Grau emphasizes that by incorporating a panoramic view with the sensorimotor exploration of image space, the scene gives the impression of a “living” environment. It is important to my work that the panorama helps to establish virtual environments in a trajectory of immersive spaces because I would like to establish virtual environments as a serious place for creating artworks. Virtual environments can be created as experiential spaces that situate perception and exploration. Virtual environments allow myself as an artist to create virtual space that explore a personal creative style and set up an immersive experience for the visitor. That experience depends in part on the visitor’s state of presence or consciousness. Slater & Usoh define presence as “a state of consciousness, the (psychological) sense of being in the virtual environment.” (Slater, Usoh 1993:91) Virtual environments are uniquely able to represent psychological states because of their ability to create living, dynamic experiences. They represent a recent example in the history of examining perceptual shifts in art.

2.1.6.0 **Immersion in painting**

This section presents a selection of artists who have examined the dynamics of novel, awkward, or extraordinary situations in order to explore how art experiences situate consciousness. Through a heightened sensitivity to the world around them, artists manifest their perceptions in creative activity.

The practice of art is a psychological activity and can be approached from a psychological angle. (Jung 1978:65) Jung considered two modes of creation by artists. (Jung 1978:72) The first was a directed purpose driven art and the second is a flow state where the art comes "fully arrayed into the world, as Pallas Athene sprang from the head of Zeus." (Jung 1978:73) Some artists rely, as I do, on these flow states for their artistic drive. There is a history of artists who are driven to create a way that "wields a power which is not his and which he cannot command." (Jung 1978:73)

In his book *Hallucinations and Their Impact on Art*, E. M. R. Critchley details how artists have represented different kinds of psychological phenomena, including those stemming from dreams, illness, and drug use. (Critchley 1987:25) He explains how conveying perception through the arts has been a powerful force on society, influencing culture and social consciousness.

Critchley contends that de Goya “through his art invented a language that conveyed the very principles of anarchy.” Francisco de Goya (1746-1828) was apprenticed as a young man of 14 and lived through the continual turmoil of contemporary Spain. Anarchy reigned in the Spanish court as the French Revolution and other European conflicts were fought using Spain as the battlefield. De Goya reflected on the foibles, prejudices and deceitful practices of man, creating such paintings as “The Sleep of Reason Brings Forth Monsters.” The 1814 painting "*The Third of May 1808: The Execution of the Defenders of Madrid*" is shown in Figure 2.1. This image is particularly important to illustrate how Goya’s social and cultural surroundings, along with the passions of his drive to create, compels him to artistic creation despite any political consequences or being forced to go into hiding (Bull, Krekeler et al. 2011:673).

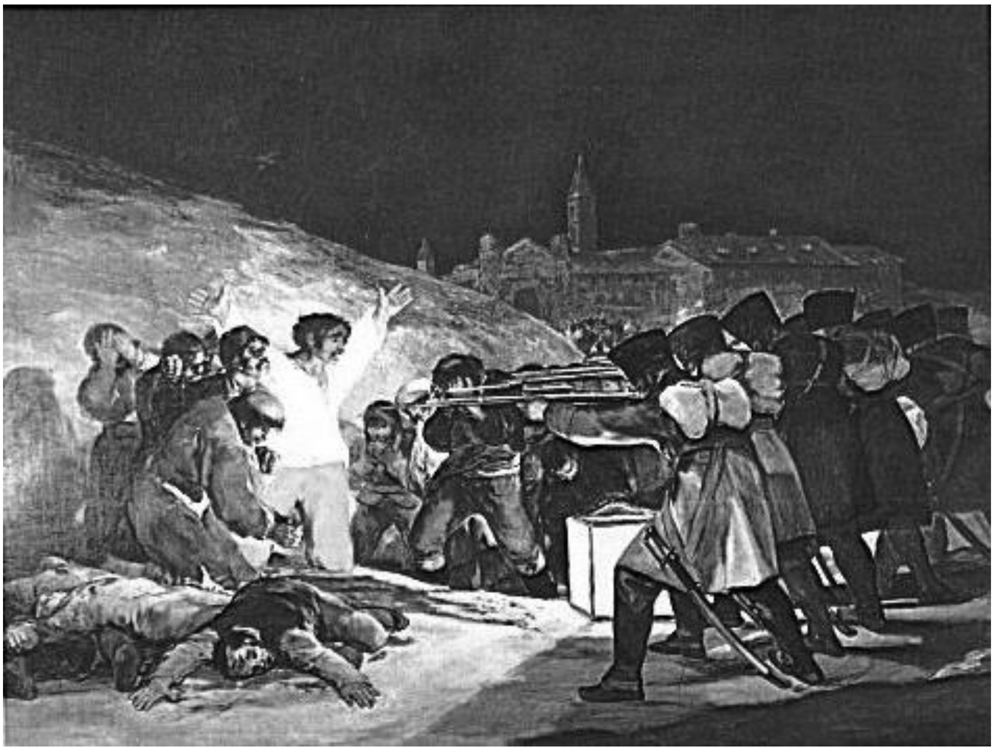


Figure 2.1 *"The Third of May 1808"* Francisco de Goya 1814.
Goya's artistic drive compelled him to create political
statements despite the social consequences.

In order to explore my drawing process further I identified other artists who were using their psychological states to create their work. William Blake, born in London in 1757, is considered a great visionary. He was a poet, painter, philosopher, and engraver who developed his work through eidetic imagery. Eidetic imagery mainly occurs in children under eleven years of age. It occurs when a thought manifests itself as a complex visual external to the self, seen in detail. Blake would actively create portraits of the deceased person(s) as though they were sitting in front of him. His symbolism often illustrated his own texts, as well as others including the Bible, Shakespeare and Dante. See Figure 2.2. Although Blake developed his art as an introspective journey, he found inspiration from specific texts as well as from his own fertile mind. (Barker 2004)

Figure 2.2 "*Beatrice Addressing Dante*" William Blake 1824-7. Blake's use of his imagination as his inexhaustible source for inspiration to illustrate texts such as Dante's Inferno was a motivating force for recognizing my own drive to make artwork.

Other famous artists who were able to channel their perceptual abilities into painting include Joseph Mallord William Turner (1775-1857). Suffering from eye disease and sunstroke, he painted canvases of amorphous oil color to invoke the romantic spirit of light and his lingering perceptions of nature. Pre-Raphaelite painter Dante Gabriel Rossetti (1828-1882) evoked religious themes and included elements of mystical symbolism (Webmuseum). It has been suggested that Spanish Cubist Painter and Sculptor Pablo Picasso's (1881-1973) imagery was influenced by his dyslexia with a right cerebral dominance. Wassily Kandinsky (1866-1944) was a synaesthetic painter of music who retained an eidetic memory even in adulthood (Critchley 1987:172).

In the early twentieth century, numerous critical and avant-garde practices emerged with the goal of making the art experience new and unfamiliar. This history of "making strange" includes Cubism, Surrealism, and dramatists like Antonin Artaud and Luigi Pirandello. Viktor Shklovsky (1893-1984) a leading Russian Formalist created the concept of defamiliarization using the word *ostranenie* which literally translates as 'making strange'. He states, "The technique of art is to make objects "unfamiliar," to make forms difficult, to increase the difficulty and length of perception because the process of perception is an aesthetic end in itself and must be prolonged."(Shklovsky 1965:12) He describes art as a technique for reminding us of the unfamiliar nature of all things, as if to shift us back to a state of time when our perception first recognizes the nature of something. Shklovsky begins to see perception, when effected by defamiliarization as a primary or original experiencing. (Crawford 1984:209) For Shklovsky, art allows us to overcome an automatic response by providing a moment of creating a sense of perception. He believes that art exists to remind us of the essence of life, to shift back to the point where things appear new and fresh. It is the awareness of these types of shifts in perception that can be utilized by the virtual environment. The psychological states that immerses the visitor in an unfamiliar apparatus –the CAVE- can be enhanced through art. By looking at artists who use their own personal perceptions to describe the world, we as viewers get a window into their perception and a new way of discovering or uncovering a representation of reality. There is a historical tradition in the arts of making strange and of seeking out a sense of immersion.

Paul Klee (1879-1940) was a Swiss painter who used imagination “to make visible as form something which is in process of forming” (Critchley 1987: 167). Klee was a musician and remained interested throughout his career in exploring how musical experience could be synthesized with visual experience. Music, an essentially dynamic medium, provided a constant inspiration for an art that embodied spontaneity and rhythm. In 1913 he met Robert Delaunay, who introduced him to contemporary color theory methods and Klee translated Delaunay’s article ‘La Lumiere’ about the basic ideas of Orphism. (Klee 1961:23) From this point Klee’s use of color became increasingly more sophisticated. In paintings like *Viaducts Break Ranks* (1937) Klee’s subtle modulations of color and pattern are evident, creating a sense of image as process and revealing the visuality of musical perception. See Figure 2.3.

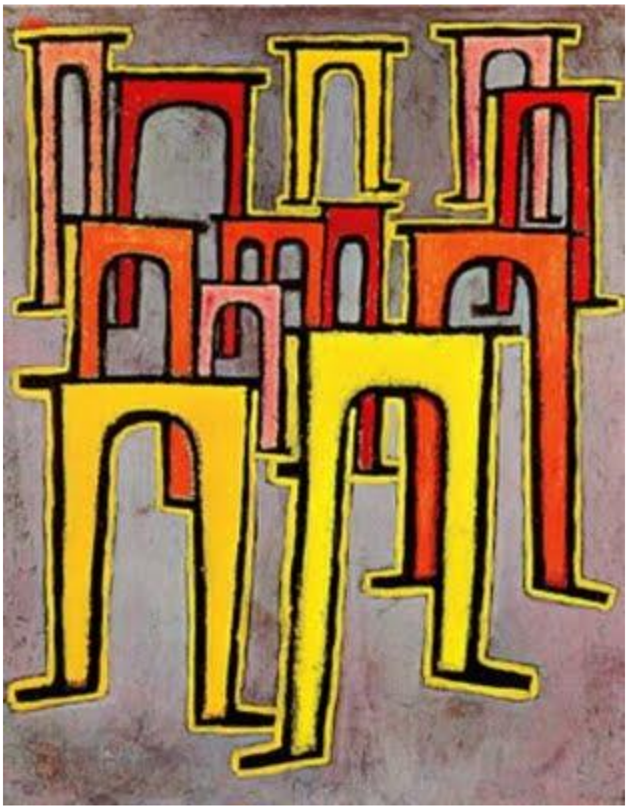


Figure 2.3. “*Viaducts Break Ranks”* Paul Klee 1937. Klee’s painting exemplifies his love of music and rhythm creating a spontaneity to his work that utilizes formal elements of art (color, shape, repetition) to influence viewers to see the world in an unfamiliar way –through the eyes of music.

2.1.7.0 **Immersion in drama**

In Klee’s work, whimsy and comedy were also strategies for “making strange.” The essay “Going for Both Laughter and Tears: The Craft of Mixing Humor and Pain,” by Andrew Horton (2002) describes how creating a sense of comedy can be a strategy for immersion. He uses

Bosnian filmmaker Danis Tanovic's Oscar-winning film *No Man's Land* to outline a series of five principles for incorporating comedy in a narrative. The discussion is directed specifically toward film, but I would argue that it also applies to virtual environments. Comedy can be a valuable method of "making strange" in order to immerse visitors in the world and make it more meaningful. Comedy can take on serious topics, allowing the viewer "to both feel the pain more intensely and at the same time gain some perspective on it" (Horton 2002:61).

Horton writes that, first, comedy does not necessarily mean laughter, but always implies "some form of 'triumph'." He finds this use of comedy characteristic of Balkan works, even as far back as 14th century epic poems from Serbia. His second principle is that irony is a powerful tool. For a visitor, realizing the difference between what a situation is and what it could be brings to mind the differences between "ideals and harsh realities, dreams and history."

Horton's third principle is that absurdity and exaggeration can be effective techniques for mirroring the larger ideas in the work. Laughing at a situation can be a powerful way to realize how real that laughable situation actually is.

Fourth, he advocates the use of the plot twist to bring elements of the work to light. He describes an effective use of this device from the film:

> "between the opposing soldiers is a Bosnian 'corpse' with a land mine underneath him that will explode if the body is moved. The final twist is that the corpse is actually only unconscious and awakens to his tragic reality that threatens all three of the soldiers. Cera, the "corpse" (Croatian actor Filip Sovagovic) was only wounded and placed on the mine as a dangerous "joke" by two Serbs as a trap for any Bosnians finding their fellow soldier" (Horton 2002:61).

Lastly, he states that an ironic subplot can enhance the theme, as when the emphasis of the film shifts from the soldiers to the news corporations that determine whether or not the soldiers' struggle will gain attention and resources from the international community.

Several figures in experimental drama of the twentieth century have focused on strangeness, the idea of altering the audience's sense of perception. Antonin Artaud's stormy interior life, augmented by a lifelong addiction to opiates prescribed to him for depression and schizophrenia, provided material for his avant-garde theater and cinema work. In his Theatre of Cruelty manifestoes he articulated a type of theatre that affects the audience on a primal level, one based on immersion in thoughts and experiences rather than adherence to a written text (Artaud 2001). Using jarring sounds, lighting and other theatrical effects he created experiences that in their startling and fleeting nature echoed the experience of thought itself.

Luigi Pirandello, too, created a body of literature and drama that embraced the dynamic nature of thought, often building a sense of absurdity. In *Six Characters in Search of an Author* the line between reality and theatre is intentionally blurred in order to present questions about the art experience. This famous example of meta-theatre begins with an acting company rehearsing for a play, the Actors soon being interrupted by Characters, who convince the Director (of the initial play-within-a-play) to produce their story (Pirandello 1998). Throughout, there is confusion about *whose* story is playing out, and by implication the position of the audience in relationship to the performers is questioned, too.

Artaud and Pirandello affirmed that thoughts and impressions were just as real as other aspects of life. They created situations in which, through an altering of everyday perception, the audience recognizes the reality of the non-concrete and the status of the visitor, as an active participant in the art experience, is made clear. Their examination of the dynamics of dramatic theatre opened up questions about this relationship of spectator and actor that continue to be addressed in contemporary virtual environments.

In theatre, there exist performers, stage elements that act as performers, and audience members whose presence situates the drama in an event and as an experience. In the dramatic theater of virtual environment, computer graphics share the stage as the performers and the audience. The relationship between the graphics, performers and the visitor/audience changes in real time as the actions and reactions between the entities update dynamically based on input-output algorithms. Rather than passively listening, politely observing and experiencing the scenario, we are gathering the images and integrating a live, real-life story as vivid theater. Visitors are positioned to perform on a stage and to create the action, critically engaged with the unfolding act of the art process.

The nonlinear, non-hierarchical virtual environment experience is never the same twice, as it depends on the mechanical hardware, the persons involved and the psychological projections, which exist uniquely within a specific time and place with a particular set of individuals and circumstances. The experience is a reflection of the art environment, active consciousness and energetic physical interaction. As a result, the virtual environment mimics the dynamics of awareness and attention in our non-virtual environments.

The virtual environment artist must be aware that her role is to create a play for visitors to perform; however, unlike a traditional director, the artist works with actors who have not read the script and are unfamiliar with the story, setting, characters, and props. For the visitor, the experience is not unlike encountering an unfamiliar setting or performing a task for the first time. There may be some performance anxiety with the unfamiliar script or joy in discovering new possibilities. This can be compared to a blind date: strangers talking, laughing, and animating their lives for one another while creating a new scenario and a fresh performance.

The goal is a shared sense of being. In the virtual environment as well as in the non-virtual world, we search for a sense of place and a sense of unity within that place. In the virtual environment, interaction creates a unity between the visitors, the space, the art, and the artists. Ultimately, it is a sense of unity that is vital to our lives. It provides an identity, one that allows us to constitute a significant difference in the environment by facilitating the events that are unfolding in our reality.

A modern instance of a reality unfolding as a seeming virtual environment occurred when a technologies alliance transpired with the arts at the 1958 World's Fair in Belgium as described by art historian Katie Mondloch. (Mondloch 2004:57-61) The Swiss-French architect Le Corbusier designed a pavilion shaped like a stomach inside which he directed "*Poeme Electronique*" with artists Phillipe Agostini creating the video and Eduard Varèse creating the music with an elaborate spectacle of equipment from Phillips Corporation. The automated multimedia event performed in the pavilion "prefigured the "virtuality" of certain computer-reliant works made with new media." Mondloch describes it:

> "The multimedia *Poème électronique* featured both visual and aural facets. The visual components were film, colored lighting, light projections of stenciled geometric shapes and three dimensional forms. The film presented images selected by Le Corbusier and montaged by filmmaker Philippe Agostini to illustrate human civilization's progress. Colored lighting effects (ambiances) were utilized to manipulate the atmosphere and mood in the pavilion. Projection devices called *tri-trous* were designed to superimpose simple stenciled shapes onto the black-and-white film. Finally, two 3D forms (volumes) hung inside the

> Pavilion and were bathed with ultraviolet light at precise moments during the performance.” (Mondloch 2004:58)

The film and photographs were presented in seven sequences with themes including genesis, matter and spirit, from darkness to dawn, manmade gods, how time molds civilization, harmony and to all mankind. Each of the seven visual sequences included immersing the audience with different colored lighting called ‘ambiances’ which effected the spatial appearance in an effort to make the piece “profoundly emotive”. (Mondloch 2004:59) Varèse’s sounds traveled in “sound routes” choreographed by placing hundreds of speakers on the pavilion’s curved interior walls, so that the visitors heard sounds slowly moving and colliding all around them. Varèse’s interest in spatialized music led him to compose with traditional instruments in combination with sirens. Varèse felt this provided “beautiful” parabolic and hyperbolic curves which he called “glissandi”. (Mondloch 2004:60) Le Corbusier said that the “reaction of the setting” needed to be artfully aligned for “a boundless depth opens up, effaces the walls, drives away contingent presences, accomplishes the miracle of ineffable space.” (Mondloch 2004:60)

This work is particularly important to recognize because of its use of a non-narrative format not only with film but its use of lighting that created multiple projections of color and shapes which was combined with the spatialized sound. It is similar to a description of a contemporary VR event. This need for immersion and emotive experience is a continuation of the ancient cave rituals in modern times. It also points to the need for artists to create expressive work rather than to describe reality at its surface level.

Other artists that Mondloch cites as establishing events that predicate towards a historiography for new media displays are Ferdinand Léger and his "*Ballet Mécanique*," Man Ray's early films, Maurice Lemaître's 1951 "*Let-trist lm Le lm est déjà commencé*?" (Mondloch 2004:59) Mondloch suggests that the closest to Le Corbusier's attempt to integrate different media for psychological and physiological effects Mondloch suggests is Janet Cardiff and George Bures Miller's multimedia environment "*Paradise Institute*" created for the Canadian pavilion at the Venice Biennale in 2001. (Mondloch 2004:59) It consisted of a miniature seventeen seat theater where visitors sat for ten minutes wearing stereo headphones that aurally situated them in the virtual surroundings of the video. Their continuation of the tropes of Le Corbusier is reminiscent of Picasso's extension of expression after seeing Cezanne's paintings. Oftentimes Cezanne's influence on Picasso is neglected, and it is important to recognize the history of experiential expression, whether in painting or active installations.

2.2.0.0 **Defining Virtual Environments**

As an artist motivated by the theories of Cubism, Surrealism, Formalism and art in general, I have a passion towards understanding the expression of the perceptual process. This curiosity about perception and awareness of our natural environment extends to my work in virtual environments with a curiosity for computer science and related graphics programming. For me, it is fascinating to consider a device such as virtual reality that is developed through the sciences in order to promote science through a visual experiential understanding and to try to use that same device for artistic endeavors and creative expression. Through the study of exhibitions, artist websites, video documentation, and critical texts by artists and theorists, I will continue by defining artistic virtual environment practices within the broader context of virtual reality. As I establish art as a perceptual process, I wish to link that to virtual environments as a perceptual process. I will explicate the theoretical and practical considerations artists have confronted when working in the medium, including how the nature of virtual environments has been understood, how virtual environments have been exhibited, and the unique challenges artists have faced in documenting the work.

Crucial developments in virtual environment technology have taken place over a wide range of application domains, including military training, flight simulation, scientific visualization, medicine, surgical techniques and therapeutic practice. For researchers using the technology as an art medium, this heterogeneity has produced both advantages and disadvantages. On one hand, artists have had difficulty finding venues for the creation and display of artistic virtual environments. Scientific conferences are the most common venue for discussions of the technology, though such meetings do not provide a satisfactory framework for the discussion of virtual environments as an art medium. Confusion stems from inadequate or inappropriate terminology and difficulties in communicating across disciplinary boundaries. Additionally, virtual reality has suffered from overexposure in the press and exaggerated media hype, which created unrealistic expectations among the public.

However, the instability of language and lack of standardized practices surrounding virtual environments have fostered a rich and varied milieu of artistic virtual environment practices. While scientists have concentrated on the efficacy of the display to produce practical results, artists have moved the technology forward in ways that scientists have not, focusing on the visitor’s relationship to space itself and the enhancement of immersion, presence and interaction. This research is a record of how the imagination and creativity of artists has expanded the potential of virtual environment technology. Throughout, the discussion stresses that the successful development and application of human-computer graphical systems depends on a matrix of interrelated factors: hardware and software in combination with artistic, scientific, philosophical and psychological components. This section also describes how virtual environments have been a foundation for technological art, and the influence that virtual environment art practices have had on other new media art forms.

This research focuses specifically on the display environment called the CAVE Automated Virtual Environment, or simply CAVE, a real time rear-projection theater that is a site for virtual environment art practices. The CAVE typically consists of a cube shaped theater made up of three to six walls and a floor, onto which stereo imagery is projected.

In non-art applications, virtual environments like those realized in the CAVE and HMDs are typically used for training, designing, marketing and scientific exploration. In skills training, Dr. Richard Satava proposed VR simulations for minimally invasive surgery and robust scientific studies now support that vision. (Seymour, Gallagher et al. 2005:364) In 2009, Halifax neurosurgeon Dr. David Clarke, in Halifax, Novia Scotia in 2009 was the first person to remove a brain tumor in a patient less than 24 hours after removing the same tumor virtually, on a 3D rendering of that same patient. (Clark 2009:1) In designing automobiles, General Motors' CAVEs have "essentially provided two VR rooms in one physical space -- one for high-resolution math evaluation using multi-pipe, multi-channel software and the second for evaluating 2D sketches and single-channel, Windows™-based CAD/CAE applications." (Siefkes, 2005:427) The goals of training and design programs in VR are purpose driven for educational and product based outcomes.

In art, my educational and product based goals are more about subjective experience and aesthetic outcomes. My art environments use the systems that harness the energy fields of computer technology and light emission to produce experiences of creative navigation, which often rely on the visitor's personal intuition to discover the environment and its goals. Virtual environments do not need to rely on physical mock-ups or actual objects to create a system for contemplation and interaction. Instead, they are computer graphical systems which are flexible and re-configurable. The hope for my art virtual environments is to alter the reactions of the human operator towards the computer display so that both work in tandem to create a dynamic interchange in an immersive environment. Virtual environments facilitate real-time interaction, present the visual space as three-dimensional rather than two-dimensional, create multi-modal human computer interactions, and immerse the visitor in the computer-generated environment (Durlach, Mavor 1995:2).

In my virtual environment, Blue Window Pane II the technology is the setting for art. The graphics display fills the field of view with a large mask that is sounding as if it is meditating by repeating the phrase "ohm." When the visitor approaches the mask, the eyes of the mask open and the sound of the mantra stops. By becoming face to face with what is representative of the psyche, the visitor is transported to a new scene. See Figure 2.4.

The environment changes and the face is at the end of a long rotating hallway that represents the turning of the unconsciousness. The scene delivers an experience using visual, auditory, kinesthetic, perceptual and psychological stimulation. The visual mask and its meditative sound draws the visitor to move their body towards the mask and the sound and space is changing so that the perception of the space and its colors, textures, size and animated dynamics pique the interest of the visitor and provide them with a goal – to see the face up close again in a new location with a different presentation. Now the face at the end of the hallway is nearly transparent, very faint. The visitor must travel a long way inside the inner tunnel to recognize and see the face up close again. These are psychological tropes that I am using to motivate navigation through an art environment. Rather than training someone or prototyping a product, the environment is guiding the visitor through a creative space that depends on fundamentals of art (size, shape, texture, color…) for its definition.

Figure 2.4 “*Blue Window Pane”* M. Dolinsky Photograph of Indiana University Bloomington CAVE 1999. The visual presence of a larger than self head or emotable becomes a spatial confrontation with the psyche.

2.2.1.0 **Types of Virtual Environments**

While the terms “virtual environment” and “virtual reality” are often used interchangeably, in this discussion the more inclusive term “virtual environment” is used except where historical circumstances warrant the use of “virtual reality” or “VR.”

A number of classification models have been suggested to describe the complex human-computer interactions that comprise the experience of a virtual environment. They are presented here in an order that provides a basic to complex understanding of frameworks for VE systems. It begins with Jacobson’s four types of reality dimensions, continues with Thurman and Mattoon’s three types of virtual reality and ends with Brill’s seven types of virtual environments. These classifications are critical because they are delineated by computer scientists and explain the hardware presentation of the virtual experiences.

In 1994, Thurman and Mattoon classified three dimensions of virtual reality: a "verity dimension," an "integration dimension" and an "interface dimension." Together, these categories form a three-dimensional classification scheme for virtual realities. This model provides a comprehensive tool for understanding and comparing different types of virtual realities.

The "verity dimension" codifies how closely a virtual environment relates to the real world. It is based on a scale that ranges from physical to abstract. A virtual environment toward the physical end of the scale would tend to include objects and behaviors that mimic real-world objects, physics, and lighting. A virtual environment on the other end of the scale would include novel constructions that may not have any correspondence to natural laws, and that may present an entirely unfamiliar experience to the viewer.

The "integration dimension" focuses on how humans are integrated into the computer system. This dimension includes a scale featuring three categories: batch processing, shared control, and total inclusion. These categories are based on three broad areas of human-computer integration that culminates with VR, which is described as total inclusion.

The "interface dimension" of the model ranges between natural and artificial, and describes the visitor’s mode of interacting with the presentation of the virtual environment (Thurman, Mattoon 1994:57).

In 1993, Jacobson wrote that there are four types of virtual realities: immersive virtual reality, desktop virtual reality, projection virtual reality and simulation virtual reality. The immersive type includes a head mounted display that may use haptic technology to mimic natural experiences through mechanical feedback. The desktop type consists of software running on a typical consumer device, in which input is handled by traditional interfaces such as a keyboard and mouse. This type of virtual reality is often referred to as fishbowl VR since the viewer is somewhat removed from the environment, watching the action through a computer screen. Projection virtual reality is a theater-like system in which graphics projected on to large screens create an environment that may be passively or actively viewed. Simulation VR systems involve interaction that is tightly coupled to a physical experience, such as a vehicle driven by the visitor. This type of virtual environment is characteristic of entertainment venues like Disneyland.

Another classification model was presented by Brill at the Virtual Reality '93 conference in San Francisco. Brill’s system categorizes virtual environments into seven types: (1) Immersive First-person, (2) Through the Window, (3) Projected Realities or Mirror World, (4) Waldo World, (5) Chamber World, (6) Cab Simulator Environment, and (7) Cyberspace. Taking newer technologies in to account, it is appropriate to add two more categories to this list: Telepresence, or Teleoperation, and Augmented Reality. Some of the categories are physically immersive while others are not, implying that virtual reality exploration does not have to be completely immersive. The critical feature of a virtual environment is that it immerses the visitor perceptually and psychologically. Visitors become immersed participants in virtual spaces generated by the computer. This participation can be direct first-person interaction or can happen at a second- or third-person level (Laurel 1991) (Norman 1993). Following is a brief discussion of the components in this virtual reality and immersion classification model.

(1) Immersive First-person is typically discussed in terms of the head mounted display or HMD. The HMD fits over the head and covers the

eyes with two small monitors that deliver the correct viewing perspective directly to the eye. HMDs are connected to input devices such as fiber-optic wired gloves, position tracking devices, and audio systems providing 3-D (binaural) sound. This type of virtual reality provides the user a first-person perspective and a first-person exploration experience. Some applications may include a treadmill or a breathing vest to simulate walking or diving through space. As an alternative to the traditional helmet, Fake Space Labs invented the BOOM, which hangs in front of a visitor's face. The visitor looks through the BOOM, which is held up to the eyes, as if they were looking through binoculars or into a window, the advantage is that the device does not sit on the head or weigh heavily on the visitor. Both systems shield the visitor’s vision from the real world and require a person nearby to act as a spotter. A visitor navigating through the virtual environment can easily lose footing or bump in to real world obstacles (Begault 1991). Artists who use HMDs are Jacqueline Ford Morie, Char Davies and Diane Gromala. Gromala develops virtual reality for HMDs to create a personal meditation chamber. (Shaw, Gromala et al 2007) See Figure 2.5.

Figure 2.5. "*The Meditation Chamber*" Diane Gromala 2009. Photograph. Head mounted display (HMD) is worn to help people experience meditation through virtual reality.

(2) Through the Window virtual reality is also first-person. It is often called desktop VR. The visitor looks through the window of the computer screen and navigates the environment using a computer device such as a mouse or joystick. There are many uses for this type of VR including architectural design, choreography and forensics investigation. Many high tech films are planned and created using computer visualization tools that allow virtual walk-throughs of complicated scenes. Programs such as LifeForms allow choreographers to compose and fine-tune dances virtually on the computer. Choreographers such as Merce Cunningham use virtual environments that offer libraries of figures in sitting, standing, jumping, sports poses, dance poses, and other positions. (Copeland

1999:43) See Figure 2.6. Forensic investigators use animation to recreate crime scenes and explain sequences of events. By mapping the speed and trajectory of bullets or cars, for example, crime scenes can be reconstructed for analysis.

Figure 2.6 "*Biped*" Merce Cunningham 1999. Photograph. Modern dance combined with digital technology is created using the desktop tool LifeForms.

(3) Projected Realities or Mirror World provides a second-person experience where the visitor is outside the imaginary world and communicates with characters or objects inside it (Lantz 1992). An early example of this type of artificial reality was Myron Krueger's

"*Videoplace*." Here visitors would stand in front of a screen, and their body motions would influence the projection. Krueger writes, "In artificial realities, the body can be employed as a teaching aid, rather than suppressed by the need to keep order. The theme is not "learning by doing" in the Dewey sense, but instead "doing is learning," a completely different emphasis" (Krueger 1991:152). See Figure 2.7.

Figure 2.7. "*Videoplace*." Myron Krueger 1985. Photograph. "*Videoplace*" combines a visitor's live video image with a computer graphic world.

A more recent example of projected realities is an artwork using the Kinect tracking system. The Kinect device is a camera that tracks visitors' body movements and sends data to a computer that can in turn manipulate sound and visuals according to programmed instructions. For example, in my work "Poking Holes in my Thoughts (Swimming at the Edge)", visitors' bodies are calibrated in front of a screen that makes them appear underwater inside a pond. Their body position and motion is then tracked as they move across the front of the projection. By extending a finger, a hand or an arm they create sounds, generate ripples in a pond, create waves beneath its surface, or make the fish swim faster. Up to four people can be tracked simultaneously (Dolinsky 2012).

(4) Waldo World is a form of digital puppetry involving actors and real-time computer animation. Here the film industry is using motion-capture and CGI technology to generate characters based on real actors' motions. The actors wear a mask or body suit containing motion-detecting sensors. These sensors send data in real-time in order to create a computer-animated figure on the screen. This technology allows directors to bring actors such as Humphrey Bogart back to life or create younger versions of actors in a scene. An example of this is the work of artist Josephine Anstey who created "*The Thing Growing*" and "*PAAPAB*" which both use real human's motions to control avatars in the virtual environment. "*The Thing Growing*" is a work of interactive fiction where the visitor becomes the main protagonist whose tracking is recorded so that there is interaction with computer controlled characters. (Anstey, Pape et al.

2000:71) “*PAAPAB*” is a VR environment of a disco dance floor where visitors record their dance motions and the computer records their head, hand and feet movements to create a data file which plays back the movements using a dedicated virtual character. (Anstey, Pape 2003:394) See Figure 2.8.

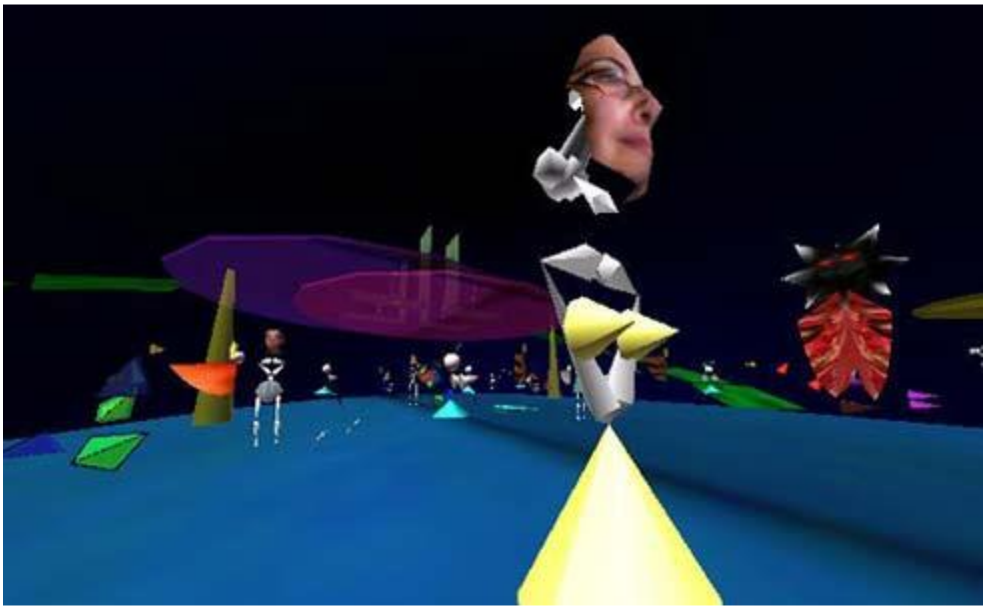


Figure 2.8 “*PAAPAB*” Josephine Anstey, Dave Pape, Dave Neveu. VR Still. Virtual characters are controlled by recording the motion of real world humans.

(5) The Cab Simulator environment is another type of first-person VR where the illusion of presence in the virtual environment is enhanced by the use of an extended simulator. The environment can be experienced by one person or by a group. Hamit defines the cab simulator environment as being generally used as entertainment. It relies on multi-channel sound inputs, mechanical motion bases, and, critically, “more than a bit of theatre,” to supplement the projected visual elements (Hamit 1993:428).

An example of this type of VR is Disney Imagineering’s “*Aladdin*” which took visitors on a flying carpet magic ride based on the animated film. The experience included a pre-immersion background story, high fidelity graphics and giving the visitor a concrete goal to perform in the environment such as controlling the carpet’s flight or talking to a character in the scene and following directions. (Pausch, Snoddy et al. 1996:193) See Figures 2.9 and 2.10.

Figure 2.9 Disney’s “*Aladdin*” Randy Pausch, Snoddy, et al. 1996. VR Still. Cab simulator environment.

Figure 2.10 Disney's "*Aladdin*" Randy Pausch, Snoddy, et al. 1996. Photograph of setup. Cab simulator environment.

(6) Cyberspace is an artificial reality that can be visited simultaneously by many people via a network of computers. The term was first coined by William Gibson in his 1986 science fiction novel Neuromancer, where he described a future controlled by databases and computer networks. Early forms of this shared virtual reality included text based MUDs (Multi-User Dungeons or Multi-User Domains) and MUSEs (Multi-User Simulated Environments). More modern forms include the Sims or Second Life,

which allow visitors to control avatars in a third person interaction. An example of this type of environment is created by the artist and designer Elif Ayiter with her "*Anatomia*" where two sister art installations are created in Second Life, which are accessed with site specific avatars. (Ayiter 2010:181) See Figure 2.11.

Figure 2.11 "*Anatomia*" Elif Ayiter 2010. VR Still. Avatar named Anatomia in Second Life who is only part human.

(7) Telepresence or teleoperation allows for the control of a device or robot in a remote location. This has been used to feed animals, water plants, operate unmanned submarines and control vehicles in locations as far away as the deep sea, the coldest parts of Antarctica, and the moon. An example of this is Brazilian artist Eduardo Kac who created the mobile

and wireless telerobot "*Ornitorrinco*" in Chicago which was controlled in real time by participants in Lexington, Kentucky and Seattle, Washington. (Kac 1996:391) The remote participants shared the body while via the internet they could see the Chicago installation through Ornitorrinco's eye. (Orintorrinco means platypus in Portuguese.) The telerobot pushed around small objects, such as a globe. See Figure 2.12.

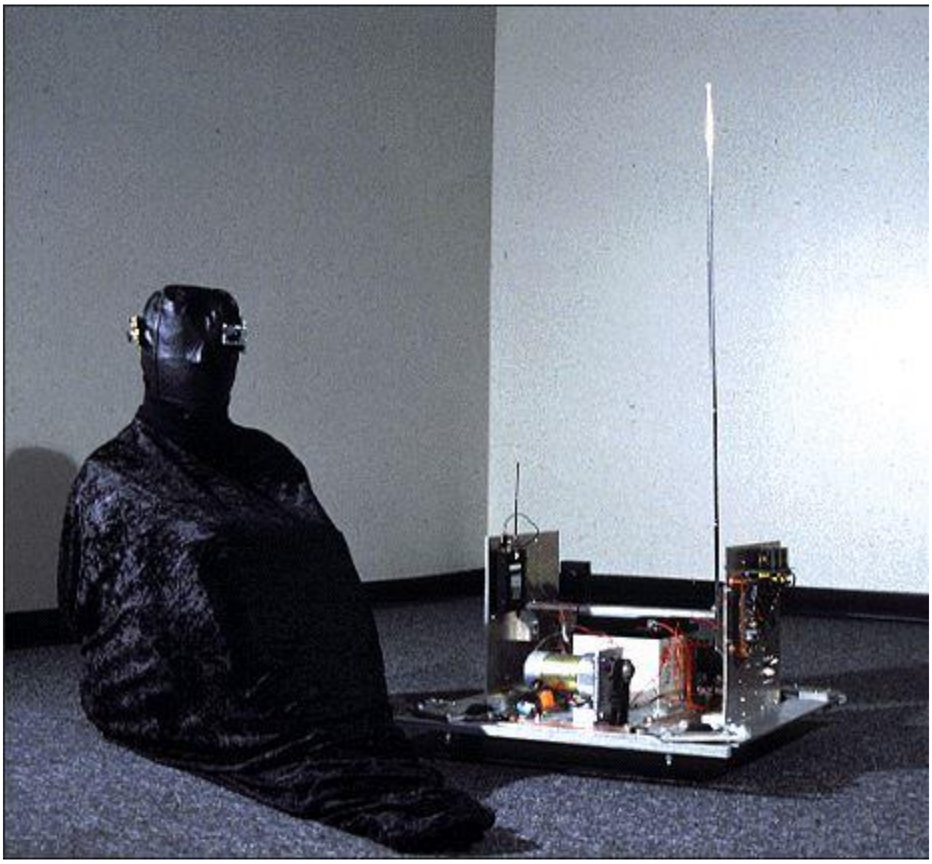


Figure 2.12 "*Ornitorrinco*" Eduardo Ka. Photo by Anna Yu. The teleborg and the telerobot Ornitorrinco.

(8) Augmented Reality superimposes computer graphics onto the real world in order to highlight certain features or enhance understanding. This is achieved by a display device that acts as a viewport onto the real world and displays computer graphics that are superimposed onto the real world. Another method uses a camera to view or capture the real world while embedded software displays graphics corresponding to a particular GPS (Global Positioning System) location. In the past, augmented reality was useful for displaying controls for pilots and anatomical sites for doctors during surgical procedures. With the advent of smart phones, augmented reality allows people to locate information as they traverse the real world. Software applications allow a user to identify stars in the sky, to find their own car in a crowded parking lot and to discover nearby bars and restaurants. A location is tied to this information and is accompanied by an information display that may include important or amusing facts, sound enhancement and links to relevant websites. Several applications allow the creation of 2D and 3D imagery that is tied to a specific location. The artwork can be integrated into other applications for specific events or into Google maps. This

enables others who download the application to enjoy the artwork when they are at the same location.

An example of this type of work is “*arOCCUPY May Day*” which was an AR art exhibition and subversion directed and produced by Mark Skwarek, a faculty member and researcher-in-residence at Polytechnic Institute of New York University. Inspired by New York City’s Occupy movement, Skwarek re-built the encampment in AR. (Skwarek 2013) He extended the encampment by inviting artists to create AR pieces that would enhance efforts to support the Occupy Movement. AR allowed him to situate the protest in cities across the United States as well as across the world in such cities as Sydney, Australia, Brasilia, Brazil and Hammam Sousse, Tunisia in Africa. The exhibition reached as far as Shanghai and a photo was smuggled out of China in support. See Figure 2.13.

Figure 2.13. “*HeARt*” Dolinsky. “*arOCCUPY MAY DAY”* Shanghai, China.

(9) A Chamber World is a virtual reality projection theater. This may take the form of a semi-circular screen wall, a dome, or a CAVE consisting of three walls and a floor. In a Chamber World, the visitor has a first-person perspective, a freer sense of movement, and can share the world with other viewers. The stereo glasses used for viewing the screens are lighter and less cumbersome than many other head-mounted displays used for

immersive VR (Cruz-Neira 1993) (DeFanti et al. 1993:30-33). This type of VR is done with CAVEs, domes and multi-projection screens. Artists who use this type of device include Maurice Benayoun, Jeffrey Shaw, Josephine Anstey and myself. An example of this type of virtual reality is Hisham Bizri's "*Las Meninas*" based on the painting by the Spanish painter Diego Velazquez in 1656. The virtual reality is psychological form of storytelling where the visitor confronts a narrative cryptogram which can be deciphered to explore the enigmas in the painting. (Bizri, Johnson et al. 1998:360) See Figure 2.14.

Figure 2.14. "*Las Meninas*" Bizri, Johnson, Vasilakis 1998. Two photographs of visitors in the CAVE art.

2.2.2.0 **Virtual environment application domains**

Virtual environments are used over a wide range of application domains, including education, medicine, science and telecommunications. Each of the disciplines outlined below harness virtual environments for directed research goals and these approaches can be useful for informing the development of artworks. Visual intelligence is being established across disciplines such as communication, computer science, art, perceptual psychology and neurobiology which are sharing insights in cross-disciplinary exchanges that is “revolutionizing our understanding of how we see, what we see, and how we interact within a visually dominated social environment.” (Barry 1997:9) This relates to Kenneth Boulding’s theory of ‘Eiconics’ which argues that all conceptual knowledge is organically related to the image. His theory reveals the cross-disciplinary power of the image by positing that behavior is a function of a mental image and that the meaning of a message is the change that it produces in the image. (Boulding 1951:3) Barry states in her book on visual intelligence that

"Boulding saw all interaction as a matter of image, in that all new information is continuously tested against our internalized image of how things function. The self each person is composed of sets of images that result from raw data from the environment being filtered through interpretation and acceptance, and to a large degree, our sense of external reality is determined by feedback from others viewing the same situations, thereby continually adjusting our world image." (Barry 1997:99)

As an artist who makes sense of the world through images, it is important to look at how other disciplines are using the visual medium of virtual environments to extend their knowledge and understanding.

Spatial intelligence is perhaps the most obvious area where virtual environments offer potential as a tool for learning and understanding. According to Jacobson (1993:72), virtual reality helps us to solve problems because it helps us visualize information -- it lets us view things spatially. When we can look at data in space as a whole or in detail, we see its elements in association with each other or individually. It is easier to solve a problem when it is presented spatially instead of on paper or computer screen. As a result, we make judgments faster than if we viewed the data in numeric or written form.

2.2.2.1 **Education**

Virtual environments are a valuable tool for education, since interactivity can challenge people's notions of their own knowledge base. Virtual environments can present information, ask questions, provide immediate feedback and encourage the visitor to try again and build up self-confidence through mastery. The systems have been used extensively in education as training simulators, providing a way to improve eye and hand manipulation during tasks that are difficult to practice in the real world, such as piloting a plane or working with hazardous materials.

2.2.2.2 **Science**

Virtual environments present visual information that illustrates scientific processes, allows us to move through astronomical data and see abstract mathematics beyond a two dimensional illustration. Virtual environments are instrumental for applied science and use in scientific experiments. Recently, virtual environments have been used to study brain activity in paralyzed zebrafish (Ahrens, Li et al. 2012). Placed in a virtual environment where they experience a simulation of swimming, the fish respond with the same neural activity as if they were truly swimming.

This allows scientists to study brain imaging scans in real time and develop an understanding of the range of neural activity across the brain during visual activity that is coupled with a physical response.

2.2.2.3 **Medicine**

The medical community adopted virtual environments early and has been responsible for their rapid development from a research curiosity to a commercially and clinically important area of medical information technology (Riva et al. 2003:274). The technology is used both to train doctors for invasive procedures and to perform actual surgical operations. Using haptic devices and visualizations of surgical procedures, invasive surgeries can be practiced repeatedly without the need of an actual person. Simple routines such as administering shots or inserting catheters can be trained to an expert skill level. Procedures can also be executed remotely. Surgeon Richard Satava, a pioneer in using virtual reality and telepresence during surgery, has used the technology for gall bladder removal. The initial incision is done by a person on-site., while the remainder of the operation is performed by a robot that follows the movements of the surgeon's hands at a remote location. Currently, telepresence surgery and remote operations can be carried out on the battlefield, in the Third World, or even in outer space, all without actually sending the doctor or any live person (Satava 1992) (Taubes 1994:84-94).

2.2.2.4 **Therapy**

Virtual environments are used in cognitive and behavioral therapy programs to enhance the senses, provide new points of view, offer new ways of perceiving and establish a new means of understanding. This includes realms that are both concrete and abstract. For example, virtual environments are used therapeutically to overcome the fear of spiders or flying as well as to overcome moments of pain such as during the changing of bandages for burn patients (Hoffman, Sharar et al. 2004:162-168). Hunter Hoffman works with patients who have severe burn wounds. Patients experience a virtual environment of a snow scene while their bandages are being changed and at the same time, their brains are undergoing imaging to establish that VR is an effective distraction for pain management.

2.2.2.5 **Information visualization**

Virtual environments are a tool that allow people to deal with information easily. As a cognitive tool, they provide a dynamic and immediate method of seeing and experiencing information. Used for model building and problem solving, the virtual environment is interactive and creates affordances that enhance the process of interpretation (McLellan 1998:175-7, 199). The volume and complexity of the information domain is constantly growing and more advanced techniques are needed to visualize and manage it. As the power of computers grows and the sophistication of the tools increases, there are improvements in accessing and manipulating large information data sets, especially hierarchical data sets (Modjeska, Waterworth 2000:215). Virtual environments offer the ability to offload the burden of conscious information processing to the human perceptual system (Card et al. 1991:181-188). In his book *Information Visualization* Chen states that virtual environments for information visualization should be implemented with attention to their ability to grow and change with the user's interaction. Virtually-visualized information can evolve and update in non-linear patterns, like the patterns of thought itself (Chen 2004:xii).

2.2.2.6 **Architecture/Cultural Heritage/Tele-travel**

Architects also adopted virtual environments early, using them to transform 2D data into 3D spatial and environment information. The technology allows visitors to actually enter the spaces in a true scale format before any building materials are purchased. This provides a better opportunity for prospective buyers to understand the design potential of their plans. Fred Brooks (1987) at the University of North Carolina developed the Walkthrough graphics system to simulate virtual buildings. The software was used to create a rapid prototype of the UNC Computer Science Department's new building. The ability to walk through the space and understand the views allowed for modifications that were implemented before actual construction. These types of architectural tools are being used for entire buildings, individual rooms and landscape design.

In a related manner, a virtual environment affords the opportunity to preserve cultural sites in 3D computer graphics and allow visitors to experience them without traveling long distances or traveling back in time. Two examples of ambitious projects of this type are Rome Reborn (Frischer 2008) and Ancient Pompeii (Maim et al. 2007:109-116). Both allow visitors to travel through the reconstructed ruins and simulate the lifestyles of the ancient Romans.

2.2.2.7 **Virtual environments as an art medium**

Research and development in the fields of business, education, science, medicine, therapy, information visualization and cultural heritage has been critical to the emergence of virtual environment technology. However, this paper examines how scientific technology has been expanded by its use in the arts. While VR laboratories typically exist behind locked doors, controlled by scientific funding, artists have realized the potential of the technology in ways that scientists have not. By focusing on the visitor's relationship to space itself and the enhancement of immersion, presence and interaction, artists have created virtual environments that shape the way that we think in and move through our world.

The research focuses on virtual environments and is motivated by the desire to walk inside the imagination and to influence a technological tool in new directions using art. Art is important to virtual reality for the same reason it is important to reality: art situates consciousness and VR situates consciousness through the experience of a first-person perspective. VR allows visitors to walk through worlds of imagination, and see them dimensionally, interactively and in real time. The CAVE is one of the most immersive medium with its theater-like setting surrounding the body and mind with computer sights and sounds. The field of view is completely filled, which challenges the visitor to find their way through the graphical environment. Six wall CAVEs exist that allow the visitors to look up, down, around and behind to discover the environment.

Artists working in labs can discover new perspectives with scientists. Since I began creating VR worlds I have included, at the start point, an environment behind the visitor. It made sense to me that everyone would want to discover beyond or what is behind the scenes, or what is not readily apparent. One CAVE scientist discovered this construction and said to me, “I would never have thought to turn around, to think that there could be more of the world there.”

Virtual environments like those shown in the CAVE represent the first redefinition of perspective since the Renaissance (Cruz-Neira, Sandin et al. 1992). VEs involve stereoscopic, three dimensional, first-person perspective with tracking that causes the visitor’s actions to have meaningful input for the environment. These dynamics are so novel that there are no standardized tools or language for how to work with virtual environments and much less how the arts work in virtual environments. As a result, a description of virtual environments as art can appear elusive; however, the lack of language and standardization produces possibilities for exploration and discovery that are rich and varied. We are only beginning to discover the implications of living and creating inside a 3D graphical simulation.

2.2.3.0 **How the CAVE works**

"CAVE" is a recursive acronym for CAVE Automatic Virtual Environment. The CAVE is a virtual reality (VR) display theater with walls that measure eight to twelve feet. The CAVE generates imagery to see, sound to hear, and both can be manipulated in real time. The setup includes a projection system, a tracking system and various computers to draw the imagery, act as a sound server and control the tracking system. Diverse software is necessary to manage the components, create images and coordinate them. A view of the projectors pointing at mirrors behind the CAVE in Figure 2.15. The mirrors shorten the throw of the projectors by bending the light and bouncing it onto the CAVE wall. The light transverses the screen and is read as a projection, though blurry because of the stereo imagery. The projectors create two images, one for each eye so that the brain is tricked into seeing in 3D. The perceptual system is given over to an illusion of seeing that is parallel to the way that our eyes take in two separate images of the real world and fuse them together for a single 3D viewing frame. The glasses are needed to fuse the images together.

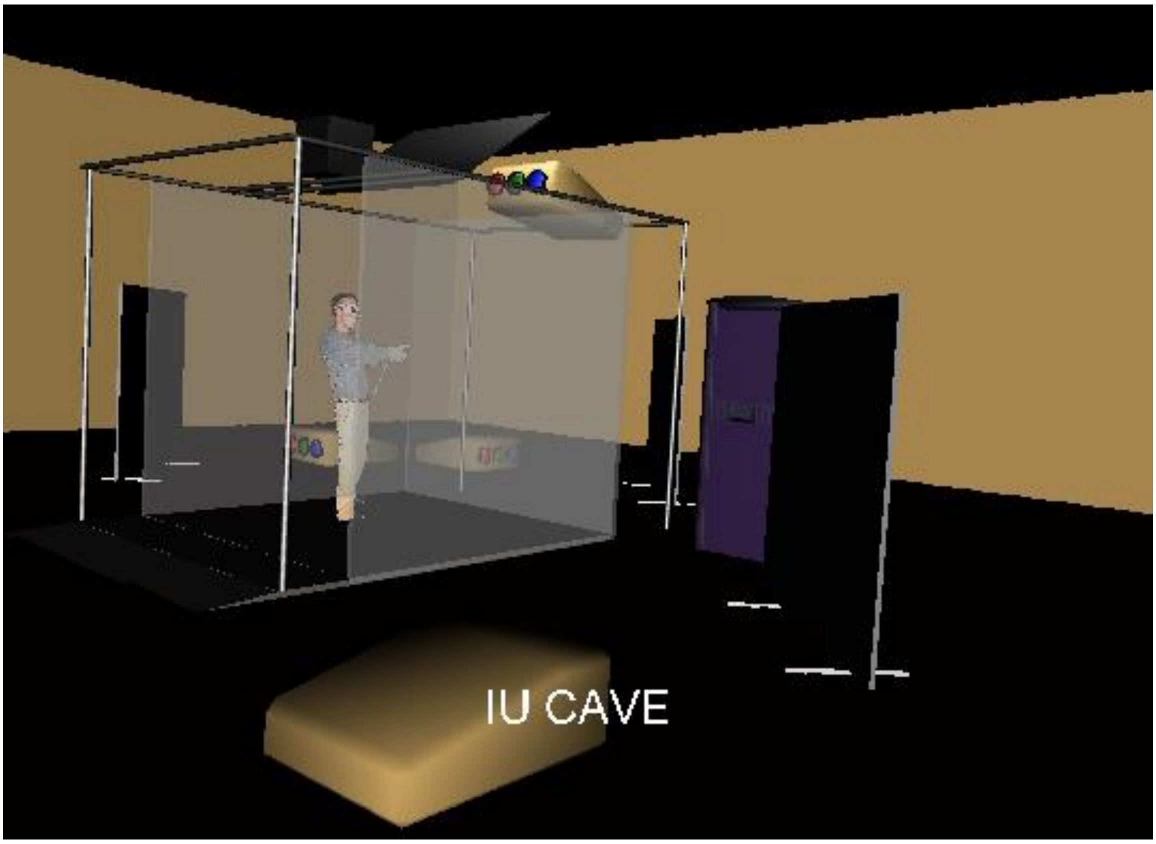


Figure 2.15 Diagram of Indiana University CAVE

The tracking system monitors the positions of body components such as the head and hand and relays the xyz positions to the computers. In the image above, the tracking unit appears as a black box above the visitor's head, in front of a mirror. The sensors are in the glasses and joystick navigation wand. By moving her head or the joystick or manipulating the wand buttons, a visitor can fly through the CAVE scene, walk around objects that hover in mid air and look underneath them. The visitor's movements update the CAVE scene to react fluidly, which increases the sense of “being there.”

Figure 2.16. Stereoscopic glasses

The stereoscopic shutter glasses appear in Figure 2.16. Each shutter synchronizes to the refresh rate of the stereo projector so that each eye receives the appropriate view. The brain converges the two views of the stereographic scene for a fused image in first-person 3D perspective. Interaction occurs when the head or hand enters specific areas, buttons are pressed or algorithmic events activate.

The CAVE was invented at the Electronic Visualization Laboratory at the University of Illinois at Chicago and debuted at the 1992 SIGGRAPH conference. Due to its visual and experiential nature, CAVE environments display 3D data and information for such disciplines as medicine, including surgery, mathematical visualization, geographical landscapes, weather patterns, flight simulation, astrophysics, chemistry and molecular visualization, education, psycho-therapy, and architecture. Indiana University has two CAVE configurations, one in Bloomington and the other in Indianapolis. The Henry Radford Hope School of Fine Arts in Bloomington, has stereo displays, PC and Macintosh machines, scanners and access to multiple image making software applications and mass storage facilities.

Figure 2.17. Multiple people in the CAVE.

Figure 2.17 shows the CAVE in Lindley Hall with the computer science graduate students. The CAVE is a multiple user system that accommodates several visitors. Those who wear stereoscopic shutter glasses without sensors receive a slightly altered perspective from the tracked visitor.

VR is realized when a visitor navigates the environment and triggers events in real time. This research is concerned mainly with environments that are non-linear and non-hierarchical, without defined pathways so that the experience is slightly different each time. This research considers virtual environment art as a performance experience. In effect, virtual environments are places or settings for art that attempt to encourage inhabitation and exploration. This research contends that immersion and interaction with the virtual environment can influence subjective states the way that the arts, perception and visual phenomena influence subjective states. Heim states that virtual environment technologies offer experiential quality based on the three 'i''s: immersion, interactivity, and information intensity. (Heim 1998:6) Immersion is generated by devices that can isolate the senses to the effect that the visitor feels transported to another place. (Heim 1998:6) This transportation or taking over of the visitor's senses occurs when perception is sufficiently stimulated - which is a goal in art according to Shklovsky- to stimulate the senses. (Shklovsky 1965:12) In my art, I depend on virtual environment technology to set the stage for shifts in perception. The second 'i' according to Heim is interaction which emanates from the "computer's lightning ability to change the scene's point-of-view." (Heim 1998:6) Although his definition of interaction is focused on point-of-view, it nevertheless makes the point that the display is tightly coupled with the visitor's perspective because the point of view updates according to the visitor’s head and hand position and the direction of their gaze. Moreover, interaction establishes the action/reaction dependency between the visitor and the system and forms their symbiotic relationship. The third ‘i’ is information intensity which allows the virtual world to provide “special qualities like telepresence and artificial entities that show a certain degree of intelligent behavior.” (Heim 1998:6) This last ‘i’ can also be expanded much like the previous ‘i’ to include any update of information (visual, spatial, auditory) that requires a computer to rapidly update in support of immersion and interactivity. Art fundamentals, art theory and visual literacy, including perception and consciousness studies, are critical to the development of immersion, interactivity and information intensity with art and virtual environments.

2.2.3.1 **CAVE-like displays**

Passive stereo wall displays use two projectors with filters. Each projector can only be seen by using corresponding 3D glasses lens, which sends the appropriate image to the corresponding eye and blocks the image coming from the opposite projector. These are single wall displays similar to one built by the Cleveland Museum of Art. See Figure 2.18. These can be networked as in Figure 2.19.

Figure 2.18. Single screen based stereo VR.

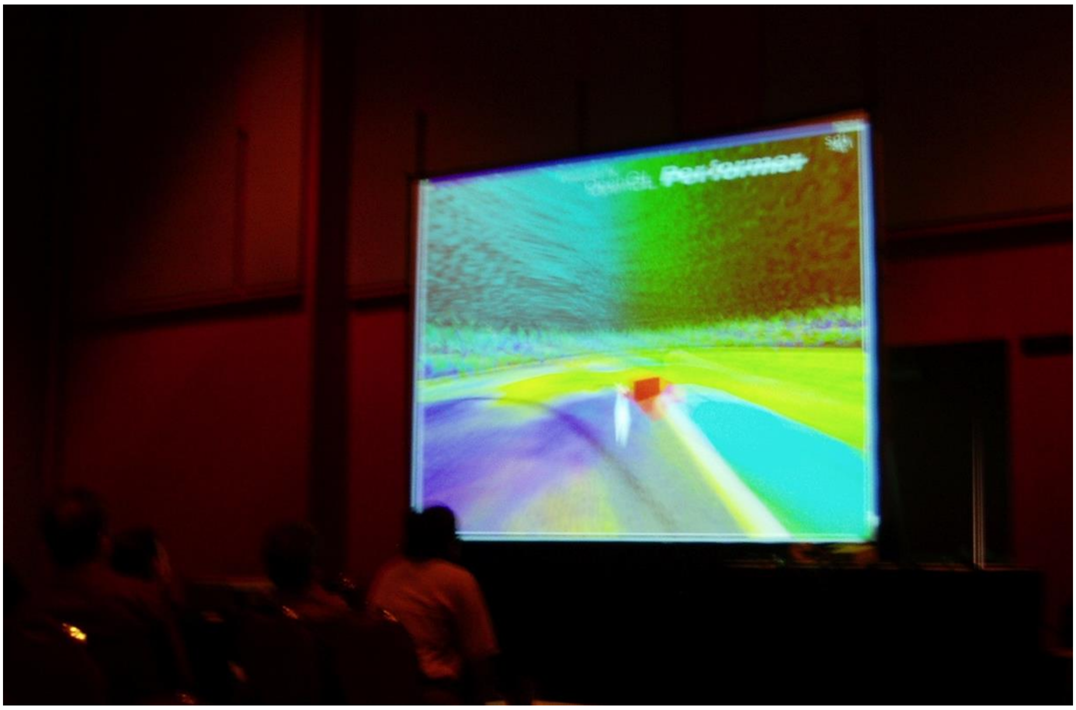


Figure 2.19. Single screen and networked stereo VR, SPIE San Jose.

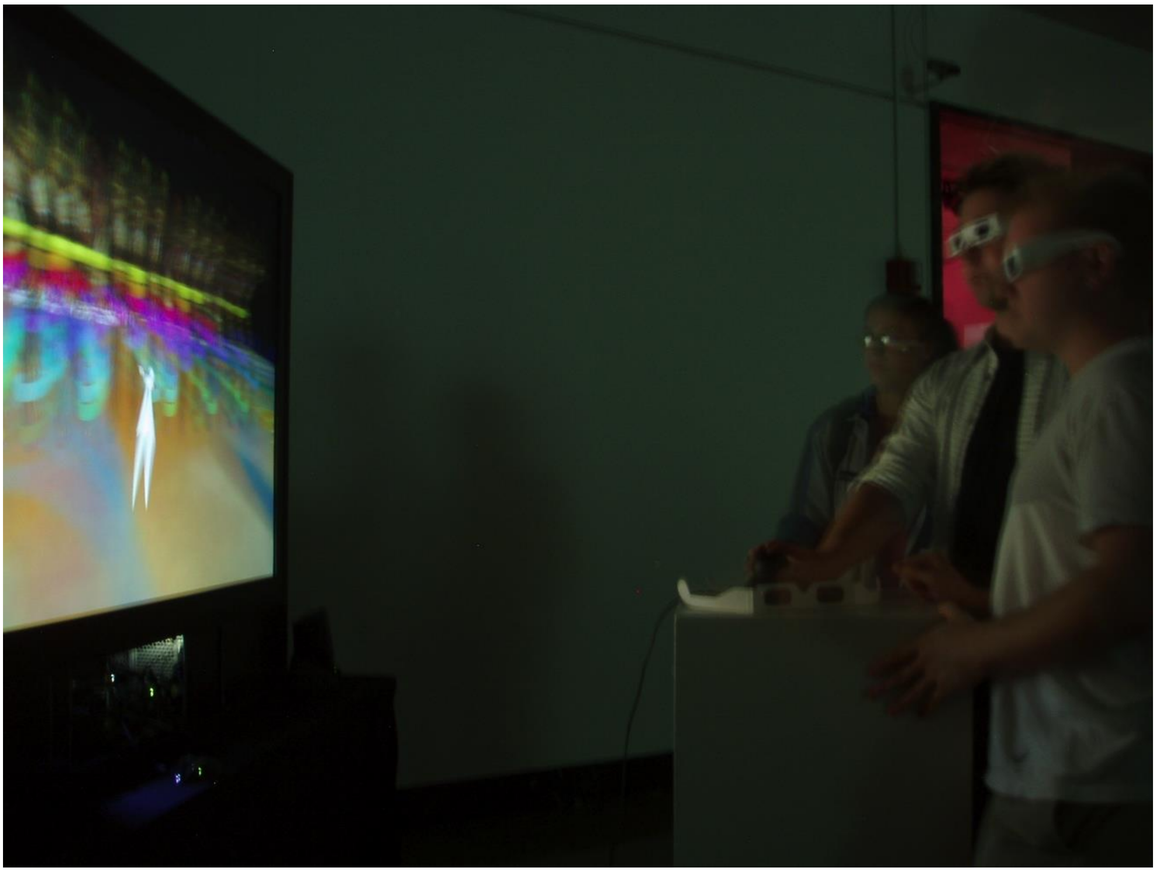


Figure 2.20. John-E-Box portable VR system.

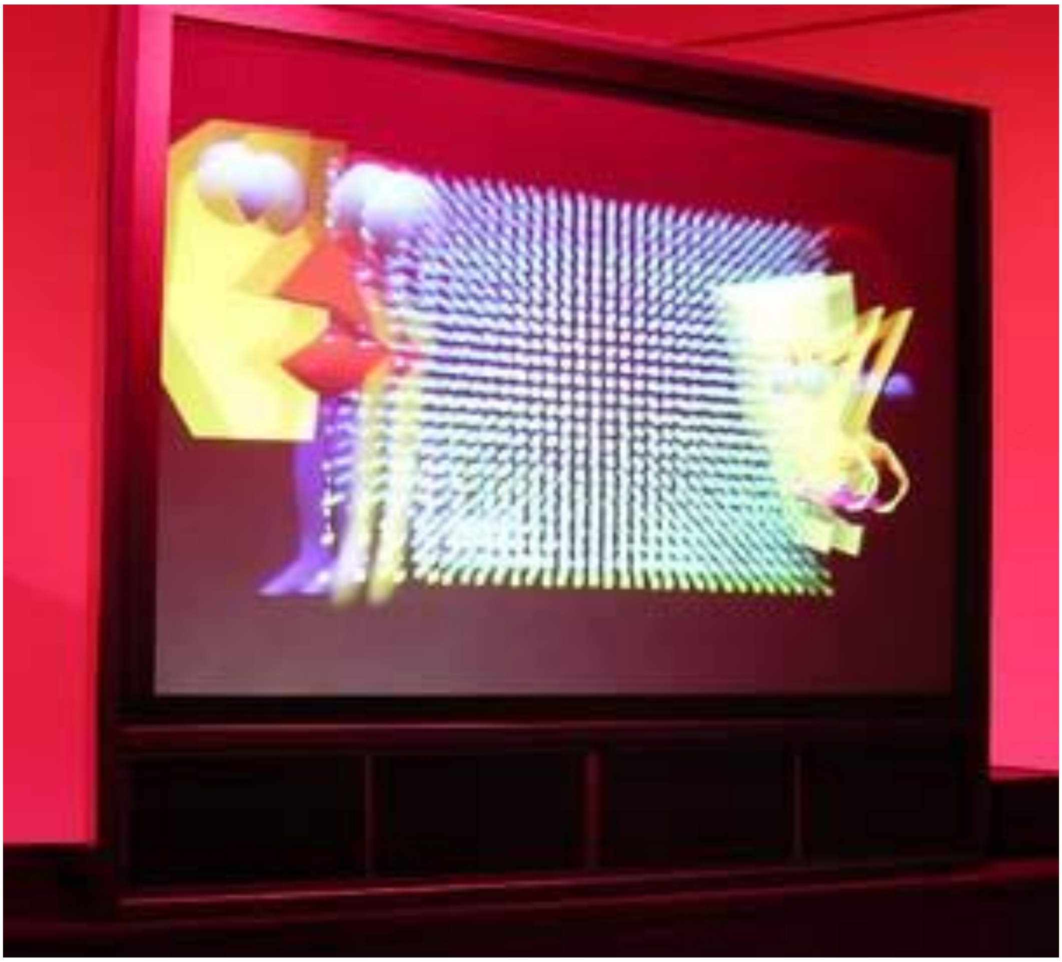


Figure 2.21 John-E-Box portable VR system.

The John-E-Box is an Indiana University passive stereo display developed in an effort to provide a portable system for displaying CAVE environments. Inside are two projectors, speakers and a computer. The John-E-box is also valuable to students, visitors and people who exhibit work in art galleries and museums, festivals and symposiums. See Figure 2.20 for “*Beat Box*” and see Figure 2.21 for “*Activations II”* at the School of Fine Arts Gallery.

2.2.3.2 **CAVE-to-CAVE Collaboration**

This research examines and develops first-person and group dynamics on computer networks using fine arts experiences. By connecting a network of multiple CAVES together, the software and hardware of remote CAVEs can work together in real time, updating the same environment. They are able to see one another as a graphical character called an avatar. The avatar’s head and hand movements change with regard to the sensors in the CAVE that controls that avatar. Therefore, for example, if the avatar is a cat and all the CAVEs know that Indiana University (IU) is the cat, each CAVE knows where in the environment the cat (IU) is at. This includes which direction I am facing, where I am moving and if I am reaching or about to trigger events. Avatars can wave to and speak with one another using video and audio networking hardware and software. The interactions are sent via a central server that updates all the CAVE environments simultaneously according to movements of the multiple tracked visitors in their respective CAVEs.

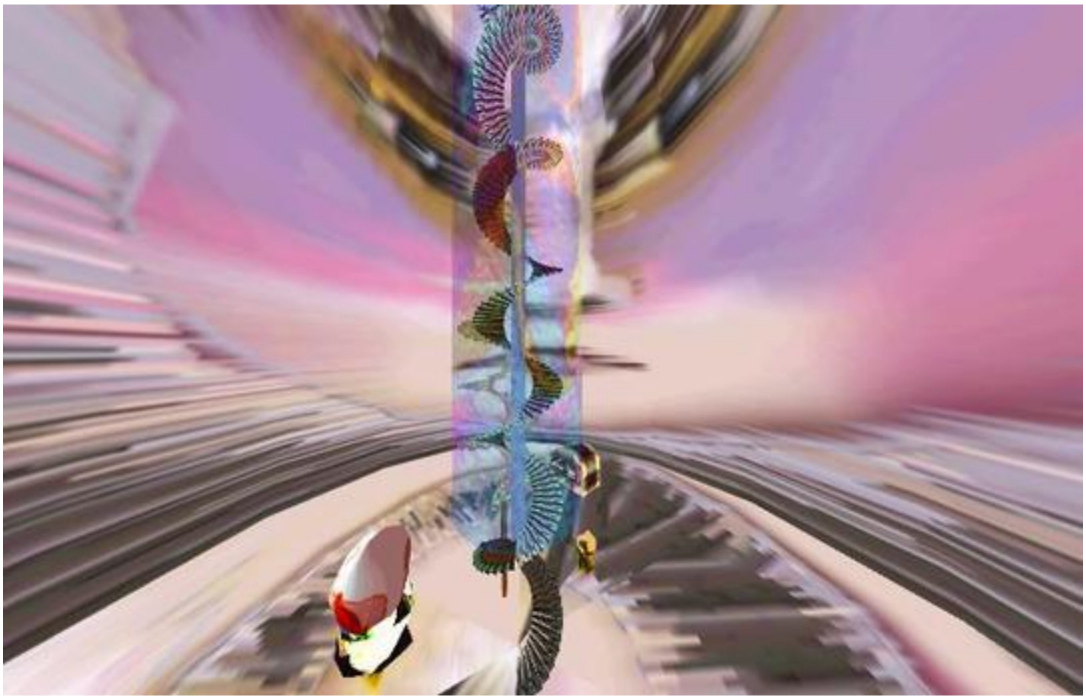


Figure 2.22 “*Blue Window Pane II, Stair Scene*” M. Dolinsky 2000. VR Still.

Figure 2.23 “*Blue Window Pane II, Stair Scene*” M. Dolinsky 2000. VR Still.

An early collaborative virtual environment event occurred at the Emerging Technologies showcase at the computer graphics conference SIGGRAPH 98. See http://www.evl.uic.edu/core.php?mod=4&type=4&indi=42. At the SuperComputing 2000 VR display in Dallas, Texas "*Blue Window Pane II*" was networked to the CAVE in Bloomington, Indiana. See images from the "*Stair Scene*" in Figure 2.22 and Figure 2.23. Other collaborative CAVE art exhibitions have been networked with Austria, Sweden, Brazil, Japan, China, Hungary, Holland, and various cities in the United States. For example, the "Alive on the Grid" exhibit at the Ars Electronica Festival 2001 was networked between six cities in the US and Europe. For details see http://www.evl.uic.edu/core.php?mod=4&type=1&indi=209. This event and many others were simulcast from the Indiana University Bloomington CAVE to the web and archived at the university via a streaming media format.

Collaborative tools expand artistic media by including location as an art component and staging performances in electronic windows and on virtual stages. Virtual environments expand the visual tradition to include what surrounds us and responds to our bodily gestures in order to establish immersion.

"*Animagina :: (life+imagination)*" is a networked or collaborative VR artwork created by the team of Daria Tsoupikova, Julieta Aguilera, Seung Kang, Damin Keenan, Helen-Nicole Kostis, Tina Shah, in collaboration with Alex Hill, Geoffrey Baum, Franz Fischnaller (Tsoupikova 2003). "*Animagina*" is an exploration of space, architecture, consciousness and paradox. They write:

> "An impetus for creating virtual reality lies on the ability to turn things around. Concepts can be reversed, as the public can become private and the small can be metamorphosed to large, a 2D image can be morphed or extruded to a 3D object and the opaque can become transparent and vice-versa. All this is happening in a user-centered perspective world where our bodies are an instrument. Experiences of gravity, speed, interaction, and basic existential necessities, such as light, heat, water, and the elimination or the surcharge of them, are absent in the physical sense" (Dolinsky, Anstey et al. 2005). See Figure 2.24.

Figure 2.24. **“***Animagina*” Helene Kostis, Daria Tsoupikova and Julieta Aguilera, shown in San Jose Convention Center 2005 at the Society for Photonics and Electronic Imaging Conference Engineering Reality of Virtual Reality.

An interesting juxtaposition occurs during networked events that will be described next but is prefaced here by a quote from Brenda Laurel, in her book "*Computers as Theater*:”

> “technologies offer new opportunities for creative, interactive experiences, and in particular, for new forms of drama. But these new opportunities will come to pass only if control of the technology is taken away from the technologist and given to those who understand human beings, human interaction, communication, pleasure, and pain” (Laurel 1991:xi)

Researchers at the Tools for Creativity Studio of the Interactive Institute in Umea, Sweden created "*Incarnation of a Divine Being*" for the Ars Electronica 2001 CAVE exhibition "*Alive on the Grid*." (Pape 2002:2) "*Incarnation*" is explicitly a theatrical production and virtual environment narrative based on an ancient Greek drama using networked participants as unsuspecting actors. (Anstey 2007:1) Based on my own personal experience in the artwork, I was confronted upon entering the Greek amphitheater with an accusatory question "Did you kill the king?" whereupon immediately I said "No, I did not." Immediately the crowd of avatars gather around me ignited in reaction, the graphical chorus responds by raising their arms and pointing directly at me while shouting, "She's a liar" and other argumentative assertions. Real life actors facilitate this exchange with charismatic style and heavy accents that keep the accused visitor attuned and somewhat entrapped, creating a lovely sense of interaction, immersion and active presence.

The creators at UMEA are interested in experiential design of computer interfaces and write,

> "the metaphor is part of the interface. This need not be the case with experientialism since, by this account, metaphor is everywhere. Taking an experientialist view of interface design

> suggests that a meaningful interface is one that is experienced in a way that supports the metaphoric projection of image schemata. This is done by the user in the same way that he makes sense of all the other experiences of his daily life, by unconscious projection of bodily image schemata. If the experientialist designer is primarily a creator of user experiences, the traditional interface designer is primarily a communicator of mental models, using metaphor as a useful device." (Lund, Waterworth 1998:1)

This self-referential dynamic is physically self-conscious by demanding that the participants become a part of the other's virtual environment and is visually and thematically self-conscious by placing participants on a stage in a graphical theater and having the graphics shout at their feeble answers when they are addressing a real person's questions. See Figure 2.25.

Figure 2.25 "*Incarnation of a Divine Being*" created by the Tools for Creativity Studio, Interactive Institute in Umea, Sweden by Waterworth et al for Ars Electronica 2001's "*Alive on the Grid*" CAVE show. The artwork is a theatrical production performed in VR.

The experience of the "*Incarnation of a Divine Being*" for me illustrates Boulding's ideas of eiconics and how knowledge is shaped by a mental image because it sets the visitor inside a construct that is perpetuated by the images surrounding them and by accusing the visitor and demanding their defense, the artwork effectively weaves the visitors into the narrative. The artwork is itself a metaphor for a mental world and the engagement exemplifies how virtual environments are an active participatory mental and visual construct for knowledge and awareness.

In order to enjoy virtual environments as interactive art, the visitor must be open to the experience. It is not uncommon for participants to feel anxious when first exploring a virtual environment, since they must attempt to interact in an unfamiliar setting with somewhat familiar devices being used in an unfamiliar manner. Luckily, for the VR artist, standing at the center of a colorful world is something that can be very motivating. The projections ignite perception. The virtual environment stimulates the senses visually, aurally and kinesthetically, creating a desire to explore, wander about and discover what events may be triggered.

Visitors enter the CAVE theater and can navigate the virtual environment using a tracking system, integrated into the glasses, and a handheld joystick wand. See Figure 2.26. The tracking system updates the stereo projections according to the actions and reactions exchanged between the navigator and the computer system. The software iteratively responds to various hand and head tracking inputs to resituate the graphical environment to display according to the navigator's viewing perspective. The sensors in the glasses indicate the navigator's head position and direction. The sensors in the joystick wand indicate the navigator's hand position and direction. The software draws the graphics and updates the projection frames in real time. The hardware and the navigator's movements update one another, co-existing as connected elements for generating the constantly metamorphosing environment. The computers and projectors respond by painting with light, emitting pixels, directing energy and causing motion to display the graphics that make up the virtual world. In response to the graphics of the virtual environment, the visitors deliberate their next move, reflecting, responding and projecting their thoughts into the space through mental awareness, choice recognition, decision-making, and kinesthetic navigation.

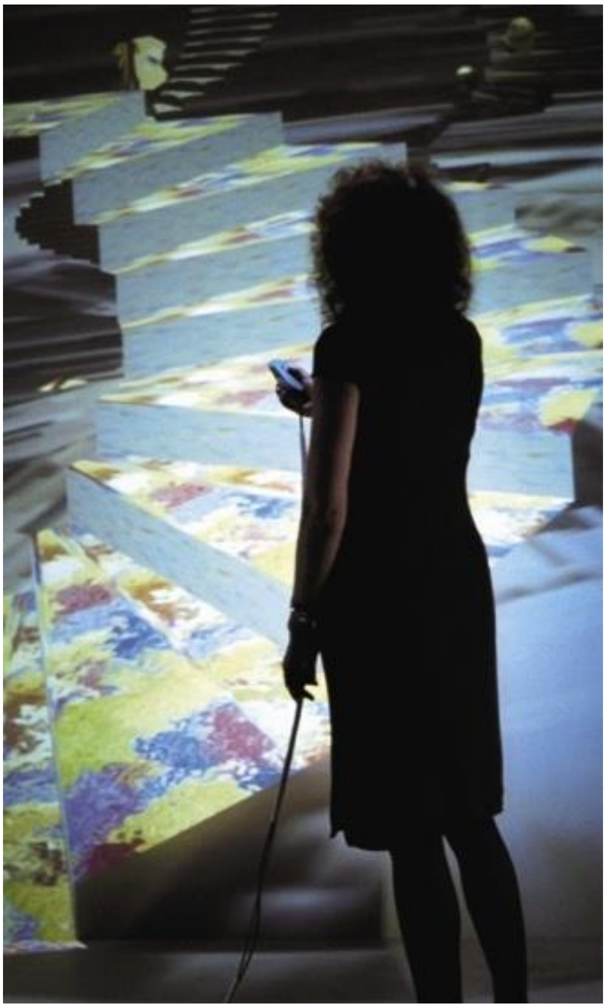


Figure 2.26. Moving through CAVE projections using a wand
for navigation and hand tracking.

2.2.3.4 **Replaying the virtual environment**

The capture and playback is not core to the thesis questions but this section does address the concern that artists who work in this medium have difficulty exhibiting their work. This is largely due to museums and galleries not being able to provide the necessary equipment for long term display and to support the technologies for rough public handling over long periods of time. Documentation of the artwork is helpful because they do not remain operational for long periods of time because equipment changes and becomes reconfigured and ultimately obsolete. In the end, the documentation is all that will remain. Oftentimes, the artifacts act as a representation of the original work. There are three stages for documentation or the re-experiencing of virtual reality experiences: capture, playback and dissemination. (Dolinsky, Sherman et al. 2012) All three are interdependent. Choices of how and what to capture impact how the art is represented after the work is not available in its original format.

In order to create interactive art for virtual environments there is an inherent difficulty in learning obscure software, configuring disparate machines and related equipment. As daunting as the development is, exhibition can also be problematic. It is difficult to take the displays and machinery out of the laboratory and place it in a public setting for mass use. Viewing VR art is easiest in the place where it is developed. See Figure 2.27.

Figure 2.27. The Advanced Visualization Laboratory at Indiana University-Purdue University Indianapolis has a CAVE and smaller VR displays for visitors wearing 3D stereo glasses to see VR. This research laboratory is the typical location for developing and seeing VR art.

The equipment is expensive and often used for multiple research and teaching projects which limits the ability to loan it out for an exhibition over long periods of time (Dolinsky et al. 2012).

Some methods for exhibiting and preserving VR experiences include documenting the creative process, archiving the work and exhibition venues, creating related works, publishing related materials and being able to compare related works (Dolinsky et al. 2012).

For example of publishing related materials, my CAVE piece “Blue Window Pane” was on the November 2011 cover of Computer Graphics World with an accompanying article about CAVE art (Robertson 2001:24-29). See Figure 2.28.

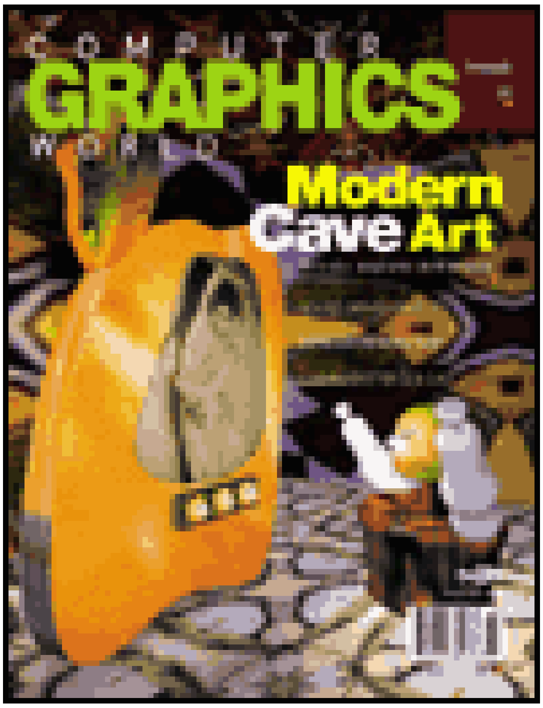


Figure 2.28. *Computer Graphics World* in November 2001 has an article describing several CAVE artworks and displays the CAVE art “*Blue Window Pane*” on its cover.

Jackie Matisse's CAVE piece "*Art Flying In and Out of Space2*" is reviewed in *Art in America* (Johnston 2005:130). Matisse is creates real world kites which were rendered in a virtual environment to appear as if they are actually flying by using a physically based animation method in VR (Venkataraman, Leigh et al. 2003:973). CAVE piece VR art is found in both computer graphics industry journals and art world magazines. This is an instance of the art world beginning a recognition for CAVE art.

It is difficult to capture virtual environments effectively for documentation because by nature VR is experiential. Photographs and video can only capture a portion of the event and typically from a third person perspective which wholly negates the first person phenomena. Low light levels and stereo screens can cause for confusing documentation that is difficult for the VR novice to correctly translate without a detailed explanation or voice over. See Figure 2.29. Visitors can also occlude the display. See Figure 2.30.

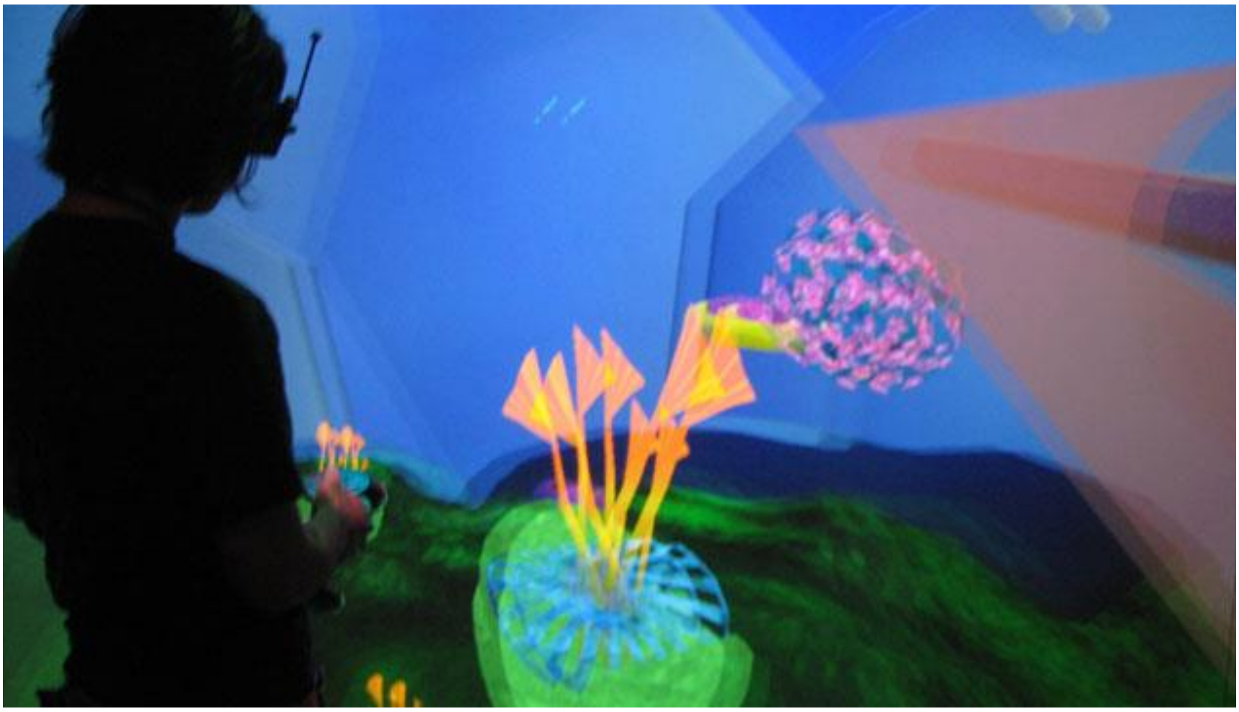


Figure 2.29 Low light levels and a stereo screen make it difficult to capture a VR experience.

Figure 2.30. “*Six Friends”* M. Dolinsky. SPIE, San Francisco 2010.

Audio can be a major component of an interactive artwork and especially with live musicians and a major theater venue. Aspects of an event have to be captured individually or in separate modalities depending on the event and if a live capture can take place during a performance. See Figure 2.31.

Figure 2.31 “*Annunciation and Visitation*” October 2009 Buskirk Chumley Theater Bloomington Indiana. Virtual sets were used with live musicians.

Interaction is a major element in many virtual environments and this interaction can be difficult to capture because interaction involves both a physical and psychological component that is typically surprising, fleeting and spontaneous. Visitors' reactions can be unpredictable and are not typically photographed or video captured. Some rare instances occur but a good view of the environment is usually sacrificed in those candid moments. See Figure 2.3

2.

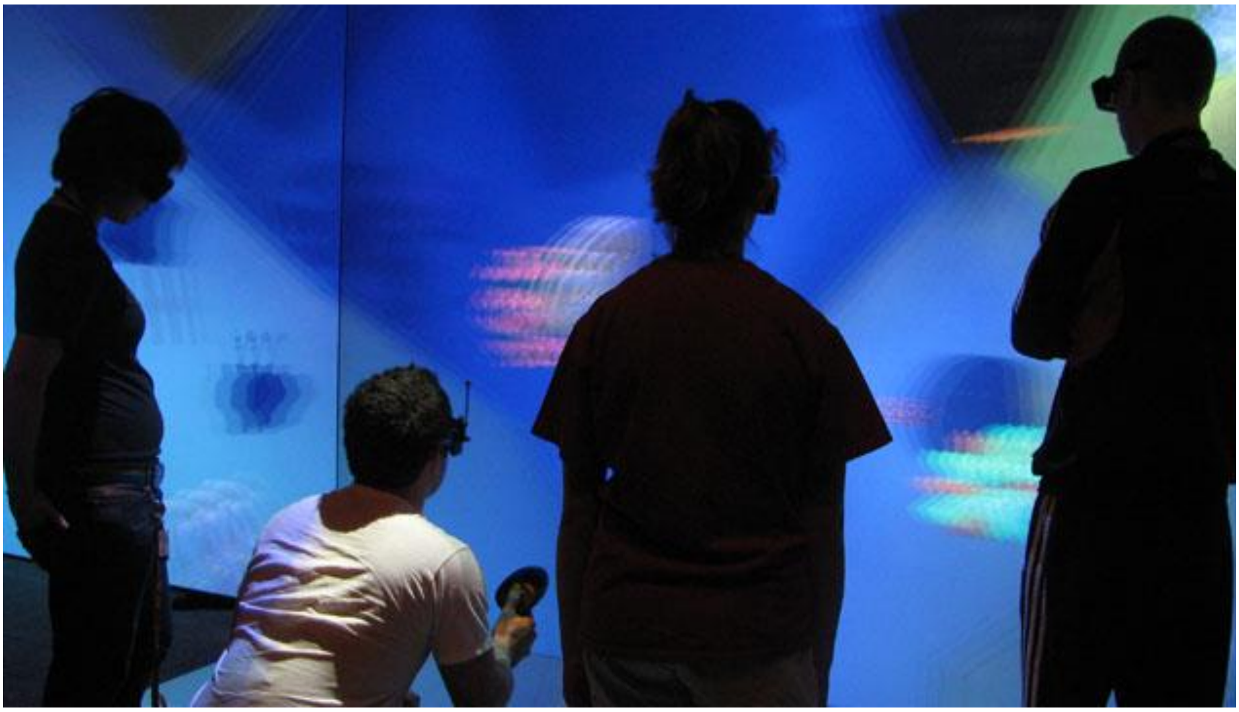


Figure 2.32. A visitor is motivated to view the 3D objects from a different vantage point by stooping down and looking up. Another visitor looks down into the floor to get a sense of height in space.

Virtual environments exploit various types of perceptual awareness such as auditory phenomena or kinesthetic sensations that are difficult to capture, replay and document. One of the more interesting perceptual experiences is a sense of height which can sometimes be captured in photographs or first person accounts of navigating. See Figure 2.33.

Figure 2.33 “*Blue Window Pane II, Stair Scene*.” M. Dolinsky. Photograph of CAVE. Visitor experiences a sense of height by moving through stairways.

The venue where a virtual environment is exhibited in can influence the quality of documentation. For example, at a conference with bright lights and open air spaces, visitors will have a chance to speak with one another and discuss various aspects of the work in a more non-threatening way than if it were in a museum. See Figure 2.34. Alternatively, a gallery or museum setting offers more controlled lighting and the opportunity to take a more polished, professional appearing documentation.

Figure 2.34 “*Emotable Portraits*” M. Dolinsky. Supercomputing 2008.

Performance and theatrical events are more difficult to capture when there are multiple vantage points and the audience is free to move about during the performance. This occurred during the opera “*Fleury:*

Massacre of the Innocents" More information can be found online about this event with the American Opera Theater. For more information see http://dolinsky.fa.indiana.edu/fleury/ See Figure 2.35.

Figure 2.35 "*Fleury: Massacre of the Innocents*" an opera where the audience experience was contingent on sight lines. The audience was also free to move about in order to change their point of view.

The virtual environment as an aesthetic experience emphasizes the experiential moment in order to convey artistic concepts with a stylized design (Dolinsky et al. 2012). What is unique about the artistic process in VR is that there is no longer a fixed frame, as in the frozen moment of a painted image. VR allows the painted image to be explored and navigated in real time. Each visitor has a different viewpoint, dynamic and reference frame in which to explore, so experiential interpretations vary. It becomes difficult to interpret the VR experience when it is considered apart from or outside of its original installation. Oftentimes reviewers are relegated to seeing images or videos of the VR experience rather than experiencing it for themselves. The documentation becomes, in effect, a stand-in for the virtual experience. Therefore, interpreting art and codifying its impact is a difficult problem in general. This dilemma is heightened even further within VR art.

Virtual environments are exhibited in virtual reality theaters, art museums and galleries, concert halls, musical and theatrical stages, and in classrooms (Dolinsky et al. 2012).

Most VR technologies are found in visualization laboratories that are typically behind locked doors but well worth the visit to experience high end displays. One example is the configurable BARCO VR theater in Indianapolis Indiana where the walls are on hydraulics and can move so that the display can appear as a cube configuration or as a panoramic display or as something in between. See Figure 2.36.

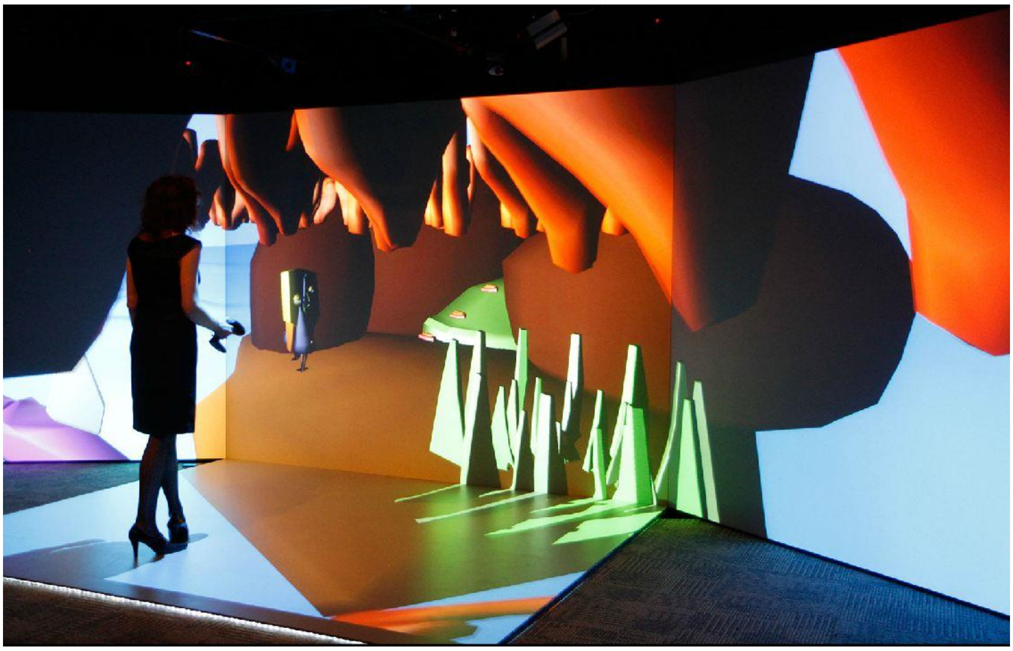


Figure 2.36 "*Figuratively Speaking*" M. Dolinsky. VR Theater, IUPUI.

VR installations in galleries and museums are typically accompanied by docents and exhibitions are experienced at scheduled times. Typically a schedule occurs much like a theatrical event with a dedicated time or ticket. The equipment can be delicate and not for rigorous public usage so it needs extra care, closer supervision and constant maintenance. See Figure 2.37.

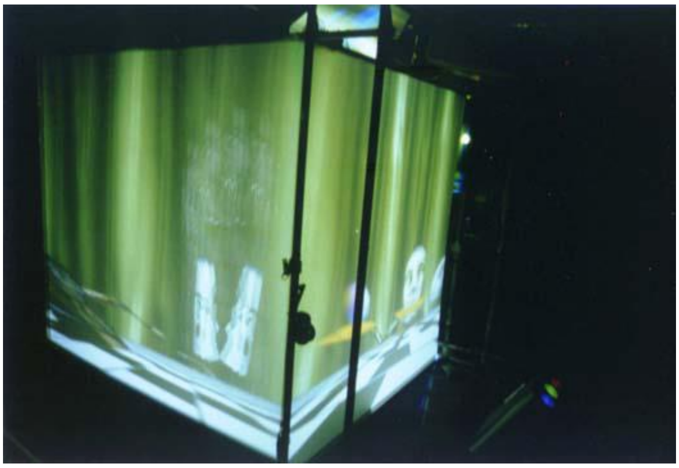


Figure 2.37 “*Dream Grrrls*” Ars Electronica Festival 1996. Linz, Austria.

One of the most elusive issues in museums are the limitations for photography. It can be difficult to obtain permission to photograph inside a museum and to photograph visitors without their consent. See Figure 2.38.

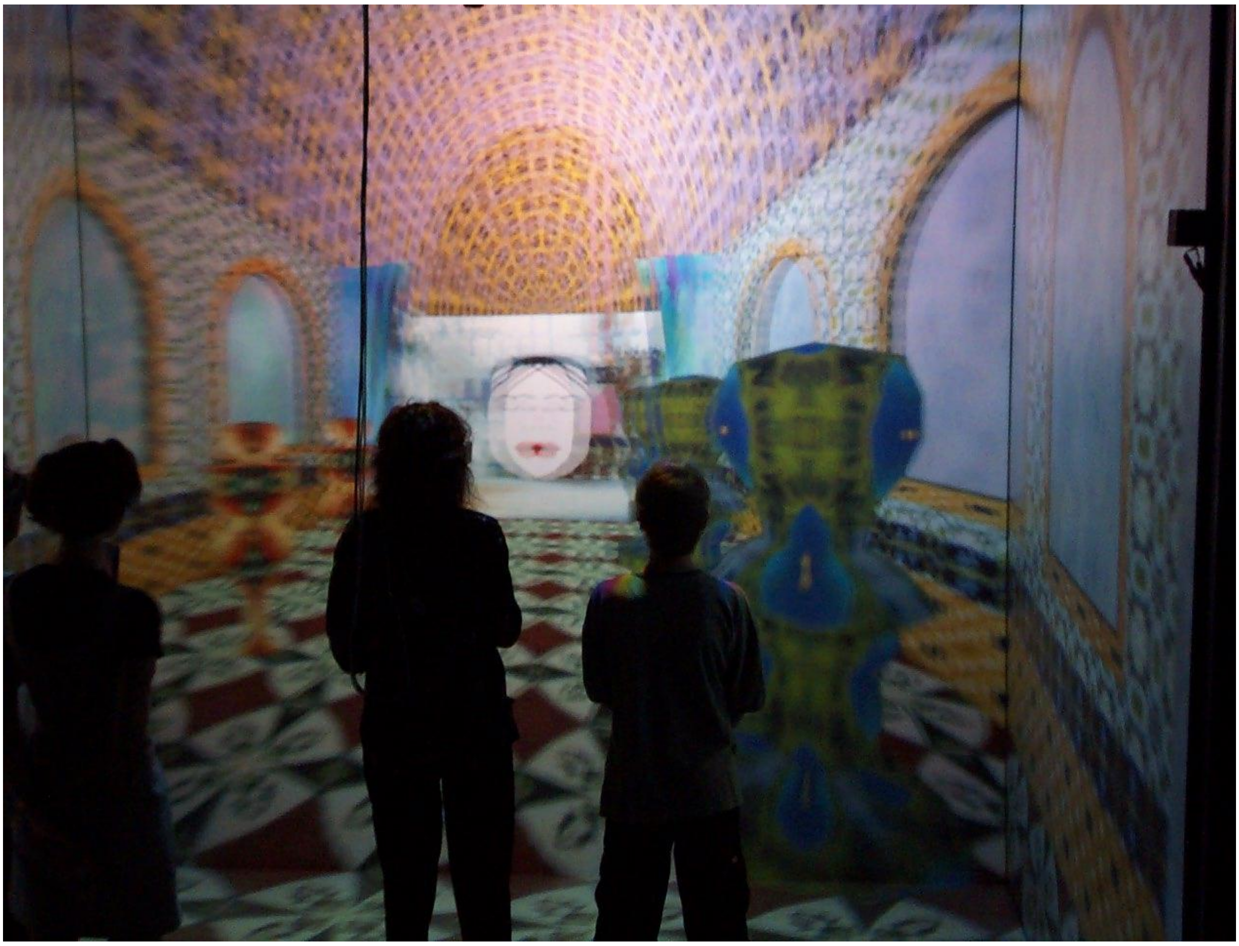


Figure 2.38. *"Blue Window Pane"* M. Dolinsky. Ars Electronica Festival 2001.

The use of interactive arts within dramatic theater events, opera and concert performances offers a new territory for virtual environments and their integration into the arts. The integration of the environments within dramatic action is compelling, exciting, and creates unique experiences that are difficult to capture. Live musicians tend to augment the virtual experience, raising it to new levels of immersion. These events cause the actors to be engaged with igniting the experience but for the would-be VR visitor to become relegated to the level of an audience.

Oftentimes documentation can be done during rehearsals but this is problematic because the actors and musicians are not in full dress and the stage and lighting is not in the final configuration. However some documentation is taken during the actual performances. See Figure 2.39.

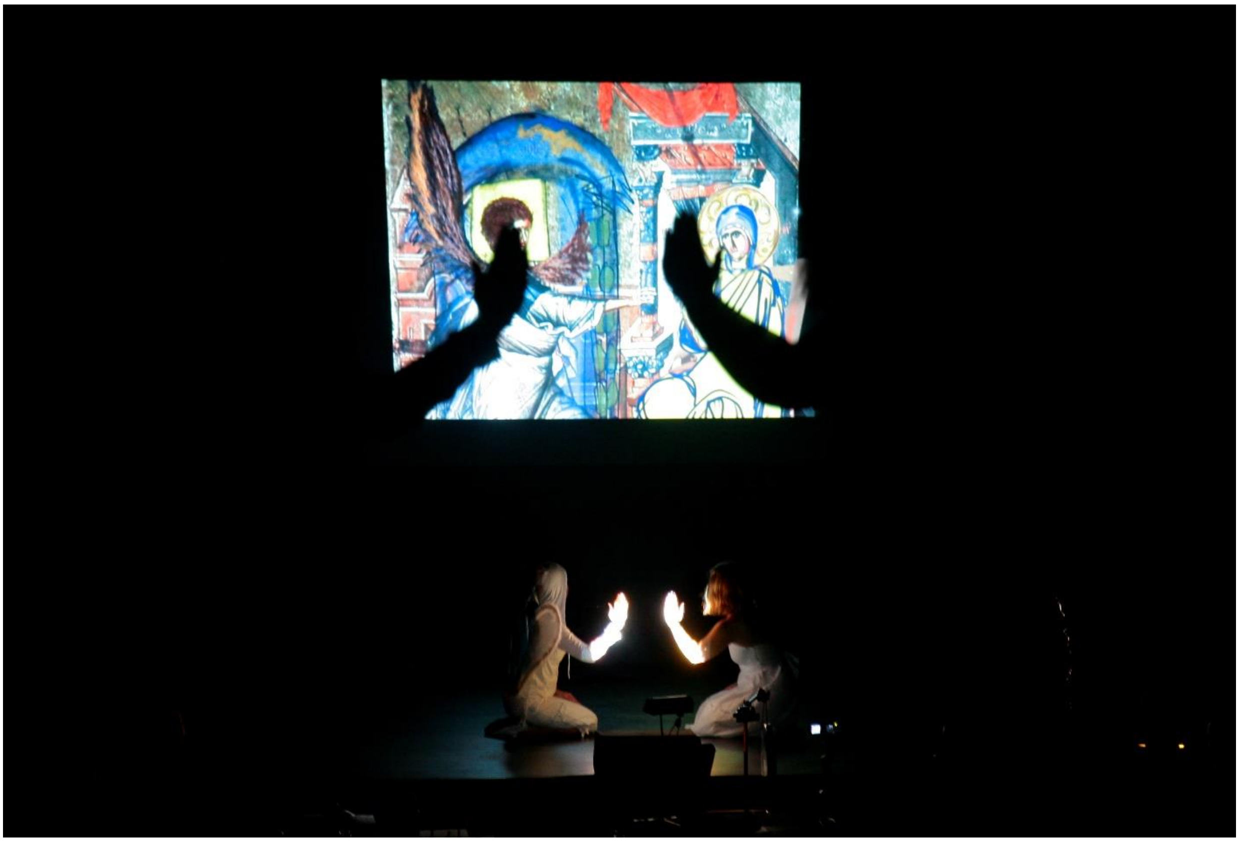


Figure 2.39. "*Annunciation † Visitation*" October 2009 Buskirk Chumley Theater Bloomington Indiana.

Classroom experiences can be documented by keeping an archive of the students' presentations in two forms. One archive is the computer files themselves, which are ready to play in an appropriate VR display. The other archive is web documentation created by each student dedicated to his or her work. For example, at IU, students use Maya for modeling and a related software game engine for constructing the virtual environment. The art work can be exhibited publically in a virtual reality theater or in a student showcase at the IU Cinema as well as online in web pages. Events that are not web based are videotaped and/or photographed. There are some challenges with where to store the videos and how to make them accessible to students over the long-term. Typically, they are given to students who request them on a hard drive transfer or snippets are posted to an online video-sharing site like Vimeo or YouTube. Photo and video documentation is crucial to documenting events and exhibitions. However, it is not always practical because photography can be intrusive and videotaping is sometimes tedious to watch later. See Figure 2.40.

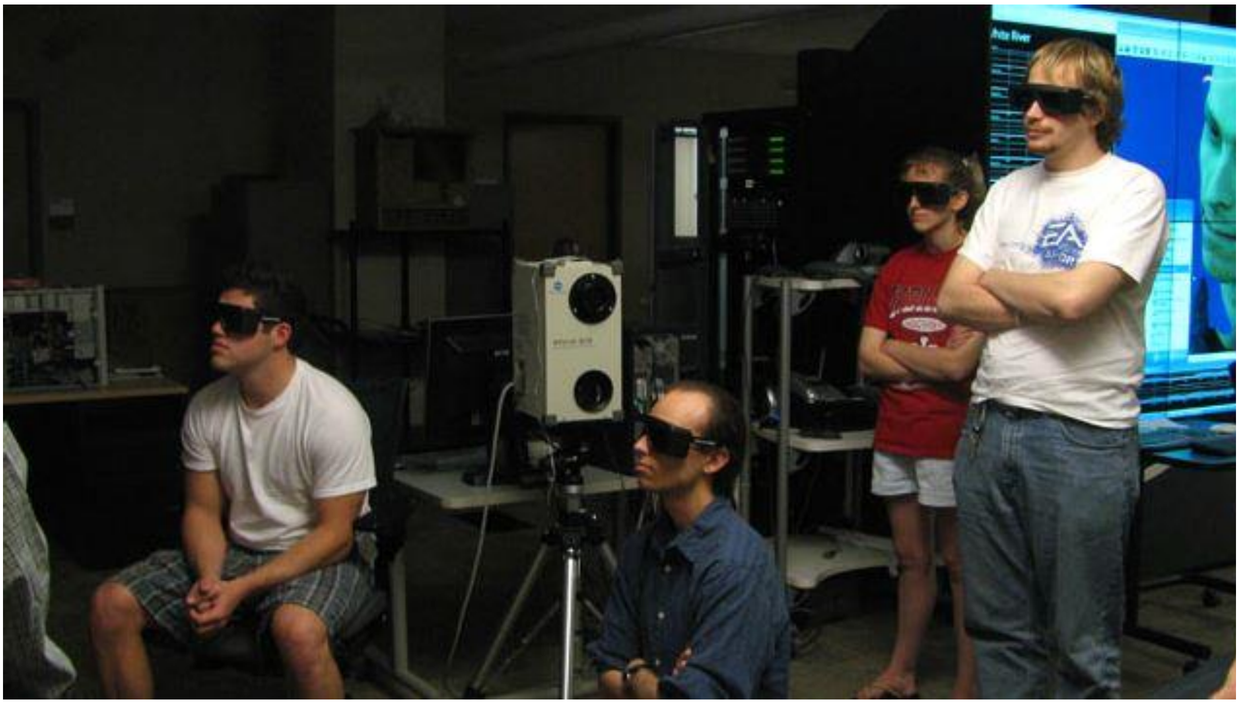


Figure 2.40 In a classroom field trip, Indianapolis Advanced Visualization Laboratory displays a CAVE theater and a 3D television to exhibit virtual environments for Indiana University and Purdue University students.

Documentation includes video, photography, still images of screen captures, tracking data, and development assets such as 3D models, drawings and paintings. These can be experienced or analyzed by restaging the work in a different format including video, 3D and 2D materials. Many artists are reluctant to share this material because a small part of the entire piece may become a representation for artwork and neglect its scope or it may be a crude documentation of a much more elaborate work. Many times it is the archival materials that are relied upon to understand the original workIn Figure 2.41, various types of virtual environments and the options for their documentation strategies are outlined (Dolinsky, Sherman et al. 2012:7). The types of environments include art, science, design, training, performances and online communities. These environmetns occur in classrooms, laboratory, museums and the theaters. The uses for capturing information are varied from replaying the original work to documenting the process for education, analysis and creative development.

I. Types of Virtual Environments

- VR Art
- VR for Science (Immersive Vis)
- VR for Design
- VR for Training
- Performing Arts
- Online Communities

II. Types of Physcial Environments

A. Type and Constraints of Physical Space

- Classroom or Development Space
- VR Laboratory
- Museum or Gallery
- Theater, Concert Hall, or Cinema

B. Incorporation of Technology into Physical Space

- Types, configuration, permanence

III. Uses for Captured Information

A. Re-Experience

- *Preservation* (full recreation) vs. *Re-simulation* (approximate recreation)

B. Documentation

- Development process (pre-event)
- Viewer/Audience reaction (during & post-event)
- Digital portfolio or notebook
- Help the field to mature by learning from the past

C. Dissemination & Education

- Journalistic and Media uses
- Share at conferences, in classrooms

D. Analysis

- HCI & psychology studies
- After-action reviews for simulation & training

E. Creative Continuity

- New exhibition opportunities
- Creating derivative works

IV. Information and Assets to Capture

A. Outputs of VR Application

- CGI - number & type of screens - mono/stereo/image+depth, resolution
- Audio - number of layers/channels, sonification, spatialization
- Haptics and other modalities

B. Video & Photography

- Camera views: first-, second-, or third-person
- Formats: mono/stereo, high-res, high-speed, spherical, LIDAR

IV. Information and Assets to Capture (cont.)

C. Interaction Data

- Tracking data (user actions)
- Event data (triggers, touches, timers, etc.)
- Data from multiple sessions or viewers

D. Synchronization Methods

- Time stamping; reconciling different recording rates

E. Original Digital Assets

- models, textures, animations, sounds
- Software tools, scripts, and programs
- Versioning - all versions or only final

F. Design Documents

- Planning - e-mails, documents, spreadsheets, storyboards, animatics, etc
- Annotations – during design, during/after event, during analysis
- Introspective – Diary, Blogging, Sketchbook, Journaling, Lab Notebook – document thought/creative processes

V. Types of Playback, Re-experience, or Analysis

A. Re-staging - rerun original application and content

- Original system vs. Emulation software

B. Interactive Approximation - convert to 3D standard

- Choice of standard (e.g. VRML); method of translation
- Accuracy and long-term viability of translation

C. Playback recordings (CGI, Video, Audio)

- Edited vs. non-edited
- Single session vs. Multiple sessions
- Single View vs. Multiple Concurrent views
- Advanced techniques (e.g. depth-enhanced video)

D. Playback Envrionment

- Displays - size, mono/stereo, number
- Ideal - play back in original display

E. Visualization of Interaction and Event Data

- Separate windows, integrated video overlays, integrated 3D representation

F. Printed Materials

- text, 2D prints (images and diagrams), 3D prints

G. Web and Online Documentation

- Event-specific vs. general repository (e.g. YouTube 3D)
- Permanence of sites and data repositories

Figure 2.41 Taxonomy of virtual environments. This chart outlines the various types of virtual environments and the options for their documentation strategies.

Archive systems that include on-site software that accommodates annotations and videos with annotations have been developed for the social sciences who have large data sets that include video and audio recordings. The Ethnomusicological Video for Instruction and Analysis Digital Archive (EVIADA) is a multi-year collaborative project between Indiana University and the University of Michigan through the National Science Foundation to simply put create a digital archive for field recordings captured by ethnomusicology researchers. (Dunn, Cowan 2005) EVIADA is primarily used in ethnographic studies by researchers who travel to remotes locations such as Africa and document and record musicians, dancers and singers. EVIADA collects recordings and allows editing the videos and annotating the events in the video as part of a ubiquitous software archive.

In the UK, Chris Greenhalgh and his colleagues have developed the Digital Replay System (DRS), innovative social science software which is part of the National Centre for e-Social Science's Digital Records for eSocial Science node. (Greenhalgh, French et al. 2007) Both projects were ethnographic study pursuits that allow the examination of social and cultural rituals and their complex interactions between dialogue, non-verbal behaviors and general activities. (Brundell, Knight et al. 2008) Some of the main features that are used include data management, synchronization and replay of multimodal data, the structuring, annotation and coding of data and some tools to interrogate the raw data.

Specific materials to archive can involve the following documentation:

- Design models
- Evolution, change management
- Prototypes
- Testing
- Version management
- Documentation
- Usability evaluation, plausibility

Being able to replay a virtual environment extends its longevity. It also serves as a tool to understand the artwork and its aesthetics. (Dolinsky et al. 2012). For example, the video for "*Dream Grrrls*," a CAVE artwork by Dolinsky and Sehmisch, is a documentary of an art piece that includes both aesthetic descriptions of the art and technical explanations of the

CAVE theater as an experiential device. The video can be found at: http://www.youtube.com/watch?v=5ZwQusWWvvQ

Documentation was the focus for Baz Kershaw from the University of Bristol's Department of Drama: Theatre, Film, Television when he led the PARIP project. PARIP, or 'Practice as Research in Performance' was a 2000-2005 study funded by the Arts and Humanities Research Council in order to investigate creative and academic issues surrounding research practitioners of performance media such as dance, film, television, video, digital media and theater who were pursuing PhDs in art. Their website is found online at http://www.bris.ac.uk/parip/index.htm. Intrinsic to their goals was to investigate how practice can be established in research and the value of documentation. PARIP differentiates documentation in terms of 'integral' and 'external' documentation. Integral documentation is considered to be the “materials that the practice process creates” such as scripts, costume designs, set designs, audio designs, reports, choreographic notations, treatments, camera reports, etc. External documentation comprises media based on the actual performance including photography, video, audio recordings, text based ephemera and similar materials that support or reference the performance as it occurs. According to the PARIP website, by developing modes of documentation and categorizing types of professional work they are developing new paradigms for Ph.D.'s.

An example of their efforts includes the work of Gabriella Giannachi from the University of Exeter, Alan Chamberlain and Duncan Rowland from the Mixed Reality Lab at the University of Nottingham and Julianne Pierce of Blast Theory, with many others involved (Foster, Benford et al. 2010). In an effort to investigate a range of methods for archiving and playing back recorded materials, the project partners used Blast Theory's work "*Rider Spoke*" as a practical project for study. They recorded for replay a live, distributed and interactive experience called "*Riders Have Spoken.*" Giannachi compiled information according to a meta data list that includes practitioner name and bio, partner names, venues, description type, keywords, relevant programs (hardware, software, OS), artist video and images, publicity, the R&D process and implementation, findings and user interaction, evaluations and instructions for restaging. This meta data forms the basis of a website http://www.blasttheory.co.uk/projects/riders-have-spoken/. Also an ethnographic video formed another avenue of research so the team describes a further iteration would have been to incorporate the website with video and more of the replay archive materials. Researchers noted that this methodology was extremely time consuming.

My arts research is similar to PARIP's in that we both investigate the creation of live performative media using technology tools and we both recognize the need for documentation. However, my approach found documentation to be extremely time consuming and challenging to realize in real time what might prove valuable to collect. Practice is an integral part of my research with web documentation being the method for establishing a presence for the work outside of the actual event. My research approach is to focus on informing my work in terms of augmenting the artistic process. I investigate various fields including specific artistic approaches for making strange (the history of immersion, Surrealism, Cubism, Defamiliarization) and an understanding of creativity through a method using the stream of consciousness (Jung, James, various artists) alongside a tradition in cognitive thinking (analogies, metaphors, visual illusions). Together these avenues build a scaffold to situate my art making methodology as an intervention in technology based systems. Using a specific trajectory of stream of consciousness created images with the technologies of art, virtual reality, and psychology I situate my drawing and painting methodology in a framework that has the ability to expand alongside my artistic investigations. Rather than generating documentation, I concentrated on being immersed in the process and found my work extending to new forums from screens to galleries to projections in architectural interiors to theatrical stages.

PARIP demonstrated that archived materials should be made easily available and this can occur on the web but some materials may take up large amounts of disk space and be difficult to organize in a clear and precise presentation. An unwieldy archive can be augmented by DVDs, catalogues, and books.

Another archive example is "*Placeholder*" (1995) was exhibited for two-weeks at the Interactive Screen Workshop at the Banff Centre for the Arts, in Banff, Alberta, Canada, http://www.banffcentre.ca/bnmi/programs/archives/1995/interactive_screen/. Several books highlight "*Placeholder*" along with a collection of VR experiences including "Immersed in Technology: Art and Virtual Environments" (Moser, MacLeod 1996), "Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation" (Dixon 2007) and "Developing Virtual Reality Applications" (Craig et al. 2009).

Virtual environment art tends to exhibit in non-traditional venues like conferences and labs, which makes a comprehensive overview of its history difficult. Several researchers have done valuable work in finding and archiving a large number of virtual environments. Jacqueline Ford Morie's thesis, "Meaning and Emplacement in Expressive Immersive Virtual Environments" (Morie 2007) includes a Chart of Artistic VEs. Oliver Grau's Database of Virtual Art is an international database of all types of virtual artwork that includes virtual reality as well as other interactive mediums (Grau 2003). There are also arts and sciences repositories such as Rhizome http://rhizome.org and the Planetary Society http://www.planetary.org. Other sites are general repositories for specific media formats such as YouTube, Vimeo, and Flickr. Many research laboratories and individuals maintain public sites such as EVL at University of Illinois at Chicago www.youtube.com/visitor/evltube, Oliver Kreylos http://www.youtube.com/visitor/okreylos and Elif Ayiter http://www.flickr.com/photos/alpha_auer/.

Figure 2.42 "*Figuratively Speaking*" 2012 VR art website documentation.

Dolinsky's website (Figure 2.42) for "*Figuratively Speaking*" combines a statement of the work with a description of the interactivity and includes imagery as photographs of the installation, still shots of the environment, and videos of both. In order to capture the work as experience and as artwork, the images include in-situ moments as well as screen stills. Future iterations would also include feedback from the audience through a comments book or a video recording of their impressions.

2.3.0.0 **Summary of key points made in this chapter**

This chapter focused on the arts as a process rather than art as an object or a particular genre or style. Art as process is investigated as a historical precedent that is a result of a biological need to engage, to act and react and to adapt to change. According to Dissanayake's research in "*Art as Human Behavior: Toward an Ethological View of Art*," humans are driven to create objects that are beyond a utilitarian design and rather make objects special in an effort to satisfy a proclivity towards creating something of greater value. This need to appreciate the significance of objects is an indicator to cognitive awareness, a drive for immersion and an appreciation of aesthetics. Perhaps among the earliest indicators of art are the drawings created inside cave walls that that may have been a response to a need for symbols of identity (Gilman, Thornes 1984), another factor in cognitive awareness. The decorated spaces inside the earth may have been a place to psychologically prepare for particular events (Barton 1994; Pfeiffer 1982; Mithen 1988) which were facilitated by the aesthetics of the drawings and the cavernous setting of immersive space. Rather than consider the cave drawings with a particular meaning, they point to a relationship between the visitors and their surroundings which facilitates an active experience of remembering and relating. The trajectory of immersion continues in various art forms including panoramas, paintings and dramatic events such as opera, theater and comedy. A contemporary vehicle for immersion is virtual environments such as the CAVE Automated Virtual Environment which is a reference to Plato's "*Allegory of the Cave*." In the allegory, cognitive awareness and perceptual mindfulness is a central theme for framing consciousness – a key element to building virtual environments. It is important to emphasize that:

- Virtual environments mimic the dynamics of awareness and attention in our non-virtual environments.
- Immersive artistic practices shift/situate consciousness by "making special" an art experience and creating a shared sense of being.

- Virtual environment art expands immersive artistic practices.
- Virtual environment applications can be found in education, science, medicine, therapy, business and the arts.
- The CAVE (CAVE Automatic Virtual Environment) is among the most immersive mediums in existence providing a theatre like setting.

Chapter 3: Creative Activity Review

3.3.0.0 **Artists in the VR field**

Now that the technical aspects of virtual reality and its methods of documentation have been given an overview, the next section will examine Roy Ascott and interactive art as a historical trajectory of art making, Carol Gigliotti's criteria for aesthetics, numerous examples of virtual reality artists, and outlines some of their work with images. The artists include Monika Fleishmann, Wolfgang Strauss, Char Davies, Maurice Benayoun, Christa Sommerer and Laurent Mignonneau, Rita Addison and Benjamin Britton. After stand-alone artworks are discussed, the thesis discusses a form of networked virtual environments featured in an exhibition in Brazil which includes Josephine Anstey, Dave Pape and Dan Neveu, Jackie Matisse, Margaret Dolinsky, Alpha Auer, Masa Jazbeck and Ursula Berlot. Then the thesis will look at three painters who turned to work in virtual environments: Daria Tsoupikova, Tim Portlock and Wille Mäkelä. This section also provides names and short biographies of other artists who have worked with virtual environments and continue to practice in the interactive arts. These names include Luc

Courchesne, Knowbotic Research, Rebecca Allen, Perry Hoberman, Jacqueline Ford Morie, Brenda Laurel, Sheldon Brown, David Em, Diane Gromala, Myron Krueger, Jaron Lanier, Michael Naimark, Jeffrey Shaw, and Toni Dove.

3.3.1.0 **Introduction**

In contrast to traditional art media, interactive art not only engages the visitor through the sensory apparatus of the body but also allows the visitor to engage the artwork, which responds and changes with the visitor's presence. Roy Ascott, telematic artist, theorist, and pioneer virtual environment artist describes the work of Marcel Duchamp and Jackson Pollack as indicators pointing to a shifting worldview and a re-contextualization of ourselves towards new media art. He states, "We begin to understand that chance and change, chaos and indeterminacy, transcendence and transformation, the immaterial and the numinous are terms of the centre of our self-understanding and our new visions of reality." He situates Duchamp's "*The Bride Stripped Bare By Her Bachelors, Even*, or *The Large Glass*," as a key moment in the development of this idea. It both embodies and eschews binary divisions between “male and female, natural and artificial, human and machine,” ultimately embracing a constant “tension and interaction” as its method of generating meaning. Pollack’s drip pictures, too, are fields of conflicting forces, “intertwining, interweaving, branching, joining, colliding, crossing, linking lines of energy” that in their interaction become whole, “prophetic of the network consciousness emerging with the telematic culture” (Ascott 1990:241-7).

Artists like these strove to expand the definition of art not only in its creation process but in its viewing as well. Through the creation of an “inclusive and inviting” space for the visitor they heralded the way for an interactive art, an art in which, according to Ascott,

> “The technology of these transformative systems fulfills a profound human desire: to transcend the limitations of body, time and space; to escape language, to defeat metaphors of self and identity that alienate and isolate, that imprison mind in solipsistic systems. Our need is to fly, to reach out, to touch, connect-to expand our consciousness by a dissemination of our presence, to distribute self into a larger society of mind. That is the future of art, that is the relevance of telematic systems. The interface to these systems is not the window to an ordered reality as presented by Renaissance art, but a doorway to an infinitely transformable reality, the threshold to variable worlds, in

> which we can creatively move and meet and have our being.“ (Ascott 2011).

Such transformations of the user’s perception and consciousness are the common factors preoccupying the artists discussed in this section. In effecting these changes, these artists seem to harbor a desire to transcend the body and become pure mind, allowing the visitor to be liberated from the “prison of the body” and the “tyranny of the flesh.” This is the same desire that is expressed in science fiction and cyberpunk films in which the virtual space of the matrix is explored as a potential space for consensual hallucination and mind enhancement.

3.3.2.0 **Artists creating virtual environments**

Six criteria for virtual aesthetics were outlined by Carol Gigliotti as interface, content, environment, perception, performance and plasticity. (Gigliotti 1995:289-295) The interface unites hardware, software and the user in a common space for action and reaction. The goal is a dynamic structure in which the participant navigates with a variety of choices, experiences and interactions for enjoyment, exploration, decision-making and learning. The content is based on imagery and experiences similar to a dream-state. Fueled by the unconscious, interaction is often indulgent, whimsical, and self-reflective.

The environment or physical space will have familiar qualities in unfamiliar settings. For example, visitors may navigate through a space to find brightly colored glass vessels to explore. The most creative explorers will interact with these objects and find themselves thrown into other challenging worlds. Perception will guide the visitors to follow the line of sight through the stereoscopic tracking glasses. The glasses and navigation wand allow interaction with objects and create a virtual sense of movement through the space. The computer provides "clues" with sight and sound. The performance is based on the visitors' action and reaction with the computer and the ability to suspend disbelief.

In order to optimize the performance, objects represent and lead to other scenes rather than presenting one world in its entirety. The program contains a set of multiple drawing functions that are executed depending on the visitor's position. The visuals become critical to achieving a smooth and unified experience. The plasticity of the artwork is represented in its ability to give, to change shape in response to the visitor's play. Design is not to be underestimated. It is an indispensable aspect, representing and providing tasks. The design includes structure, graphics, sound, tactile and kinesthetic effects. This provides sensory, cognitive, and emotional stimulation, which shapes participants' actions.

Equipment used for virtual environment art is typically contained in research laboratories, to which artists have limited access. The development of the applications is not trivial and includes many programs, machines and network infrastructure. A detailed description of application domains and hardware configurations of virtual environments can be found in Section 3.2.0.0 of this chapter. Because of the specific nature of the hardware requirements, communities of virtual environment artists come to know one another and share their work at a relatively limited number of venues, some of which do not cater to artists specifically. In addition to university galleries and museums that are able to handle the technological demands of the presentation, virtual environments are most often shown at computer graphics conferences and engineering symposia. At these venues, the work is referred to in a broad array of contexts and presented on many different kinds of devices, making it hard to categorize.

Additionally, an informal culture of sharing and discovery among artists prevails at these events, with the unintended consequence that some degree of the development of virtual environment art is difficult to trace. This being said, the artists discussed here represent a view of the history of virtual environment art in which the consistent goal is a desire to facilitate shifts in consciousness, shifts in perception, and a sense of immersion in novel thought and time processes. In each case the artist works collaboratively with the visitor, who realizes the artwork through her navigation of time and virtual space. Roy Ascott states that

> "The very technology of computer telecommunications extends the gaze, transcends the body, amplifies the mind into unpredictable configurations of thought and creativity... At the same time, the status of the art object changes. The culturally dominant *objet d'art* as the sole focus (the uncommon carrier of uncommon content) is replaced by the interface. Instead of the artwork as a window onto a composed, resolved, and ordered reality, we have at the interface a doorway to

> undecidability, a dataspace of semantic and material potentiality. The focus of the aesthetic shifts from the observed object to participating subject, from the analysis of observed systems to the (second-order) cybernetics of observing systems: the canon of the immaterial and participatory. Thus, at the interface to telematic systems, content is created rather than received. By the same token, content is disposed of at the interface by reinserting it, transformed by the process of interaction, back into the network for storage, distribution, and eventual transformation at the interface of other users, at other access nodes across the planet (Ascott 1990:241-7).

3.3.3.0 **Selected Examples of Virtual Environments as Art**

The following contains selected examples of virtual reality art in order to examine some of the elements that have motivated artists towards immersive works. It includes artists who work in the United States, Asia and Europe with a variety of projection display systems such as the CAVE theater and head mounted displays or HMDs. It became important to understand what my peers were creating in order to find commonalities in the approaches and unique solutions. Virtual reality does not have a prescribed language for the strategies used in the environments so often terminology is used from other media such as video games or cinema.

3.3.3.1 **Monika Fleischmann and Wolfgang Strauss, "*Home of the Brain*" 1992**

Monika Fleischmann is a German research artist, scientist and pioneer at the Fraunhofer Institute for Intelligent Analysis and Information System (IAIS). In 2001, she founded the MARS Exploratory Media Lab with her collaborator Wolfgang Strauss. MARS is an experimental research laboratory for living in mixed realities and designing future models of networked knowledge and communication spaces. Their objective is "to make artistic strategies for developing media technology productive and to promote media-technological skills in art, culture and education" (Fraunhofer 2009).

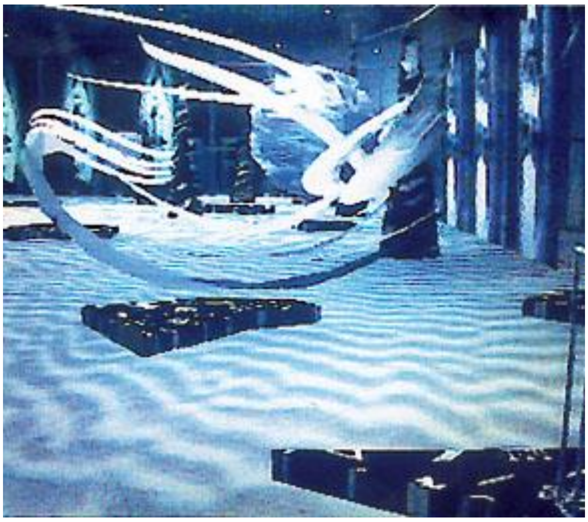


Figure 3.1. “*Home of the Brain”* Fleischmann, Strauss 1990-92. (Fleischmann, Strauss 2001).

“Home of the Brain” (Figure 3.1) is referred to as one of the first artistic virtual reality installations. It was awarded the Golden Nica for Interactive Art at the Ars Electronica Festival in 1992 (Ars Electronica Linz GmbH). The environment was a navigable 3D world of houses inside a central labyrinth filled with a world of symbols, reminiscent of Carl Jung's concept of the collective unconscious. (Fleischmann, Strauss 2001) The world of philosophers is made of words and thoughts that act as powerful symbols. The virtual space visualizes these symbols and transforms experience of the philosophies by using light, colors, shapes and words. Each philosophical concept is paired with a color, for example green for hope, blue for fairy tales, yellow for hope and red for adventure.

“Home of the Brain” uses a data glove and data visor to transfer the concept of the museum to a navigable space similar to a museum for the express purpose of discussing the controversial ideas of media theorists Vilèm Flusser, Paul Virillio, Joseph Weizenbaum and Marvin

Minsky. (Fleischmann, Strauss 2001) Each theorist’s theses are represented in various houses with corresponding trees of knowledge. “*Flusser's House of Adventure*” depicts flowing space and "walls that can be changed at any time, of a world whose structure is no more than an expression of my ideas." “*Virillio's House of Disaster*” tests the "racing standstill" under trees falling in slow motion. "*Weizenbaum's House of Hope*" warns against the power of the computer and the impotence of reason. "*Minsky's House of Utopia*" is a crystalline object representing the future of the computer and its potential to keep humans as pets.

“*Home of the Brain*” extends "the Platonic interpretation of the basic bodies, their forms and colours combine to form symbolic commentaries on the worlds of thought. Alongside the symbolic organisation, the forms and colours provide orientation in the virtual space" (Fleischmann, Strauss 2001). The houses take the form of a cube, a pyramid, a globe, and an octahedron, which represent respectively the four elements earth, fire, water and air. The visitor navigates through the world using the movements of their gloved hand. Pointing a finger can navigate downwards to the foot of the cube or upwards for a bird's eye view. Movements of the head and hand generate unusual points of view and changes in scale.

Cybernetic themes cultivated in "*Home of the Brain*" include the organization of information, information linking, interacting with virtual space, and telepresence--many of the paradigms that are considered today in discussions relating to new media and communication technologies. Significantly, the work codifies perception in a virtual world on a very deep level by translating philosophical comprehension into a 3D computer space. By linking philosophical texts with symbolic representations in virtual reality, the artists presented a wholly new way to understand these texts, for the texts to be experienced rather than read. By carefully linking artistic fundamentals (color, shape, form), sound, and humanities texts, and placing the visitor in a position to engage and confront these phenomena, the artists immerse the visitor physically, psychologically, aesthetically and philosophically (Database of Virtual Art 2011).

In his book *Virtual Art*, Grau writes that "*Home of the Brain"* as a networked interactive installation was an early appearance of the epistemic innovation of telepresence because it

> "visualized in a remarkable way an overview of the new paradigm of communicating via technical images. Further, it was a metaphor for the new public space of telematics, an entirely new kind of public forum, which developed rapidly through the Internet and its associated technologies" (Grau 2003:228).

3.3.3.2 **Char Davies, "*Osmose" (*1995) and "*Ephémère"* (1998)**

Char Davies, a painter and artist living in Canada, was a vice president in the early days of SoftImage, a computer company that went on to create the dinosaurs in "*Jurassic Park*" (Grau 2003:197-98)" Subsequently, SoftImage was bought for 130 million dollars by Microsoft and Davies remained as an artistic director. With her close proximity to the development of advanced computer graphic techniques, Davies was a complex force in creating virtual environments using a head mounted display (HMD). An avid diver, she was inspired to integrate a breathing vest with the HMD. In order to control the navigation of the environment, the visitor uses breathing to gain a sense of direction, much like a diver's suit allows one to ascend or descend through the water.

"Osmose" explores the interplay between self and world by presenting twelve different worlds that are "based on the metaphorical aspects of nature." (Davies 2008a) The worlds include Clearing, Forest, Tree, Leaf, Cloud, Pond, Subterranean Earth, and Abyss. Two other strata called Code and Text contain text reflective of the actual software used to create the work and quotes from relevant texts on technology, the body and nature. Code and Text "function as conceptual parentheses" around the other worlds. Based on a large number of responses from people who have been immersed in the environment, the experience is profound. Visitors often report that they rediscovered some forgotten aspect of themselves or the world, which is often surprising and sometimes emotional. On the Immersence website, Davies writes that such findings indicate that

> "traditional interface boundaries between machine and human can be transcended even while re-affirming our corporeality, and that Cartesian notions of space as well as illustrative realism can effectively be replaced by more evocative

> alternatives. Immersive virtual space, when stripped of its conventions, can provide an intriguing spatio-temporal context in which to explore the self's subjective experience of "being-in-the-world"—as embodied consciousness in an enveloping space where boundaries between inner/outer, and mind/body dissolve" (Davies 2008a).

"Ephémère" extends the metaphors of nature in *"Osmose"* to include the corporeal body as an element of the natural world. (Davies 2008b) Organs, blood vessels and bones inhabit the landscape and symbolize the "correspondence between the chthonic presences of the interior body and the subterranean earth. . . Deep within the earth, rocks transform into pulsing body organs, eggs appear, and aging organs give way to bone." The dozen or so worlds are structured in a progression of winter, spring, summer, autumn, and end with each season made of one, two or three levels. For example, winter stands alone in one level while spring includes the levels of blooming, germinating and body/organ/eggs. Summer has two levels, leafing and fruition. The progression finishes in *"End,"* which has three levels of falling leaves, embers and ashes, and dust. The viewing portion lasts for fifteen minutes and the artwork does effectively end. However, a visitor could remain in one level for the entire viewing period if they navigate solely within that world and do

not venture out to the others. Davies' Immersence website describes the finale as an immersion in the flow of time and seasons passing: "the experience slowly draws to a close, its endings dependent on the participant’s location, as the landscape’s autumnal leaves, the earth’s roots and rocks, the body’s bones, give way to drifting ashes, embers and dust" (Davies 2008b).

The unique aspect of both pieces is that they rely on a breathing vest for navigation. (Grau 2003:198) writes that the vest creates "a profound feeling of embodied presence, which, in the course of the "immersion," results in an emotional state of being that is heightened still further by the music. Each zone has its own localized sound; in fact, sound in general plays a decisive role in generating the feeling of presence."

Davies carried out formalized studies on the VR works in 2002. She surveyed and interviewed visitors at the Curtin Gallery in Perth Australia during the Biennale Electronic Arts Perth (BEAP) festival. The first report on this project was written by Thwaites, who concluded that while the immersive experience was still very new for most visitors, most enjoyed it and many were anxious to try it again. In particular, users responded positively to Davies's breathing-vest navigation system, which gave them "an increased awareness of their bodies while immersed, causing little or no instances of cybersickness." The most often-cited negative aspect of the experience was the uncomfortable HMD. In regard to recounting their experiences of the immersion, Thwaites found that

> "The subjects were willing to participate in VR research given a concise and simple research tool such as the questionnaire but they were less willing to do video interviews. The 'motion paths' proved to be a valuable addition to the questions in support of where immersants think or remember they were in the environments as a personal visit record. Overall the research subjects were articulate, detailed in their replies and willing to participate in this study on the immersive experience of "*Osmose"* (Thwaites 2006:291-297).

Figure 3.2 “*Ephémère*” Char Davies 1998.

Char Davies’s work is shown in Figure 3.2. She comes from a painting background which inspires her imagery. Her HMD work grounds perception in experience through navigational time. By freely leading the visitor to various worlds, she employs what she refers to as “a non-linear means of navigation” and the branching structure is outlined with illustrations and a movie clip at http://www.immersence.com/ephemere/ The choices for exploration are not wholly dictated by the imagery but rather by the choices made through bodily awareness rather than in the cerebral moment. There is no right and wrong way to move or length of time to dedicate to a specific world. One visitor wrote: “[This experience] heightened an awareness of my body as a site of consciousness and of the sensation of consciousness occupying space. It's the most evocative exploration of the perception of consciousness that I have experienced since I can't remember when" (Davies 2004:70). The artwork unfolds very much like a dream sequence. This is the nature of the virtual environment as a medium; its dream-like interactivity gives the medium the power to change the viewpoint. Also see http://www.immersence.com/.

3.3.3.3 **Maurice Benayoun, “*World Skin*” 1998**

Maurice Benayoun, a transmedia artist living in France, created *World Skin: a Photo Safari in the Land of War* which won the Golden Nica for Interactive Art at Prix Ars Electronica in 1998 (Benayoun 2012a). He describes the piece as follows:

> "Armed with cameras, we are making our way through a three-dimensional space. The landscape before our eyes is scarred by war-demolished buildings, armed men, tanks and artillery, piles of rubble, the wounded and the maimed. This arrangement of photographs and news pictures from different zones and theaters of war depicts a universe filled with mute violence. The audio reproduces the sound of a world in which to breathe is to suffer. Special effects? Hardly. We, the visitors, feel as though our presence could disturb this chaotic equilibrium, but

> it is precisely our intervention that stirs up the pain. We are taking pictures; and here, photography is a weapon of erasure" (Benayoun 2012b).

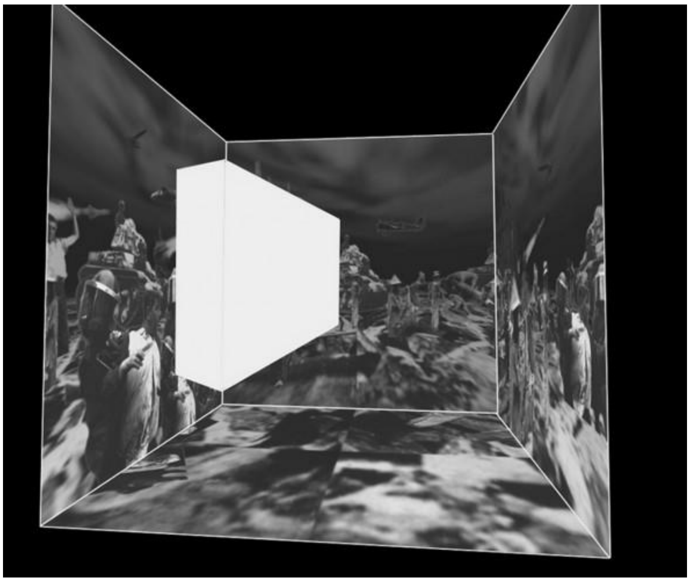


Figure 3.3 "*World Skin*" Maurice Benayoun 1998.

As we move through the environment, we perceive using multiple levels of awareness. At the most basic level, there is neurological perception, the way we perceive sensory-based things. Neurological perception is used to emphasize our end receptors, i.e. the skin. The screen is made up of a landscape and as you take photos of the landscape the photographed area becomes frozen. See Figure 3.3. Black silhouettes appear that seemingly leave behind a skin, the evidence of the violence of the war. The visitor who takes on the camera, shooting and executing the artwork, becomes complicit in the maneuvering, strategizing and violence that leads to the cessation of landscape and, symbolically, life.

The significance of this virtual space is its tight interdependence between the environment and the visitor. The visitor makes a difference – her presence there modifies, constructs and reformulates the reality, both physically and mentally. The visitor's response updates as the computer updates the environment. Like turning out the lights in a bright room, the gradual emergence of vague silhouettes is all that is left to define the space. We have to feel our way around when the lights are out, referencing our memories of past events and intervention. We know where we have placed our furniture and our belongings, and as we move through our knowledge space we discover our living space. In Benayoun's piece, this phenomenon is used to chilling effect: in essence, we know where the bodies are buried.

Painting a picture of mental space in real time is integral to my research into virtual environments. My intention is to include the visitor, and change their perception of their space according to the input they provide to the system. Moreover, I hope that the visitor is actively aware of the choices she makes, alternately forgetting and remembering her space and her choices. My interest is in how the two are woven into the subsequent development and revealing of the immersive experience.

3.3.3.4 **Christa Sommerer and Laurent Mignonneau, "*The Living Web*" 2002**

Austrian Christa Sommerer and French Laurent Mignonneau have collaborated on many immersive art works using novel interfaces, often at the cutting edge of art and technology. *The Living Room*, created in 2001, uses ten different search engines to generate images that flow freely across four different projection walls (Sommerer 2011). In 2002, it was transformed into VR for the CAVE and named *The Living Web*. Their book *Interactive Art Research*, written with Gerfried Stocker, describes the virtual environment as an effort to produce a novel system for intuitive, immersive and entertaining information creation and retrieval:

"Users of this system can physically immerse themselves into the data space of the *The Living Web* and interact with image data and sound data through a specifically designed tweezers interface... When users talk into their headset microphones, conversation-related images are streamed from the Internet and displayed in 3D to completely envelope them. Grabbing one of the floating images, the user can retrieve more information about his specific image (for example its URL), place the icon in a 3D space to bookmark it and sort the various selected icons as 3D bookmarks to create further links, weight of interests and connections between the various topics selected" (Stocker, Sommerer et al. 2009:187-89).

Figure 3.4 "*The Living Room*" Christa Sommerer & Laurent Mignonneau 2001.

Sommerer and Laurent's work (Figure 3.4) is an answer to Rudolf Arnheim's appeal for integrating images from past works of art into new interactive and process-based worlds that allow us to dynamically understand images as insightful and richly aesthetic in an experiential way (Arnheim 2000:167-169). Oliver Grau (2002:97-100) situates their work in a historical context where the idea of merging physical space and a space of illusion occurs in Roman and Pompeian villas. The grotto chambers provide a boundary for reality, which then opens up into spaces seen in the images on the walls. Grau describes the phenomenon as a sense of immersion, using the Villas dei Misteri as an example. It houses a chamber dedicated to the cult of Dionysus, the walls of which are covered with life-size painted mythical figures that seem to communicate with each other and with the visitor. The mythical beings are made manifest as physical presences and, conversely, the visitor is placed on the same "image level" as the gods themselves. Visitors are thus integrated into this space in a way that

> "'opens up' the boundary with the image space, integrates the observers in the scene, and conducts them toward the central ritual of the mystery cult - the state of being emotionally, even ecstatically, engaged and absorbed. . . History has shown that there is a permanent cross-fertilization between large-scale spaces of illusion that fully integrate the human body (360° frescoes, the panorama, Stereopticon, Cinéorama, IMAX cinemas, or the CAVEs) and small-scale images positioned

> immediately in front of the eyes (peepshows of the 17th century, stereoscopes, stereoscopic television, Sensorama, or HMDs)" (Grau 2002:98).

The flow of information in three-dimensional space becomes a metaphor for knowledge, image making and personal integration into image and data flow. Often it is easier to understand a familiar image than to assimilate an unfamiliar image. The use of familiar images—images generated by the voice of the visitor–allows the visitor to conjure or channel their own thoughts. It is reminiscent of a séance where the medium announces the connections to the underworld by invoking messages and admonitions from those that are on the other side. In a CAVE filled with the data space of generative images, visitors invoke, through their own speech, images from internet space. This is significant in my research of virtual environments because the visitor's input (voice and hand gesture) changes her space not only physically but also visually and aurally which promotes a stream of consciousness type of experience. This streaming is integral to my own work where instead of providing downloaded images, the images flow from one sequence or space to another, usually with accompanying audio and music transitions.

3.3.3.5 **Rita Addison, "*Detour*" 1994**

After a serious car accident that left her brain-damaged, Rita Addison's mental function and ability to work were dramatically changed. In *Detour*, she sought through a VR re-creation to share the experience of this altered reality that affected her and other brain-trauma patients. (Addison 1995, Brandt 2005, Craig et al. 2009) In this VR environment, themes of face and figure play a central role, as the technology allows the visitor to take on the artist's eyes and ears and in fact to put their entire body in the artist's place, experiencing the artist's altered sensory awareness. The role of the virtual environment is not to create an entirely synthetic world but rather to emulate an individual's consciousness and perception, communicating this individual experience in a way that would be difficult or impossible by other means. Through this communication, including altered representations of a car crash world using the artist's own photographs, Addison attempts to establish a sense of empathy with the visitor, who becomes intimately bound up with a moment in the artist's life experience.

3.3.3.6 **Benjamin Britton, “*Lascaux*” 1995**

Benjamin Britton’s “*Lascaux”* uses virtual reality to recreate a real-life experience, but one that is inaccessible to most people. (Sherman, Adams et al. 1997:473-476) The cave paintings of Lascaux were originally linked with the space they occupy such that the experience of the paintings was inaccessible unless they were viewed in situ. By modeling the caves digitally, Britton opens up our access to the paintings and establishes a connection between the people of that time and contemporary society, pointing out commonalities between the two in desiring to witness the markings. A connection is possible as the visitor becomes able to glimpse into the life of Lascaux people and see the space where rituals occurred in the Lascaux caves, and perhaps thereby realizing the similarities between the caveman-artists’ goals and the goals of VR artists today—to imbue a space with significance and magic. Britton says:

> “I suppose that the cave has become a spiritual phenomenon for me. In a time when we may fear the future, the cave stands as a message of hope, saying humankind will survive and prosper. Our work today builds that future world.” (Craig et al. 2009:298)

Britton translates the magic of the original space and also adds to it by, for example, including video animations of some of the paintings that appear when the viewer concentrates intently on a specific part of the cave wall.

For Britton the physical site of the VR experience is important. He does not show the piece online, restricting it only to venues where a full-scale CAVE-like projection experience is possible. This is to maintain the specialness of the experience, which requires “a higher level of personal investment from audience members. A viewer must really wish to see the virtual cave if they are to make that experience happen for themselves” (Craig, Will 2009:294).

3.3.4.0 **Selected examples: collaborative virtual environments as art**

Collaborative virtual environments occur when simultaneously sharing the same virtual environment using a network connection for communication. In a collaborative virtual environment art exhibition, artwork is shared between disparate cities. Exhibitions using stereo displays such as the CAVE as a visual medium have developed over the decades for conferences such as Ars Electronica Festival http://www.aec.at/festival/en/, ACM SIGGRAPH http://www.siggraph.org/attend/annual-conferences, SuperComputing http://www.supercomp.org/, IGRID http://www.igrid2005.org/, and SVR Virtual Worlds Festival http://www.sbc.org.br/ce-rv/svr2004/ing/mundos.htm, among others. These venues focus on emerging technology and innovations by showcasing applications in not only math, physics, and science but also art, humanities, and cultural heritage. The science of virtual environments lies in its software programming and computer hardware but its language and experiences are developed through the visual, cognitive, kinesthetic and proprioceptive realms of the body and mind. Art tradition informs the virtual environment experience through emphasis on visual quality and experiential conceptualization of sensorial communication, visual metaphors and navigation strategies (Dolinsky 2004).

This section will discuss collaboration as it applies to a selection of specific works. These works include *"PAAPAB"* by Josephine Anstey and Dave Pape and "*Kites Flying In and Out of Space"* by Jackie Matisse and Dave Pape, Margaret Dolinsky's *"Beat Box,"* a playground of audio sequencers for sound collaboration, "*Rutopia*" by Daria Tsoupikova, about Russian folktales.

Collaboration adds a lively element to virtual environments because anyone sharing the art environment has the ability to communicate with anyone else in real time. The artwork is networked through a central server that sends the hand and head positions of each avatar to each site and triggers events to all the sites simultaneously. The artwork also runs independently at each site without a collaborator. However, the liveliness occurs when a group gathers to explore the virtual worlds, artists in different locations explaining their work and experiencing the art alongside others. At the beginning of the exhibition, each site will introduce itself in a common environment, a world that leads to all the other worlds. In *"V_Hive"* (Figure 3.5) for example, the main world is called "*Confluxus*" and mini-globes represent different art projects. The environment is a glowing 3D grid with swirling globes that display images and act as signposts for each world. In anticipation of approaching a new world, all the avatars are visible in a cluster around a spinning globe. Their shared experience begins as they slowly disappear, transported inside the globe to the other world.

Figure 3.5 "V_Hive" at the SVR Virtual Worlds Festival in Brazil, October 2004.

At each remote location, the visitor driving the virtual experience is strapped to a tracking system. Typically, they will wear a tracking sensor on their heads as part of a pair of stereo viewing glasses and on one or two hands as part of a navigation device. The tracking system also governs the visitor's avatar. The head and hand movements update in the graphical depiction that imparts a sense of real life to the avatar. The avatar or virtual representation of a person appears in the virtual world to all the other participants. Their movements become the avatar's movements. A visitor cannot see his or her own avatar without a virtual mirror. In 2004, I exhibited at the SVR Virtual Worlds Festival in Brazil (http://www.sbc.org.br/ce-rv/svr2004/ing/mundos.htm), using the CAVE at Indiana University in a networked exhibition. One participant who was networked in from the University of Buffalo was most impressed by the sense of co-presence evoked by being able to see the small, natural movements of Indiana's avatars. Together we moved around the environment talking, following each other's avatars, running over to objects to show one other their features and being able to orient ourselves and point with animated gesticulations.

As each artwork is unique, the avatars are also different. They range from a smoothly curved abstraction that evokes ideas of whales and water-eroded rocks, to green robots and Norse Gods. Many researchers suggest that a photo-realistic level of detail is necessary in order for people to feel immersed in a believable world (Pausch, Snoddy et al. 1996). Others suggest that representations that are more abstract leave room for the participant's imagination to fill in details more richly (McCloud 1993). Others argue that "realism" is not only, or mainly, about how things look in a virtual world, but how they move and respond (Sandin 1998). Our shared VR experiences seemed to point out that a more abstract avatar speaking with natural language and body movements can easily read as a living "person" and can represent a human effectively. This experience of presence was actually investigated by Nick Kaye and Gabriella Giannachi in their four year study, "*Performing Presence*" where they analyzed contemporary art and theater to develop scenarios for the CAVE in order to explore how performance theory could enhance the phenomena of presence. (Kaye, Giannachi 2011:88-94) The effort attempted to displace visitors' perceptions from the "real" place of the laboratory and CAVE theater toward the virtual environment so the social actions and reactions that occurred were specific to the virtual environment and established a "presence response" but became an awareness a both as being most effective with the qualia dependent on "temporary acts, meanings and exchanges- and of juxtapositions, potential reversals, and imbrications of perceptions and so experiences of the "real and the "simulated."

3.3.4.1 **Josephine Anstey, Dave Pape and Dan Neveu, *"PAAPAB"* 2000**

"*PAAPAB*" created by Josephine Anstey, Dave Pape and Dan Neveu at the University at Buffalo appears in V_Hive. (Dolinsky, Anstey et al. 2005) "*PAAPAB*" is a disco dance scene filled with life size dancing characters –what Anstey calls characters- some of which are controlled by remote visitors from the real world. The "*PAAPAB*" environment opens in a dance recording studio where after recording a dance, the avatar jumps down to the dance floor. The visitors are represented by one of the characters as an avatar which is dancing with the recorded movements. Remote visitors control the characters by recording movements. The remote visitors are tracked and when they stand on a recording platform, their motions are recorded and embedded in the dancing character. There is a platform for recording stations and a main floor where the disco dancers gyrate. Some of the dancers are canned movements and others are created in real time. Visitors can move freely throughout the environment.

The recording mechanism is similar to a methodology in Anstey's previous work "*The Thing Growing*" where the creators used the tracking system to record motion and save it in the form of data files that are then used to be able to play it back. (Anstey, Pape et al. 2000) The process uses a number of head and hand tracking devices so that the movement of the head, the hands and both feet are recorded at one time. This allows the computer-controlled characters to animate after the recording process. The movement then appears rather natural as if a real person were moving about. During the production of "*PAAPAB*", they authors stated that the motion capture process was a pleasure to watch in action: "Watching your own very idiosyncratic movements mapped onto another being can be pleasurably narcissistic. Is there also pleasure in controlling that remote body?" (Dolinsky, Anstey et al. 2005) They had set up a recording environment that allowed everyone to watch an avatar as if they were watching their own colleague dance in real time, complete with record, playback, and rerecord features.

The dance floor environment has three distinct platforms. The first platform is the largest and contains four interactive recording booths, complete with a distinct character that can be recorded for 15 seconds. Each recording is either approved or deleted and a new set of motions can be recorded. If the dance recording is approved then the character dances to the main floor. The recording studio resets itself, presents a fresh character and the process is available again or the visitor can travel to the dance-floor where there are forty other characters dancing according to their own recorded motion using the same recording technique. The tunes played are a type of computer-generated techno style music.

"*PAAPAB*" is a light-hearted artwork that raises a variety of issues. The artist Anstey believes that there is a certain narcissism in watching your avatar follow your movements. She states that, in allowing visitors to choose one of the available avatars, the work points to subconscious indicators about how people view themselves. There is also an intentional blurring of the line between the virtual and the real. She states that "Some of the models used for the characters are also used as avatars; all the beings are moving realistically, so it can be challenging to figure out who is real and who is not. Finally “*PAAPAB*” allows a kind of social interaction based in the body to be shared, virtually, across the network" (Anstey et al. 2000).

Anstey also admits that there were challenges and choices involved in making a real-time, networked motion-capture environment. She writes that

> "Although the controller we use has buttons we don't use them to stop and start the recordings. Instead, we made the recording booths as automated as possible so that it was easy for first time VR users. This automation included triggering the booth's response to the user based on proximity and then positioning the user facing the character - as many users would take so long maneuvering into position, they would miss the recording window. Our animation system also had to take into account that people at different locations had different numbers of tracking sensors. We made a virtue of this necessity and programmed it so we can animate more body parts than we have sensors, by mapping all the body parts to the sensors available but then adding suitable offsets and delays to some of the parts. We ended up making two versions of the system that saves the motion capture data and shares it among the different locations. One, for use on faster networks, streams the animation data for all 40 characters over the network. The other allows each location to save any avatar's tracking data into a file locally" (Anstey et al. 2000).

“*PAAPAB*” is particularly interesting for my research because the characters are similar in function to what I would term an emotable. The character or emotable leads the way for navigation and directs the movement of the visitor not only bodily in terms of dancing and recording their dance but also in terms of spatially. The emotables in “*PAAPAB*” also lead the visitor to the dance floor if the visitor follows their recorded character to the dance floor. See Figure 3.6. Also see http://josephineanstey.com/Projects/PAAPAB

Figure 3.6. *“PAAPAB”* Anstey, Pape, Neveu 2005. VR Still. Characters dance according to the movements recorded by real live persons.

3.3.4.2 **Jackie Matisse*, “Kites Flying In and Out of Space”* 2001**

Jackie Matisse, granddaughter of Henri Matisse, is a French kite artist who created a virtualization of her real world kites in the virtual environment “*Kites Flying In and Out of Space.”* See Figure 3.7. The flowing linear kites often have tails up that are 35 to 49 feet in length which are decorated in various abstract patterns by Matisse. Matisse’s marks, rendered on the kites, are suggestions of the trajectories that a bee follows as it moves and changes directions in space; the kites embody his conception of the bee. (Dolinsky et al, 2005).

As the exploration of the motion and trajectories of the kites is the core element of Matisse's work, simulating this motion digitally is a key part of the artwork. The realistic animations of cloth and simulations of cloth-like objects are generated using a mass-spring physics system (Witkin, Baraff et al 2001).

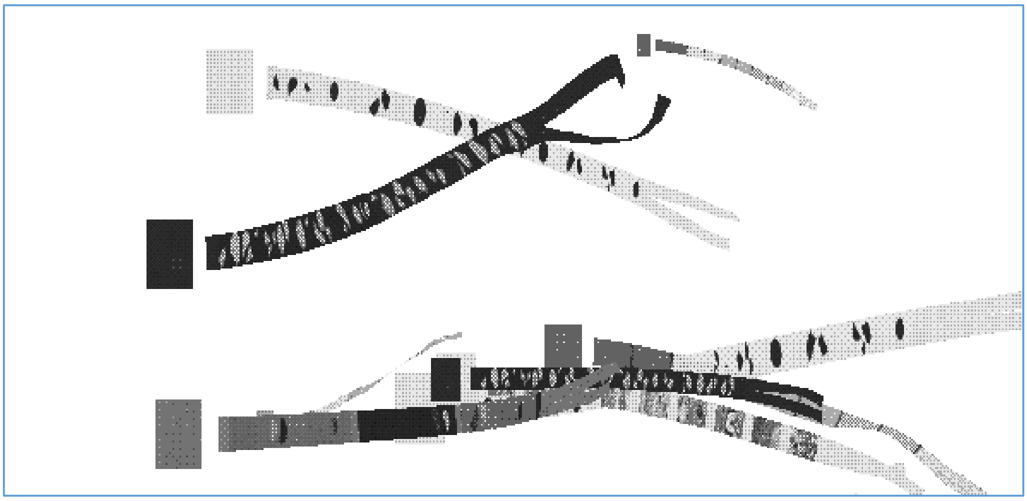


Figure 3.7 “*Kites Flying In and Out of Space*” Matisse. VR Still.

Dave Pape, the lead programmer, states that

> "The *Kites Flying* environment was previously implemented, using a mass-spring model, for iGrid 2002, an international testbed event for grid-computing applications. In that case, the simulation was free to consume large amounts of computational resources. Twelve kites were simulated, each one comprising approximately 250-point masses and 900 springs. Each kite ran on a dedicated processor (at one of four different computing centers), and used roughly 1.1-megabits/second network bandwidth from each simulation computer to the VR display system" (Venkataraman et al. 2003).

Of particular interest is how the collaboration was technically achieved between remote locations. There was no “master simulation” sending the exact same scene to each participating system; only the positions of the kites’ heads were shared. A disadvantage to this method was that each participant was not seeing the exact same results at the exact same time; however, sending only a small amount of data between machines was much more computationally efficient than sending information defining the whole scene. Based on previous experience with complex networked VR systems, Pape explains that “cheating” of this type is acceptable because “the different participants do not know exactly what the others are seeing, so as long as the virtual objects behave roughly the same way on each VR display, people will believe that they are identical, and the illusion of a shared world is not broken" (Venkataraman et al. 2003).

3.3.4.3 **Margaret Dolinsky, “*Beat Box*” 2001**

“*Beat Box*” (Figure 3.8) is a collection of interactive sound instruments. The environment motivates possibilities for decision making and acting within virtual environments by exploiting the perceptual possibilities of the use of image, sound and kinesthetics. “Beat Box” is an environment of audio sequencers and drum machines for sound collaboration. The art imagery explores the concepts of gesture, voice and dialogue as they resonate with each other through bodies, instruments, sounds and avatars in real-time computer graphics. Gestures and movements of the visitor’s body trigger the movement of musical instruments and avatars.

Each audio sequencer is an instrument devised as a series of graphical heads. Each head is a placeholder for sounds selected by a visitor. As the sequencer plays, a head represents an interval in the

Figure 3.8 “*Beat Box*” M. Dolinsky. Interactively placing sounds at an interval or head on an audio sequencer.

sequence. Moving across the instrument, each head expands in turn to figuratively expel its voice and call out a sound. Three audio sequencers control, respectively, percussion, ambient and bass sounds. The visitor plays the drums interactively by “hitting” them with the navigational wand. This provides immediate feedback and provides purposeful, real-time expressive movement that may be noticed by visitors at remote sites. This motivates visitors to visit the drums together.

The environment of “Beat Box” can be enjoyed through a variety of heights and vantage points. More importantly, it was created as a challenge to “work” at play in VR. The selection of sounds occurs by pressing the first button on the navigation wand. This allows a new sound to be activated. The active sound is then attached to an interval by approaching a head and pressing the second wand button. The attachment of the sound gives the interval a voice made up of that sound. Sounds are updated in real time across the network. Initial attempts to network such an audio-intense piece were difficult – the network messages lagged so that the audio and the graphics did not always synchronize. Performance on the IGrid infrastructure was smoother, allowing “Beat Box” to be shared across five collaborative CAVE sites: IUB AVL, UIC EVL, NCSA IL, UB and SARA in Holland.

3.3.4.4 **Alpha Auer, “*alpha.tribe*” 2009**

Second Life is a virtual world in which real people create avatars that live virtual lives, for example buying and selling goods, traveling, participating in community events, building structures, and making art (Linden Research, Inc. 2012). Alpha Auer is a Second Life avatar created by designer and artist Elif Ayiter. In her project “*alpha.tribe*,” Ayiter created several “alt avatars” of Alpha Auer that pooled their resources to start a fashion business in the virtual world. Each avatar expressed a unique creative vision through the clothes they produced and sold (Auer 2012). The creative activity of each allowed Ayiter to explore “visual manifestations of the diverse facets of the human persona” (Ayiter 2009). In focusing on fashion and the way that the body is represented virtually, Ayiter emphasizes the importance of the visual in representing a virtual personality.

3.3.4.5 **Masa Jazbeck, *Monolith*, 2012, Ursula Berlot, *"Vanitas –Self Portrait*" 2012**

Two Slovenian artists have recently dealt with the face as representative of what they see as the shift from actual to virtual reality happening in society at large. Masa Jazbec's "*Monolith"* (Jazbec 2012), presented at Ars Electronica 2012, is an interactive installation consisting of a large black object sitting in an open space. As the visitor approaches the object, her image appears in a ghostly, detached form on the face of the object, referring to the complex relationships among "human, screen and virtual world." Ursula Berlot's "*Vanitas – Self Portrait"* (Berlot 2012) suggests the inextricability of the physical and the virtual in understanding who we are. Known for her use of natural processes like gravity and magnetism (Anon. 2012), in this video Berlot uses experimental radiographic photo techniques and computer graphics to represent herself as a being in flux, her portrait changing from state to state by a process in which organic and computer-generated elements are indistinguishable from one another.

3.3.5.0 **Painters Working With Virtual Environments**

Several contemporary painters who have become technology artists are using a CAVE or CAVE-like virtual reality system that simulates the artists' landscape in a three-dimensional theater setting using stereo computer graphics with real time interaction.

3.3.5.1 **Daria Tsoupikova, *"Rutopia"* 2006**

Rutopia is a networked virtual environment created by Russian-born artist Daria Tsoupikova. "*Rutopia"* is inspired by childhood folktales and Tsoupikova's dream that the entire world should become a type of park-like paradise (Tsoupikova 2007:224). The piece begins in a monochromatic environment where trees grow based on the proximity of visitors. As the trees expand, they contain windows to alternate environments. Visitors can view the environment by looking at the tree or enter the environment by putting their head into the window on the tree. See Figure 3.9.

Figure 3.9 “*Rutopia*” Daria Tsoupikova 2006.

For Tsoupikova, the navigation was designed as a study in traditional art techniques and the effect of VR aesthetics on the user's perception and emotions (Tsoupikova 2006a). *“Rutopia”* examines how traditional art principles, such as balance, color, repetition and rhythm can enhance navigation and interactivity in real-time, virtual 3D environments. She writes about principles including the golden ratio, color theory, gestalt theory and art history. Her designs use scale and proportion for balance and she explains it by linking her spiritual ideas to recent discoveries in dynamical systems theory. Regarding her use of color she credits color theory and a drive to achieve unity and harmony within an environment and to direct the visitor's eye. She exploits how color can manipulate our perception and cognition as our eyes respond to various wavelengths of light. Color communicates with the brain through various nerve impulses and stimulates our emotional response toward the artwork.

The project was first conceptualized using storyboards hand painted in gouache and watercolor. The visual elements - trees, house, island, and bridges, were designed in anticipation of developing future interaction strategies (Tsoupikova 2006b). The imagery is reminiscent of the toys of Dymkovo and the painting technique of the Khokhloma. The aesthetics are based on principles of composition that rely on bright colors and simplified, contoured shapes inspired by craft objects representing pagan gods and mythological characters and sold at country fairs. The traditional Russian folk aesthetic gives this virtual environment a magical atmosphere communicating harmony and balance. It creates a new emotional experience while maintaining aesthetic principles of previous centuries. See Figure 3.10.

Figure 3.10 Painting by Daria Tsoupikova.

Bringing this aesthetic to a virtual environment required different considerations than those made in creating a 2D work. In interactive projects, time-based development and composition style must coordinate because an object or scenario will remain static until the visitor triggers an event and generates an animation through their interaction. The color or compositional emphasis in the environment is placed in three dimensions: depth, width and height, and extends to the dimension of time. This generates a need to control color impact within a time sequence, rather than in the fixed space of a picture. Tsoupikova states that, as compared to a static image,

> "the time-based moving image requires less detailed artwork because the human eye tends to lose concentration on details in the moving image proportionally to its speed. Looking at the fast changing images on the screen, we seek the familiar and common artistic features to understand the overall art style. Thus, each individual moving image must follow the overall style guidelines while permitting a lower level of details" (Dolinsky et al 2005).

3.3.5.2 **Tim Portlock "*Super Spectacular*" 2001**

Tim Portlock, currently a freelance VR artist and developer in Philadelphia, includes a strong traditional fine arts portfolio that includes cityscapes and self-portraits. See Figure 3.11.

Figure 3.11**.** "*Cityscape"* Tim Portlock. Painting.

His CAVE work incorporates hand drawn images that give his CAVE VR a definitive and painterly look. The stylized images capture visitors' attention and quickly immerse them. They move beyond the auto park and through the factory doors to work the production line in a plant using horses to produce glue. Once the work is done, there are arcade games to play, or just beyond them, one can enjoy a huge, very crowded and loud boxing match. http://www.timportlock.net/

"*Super Spectacular*" uses black and white line drawings to depict the spectacle nature of large parking lots, bustling factories and entertainment arcades. See Figure 3.12.

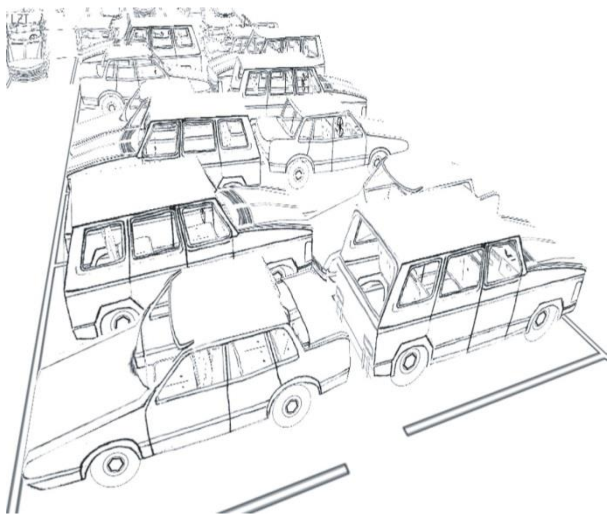


Figure 3.12. ***"Super Spectacular"*** Tim Portlock. CAVE still.

Portlock says of his work,

> "The discourse around digital art, particularly virtual reality, often posits this work in terms of older art forms, such as painting being dead. Ironically the most characteristic feature of virtual reality, its presentation of space, is based on an unchanged spatial model developed by a painter 500 years ago. Just as with painting or glue and scissors, digital technology is just another way for me to collage together narrative images. My most recent work, "*Super Spectacular*," is an environment where, among other things I make parallels between the most fundamental aspects of virtual environments and drawing. The literal void of the virtual environment and the literal void of the white sheet of paper both must be filled in order for the artist to create meaning" (Portlock 2004).

Artistic constructs in virtual environments suggest new methods for understanding concepts and their relationship to others, ourselves and how technologies play a role in a social world. The dialectics of being in virtual worlds allows the computer the potential to go beyond an information machine and data calculator to become a legitimate device for understanding the values of expression (Fors, Jakobsson 2002).

3.3.5.3 **Wille Mäkelä "*Skiing*" 2004**

Helsinki artist Wille Mäkelä not only paints but also uses the CAVE as a canvas and palette. He paints in 3D space and explores how the act of expression changes from a 2D surface to a 3D environment. See Figures 3.13 and 3.14 for canvas painting and CAVE painting.

> "I draw in the air, because it is a more natural way, compared to stooping over a desktop and keyboard with a mouse. …using and developing tools for immersive free hand operations in fine art purposes. There is no atelier CAVE on earth yet, dedicated solely for artistic work. That is a pity, with respect to millions of individual artists with remarkable drawing skills. I have initiated an artistic development in the EVE. My first aim is to prove in the Finnish practice that the art potential can be proved even with a rare prototype, if it is made for an artist" (Mäkelä, Ilmonen 2004).

Figure 3.13 **“***Untitled***”** Wille Mäkelä. Oil Painting.

Figure 3.14 **“***Skiing*” CAVE Painting. Wille Mäkelä 2004.

3.3.6.0 **Contemporary interactive arts**

Much of the technology originally developed for virtual reality has expanded into other areas. Computer graphics can now be realized on affordable display devices and many software platforms. As video games made their way into the daily lexicon, computer graphics systems became more powerful and more affordable, and technology in general became a ubiquitous part of our daily lives, artists began to explore and repurpose the systems that surround us every day. A broad range of technology-based art arose, much of which involves artists working at the level of software code to exploit potential in consumer technology. This includes such fields as interactive installation, video installation, interactive video, motion graphics, bio-art, information art, net art, systems art, glitch art, hacktivism, robotic art, and GPS tracking. These movements have provided opportunities for artists and non-artists alike to explore visual and aural art, aesthetics, and technology to create work that is both visually engaging and perceptually immersive.

VPL Research, Inc. was founded by Jaron Lanier in 1984 and sold to Sun MicroSystems in 1990. It was the first company to sell VR products including head mounted displays and the DataGlove™. VPL also developed applications for medical simulations, vehicle prototyping, television production and other related areas (Lanier 2010). The glove from VPL Research was adapted to produce a low-cost design that became Mattel's Power Glove™, used as an interface with Nintendo Games. The Power Glove™ was an unsuccessful toy, but it gained some success as an interface device in some low cost virtual reality systems that became known as "homebrew" or "garage" systems (Jacobson 1994). Inexpensive software and computer cards were available that made the Power Glove™ an input device for Amiga, Macintosh or IBM computers (Eberhart 1993; Stampe et al. 1993; Jacobson 1994; Hollands 1995).

Another tech toy that found favor among artists was the Fisher-Price Pixelvision movie camera, which stored data on cassette tapes. The pixelation produced by this storage method was incorporated by many artists as an intentional aesthetic choice. Notable uses of the technology include Sadie Benning’s short Pixelvision films shown at the 1993 Whitney Biennial, the Pixelvision films of Michael Almereyda, and the Pixelvision sequence in Richard Linklater's 1991 film "*Slacker*" (McCarty 2005).

An exciting development for artists creating virtual environments is the availability of off the shelf video game hardware that are used as kinesthetic input devices such as the Wii controller, PlayStation Move controller and Xbox Kinect. The controllers use body movements to navigate and control the environments in order to promote an engaged experience where physical sensations can accompany an experience in the virtual realm. Open-source computer drivers have been written that allow artists to take advantage of these controllers outside the context of the video game consoles for which they were originally designed. Artists have combined these input systems with programming languages and 3D rendering software to create low-cost virtual environments with a high degree of interactivity. For example, Oliver Kreylos who is known for his scientific annotations in VR (Kreylos 2006) has written software that allows the Kinect to be used as a 3D camera to capture point cloud representations (Kreylos

2010). The software renders real objects in 3D space and can combine them with purely computer-generated objects in real time.

Due to the ubiquity of digital video cameras, computer vision techniques have also come to occupy a prominent place in contemporary interactive and immersive arts. Daniel Rozin's "*Snow Mirror*" (2006) uses software written by the artist and a video camera to render a ghostly image of the visitor in a field of falling digital snow. Different densities of snow represent areas of light and shadow in this ever-changing portrait (Rozin 2006).

Scott Snibbe's interactive "*Screen Series*" (2002-8) is composed of a number of works that use similar software techniques, altering a projection based on the viewer's presence (Snibbe 2002). "*Deep Walls*," (2003) for example, consists of a grid of 16 looping movies, each of which represents the shadow of a visitor during the time she stood in front of the projection. People who linger longer in front of the piece will produce correspondingly longer segments of looped footage. The gridded repetition of dissimilar segments creates an effect that is both organic and mechanical, in which "the rational process of organization brings out an unconscious irrationality” (Snibbe 2002).

By making the visitor’s presence an integral part of an interactive virtual world that does not conform to the laws of the physical world, artists evoke shifts in perception and follow in the tradition of earlier virtual environment art. Other artists who have developed virtual environments include the following people.

Luc Courchesne, a French Canadian artist whose works and image series include Encyclopedia Chiaroscuro (1987), Portrait One (1990), Family Portrait (1993), Hall of Shadows (1996), Landscape One (1997), Passages (1998), Rendez-vous... (1999), Panoscope 360° (2000-), Panoscopic Journal (2000-), The Visitor: Living by Numbers (2001), Untitled (2004), Where are you? (2005-2010), Horizons (2007), the Shores Series (2007-), Icons (2009) in a co-creation with artist and choreographer Marie Chouinard, the Posture platform for immersive telepresence (2010-), You are here (2010-) and McLuhan's Massage Parlor (2011) has written

> “We have to agree, again, with psychologist William James (1842-1910) that there is only one, experience based, reality. To Myrion Kruger’s Artificial Reality (1983), Jaron Lanier’s Virtual Reality (1989), Thomas Caudell’s Augmented Reality (1990), Steve Man’s Diminished Reality (2010), Paul Milgram and Fumio Kishino’s Mixed Reality (1994) and probably more, it is reasonable to oppose a unified reality model made of folds…” (Courchesne 2013).

Courchesne’s work is also found at http:// http://courchel.net/

Knowbotic Research is a group of German and Swiss artists in Zurich, Switzerland that include Yvonne Wilhelm, Christian Huebler and Alexander Tuchacek who work with immersive virtual reality and intelligent virtual spaces. Their name is a combination of the words knowledge and robot and their work focuses on intelligent agents and the internet. Their work has exhibited at the 48th Venice Biennale (1999), Seoul Biennale (2002), Hongkong Shenzen Biennale (2007), Biennale Rotterdam (2009), Moscow Biennlae (2011), exhibited in Museum of Contemporary Art, Helsinki, (1994), Hamburger Kunstverein (1995), Henie Onstad Kunstsenter Oslo (1996), Museum Ludwig Köln (2000), New Museum New York (2002), Witte de With Rotterdam and MOCA Taipeh (2004), Kunsthalle St. Gallen (2005), Wilhelm Lehmbruck Museum and Skuc Gallery Ljubljana (2006), NAMOC Beijing (2008), Aarhus Kunstmuseum (2009) and has received major awards including: the Swiss Art Award (2012), the Claasen Prize for Media Art and Photography, Cologne; the international ZKM Media-art award; August Seeling-Award of Wilhelm Lehmbruck Museum and the Prix Arts Electronica. See this information and more at http://krcf.org/

Rebecca Allen, a professor at UCLA and an American installation artist works in technology with artificial life systems and virtual reality. Her 2004 work "*Liminal Identities*" is a virtual world about nature and illusion allows one to interact by breathing into a sensor which affects both navigation and the environment. She is interested in how "our changing perception of reality affects our understanding of human identity." Citation from and more information, including imagery on "Liminal Identities" is found at http://rebeccaallen.com/v2/work/work.php?is3D=1&wNR=28&wLimit=0. Allen has collaborated with artists such as Kraftwerk, Mark Mothersbough from Devo, John Paul Jones from Led Zeppelin, Peter Gabriel, Carter Burwell, Twyla Tharp, Joffrey Ballet and La Fura dels Baus. Her artwork is exhibited internationally and is part of the permanent collection of the Whitney Museum in New York and

Centre Georges Pompidou in Paris. Frank Popper writes: "…her main concern appears to be the investigation of the perceptual and cognitive processes of the viewer. Thus she approaches technology from an almost expressionistic angle, where human feeling and emotional reaction predominate the art." From http://rebeccaallen.com/

Perry Hoberman is an American installation artist whose work focusses on the interactive nature of people and technology and is noted for his works, "*Bar Code Hotel"* (1994) and *"Systems Maintenance"* (1999) which uses, respectively, bar code systems and video projections with camera tracking to control real world objects in relation to virtual environments. Zielinski writes of his work, "Hoberman makes refreshingly direct assaults on those aspects of daily life that we most readily take for granted. "*Workoholic*" is about work: ceaseless, pathological work… "*Timetable*" is about time: social time, machine time…" (Hoberman 2001) His "*Out of the Picture"* was included in the 1985 Whitney Biennial and the 3D installation "*Bar Code Hotel"* received the top prize at the Interactive Media Festival (Los Angeles, 1995). In 2002 Hoberman was both a Guggenheim

Foundation Fellow and a Rockefeller Media Arts Fellow. In 2008, Hoberman presented "*Denial Clinic*," a performance with songs and 3D projection in Los Angeles and Vancouver. Currently, Hoberman is an Associate Research Professor in the Interactive Media Division at the University of Southern California School of Cinema-Television, where he heads S3D@USC, the Center for Stereoscopic 3D at the USC School for Cinematic Arts. Also see http://www.perryhoberman.com/

Jacquelyn Ford Morie, American artist, owns the company All These Worlds, LLC and works with immersive worlds, games and social networks. Formerly a researcher at the Institute for Creative Technologies (ICT) at the University of Southern California, she created multi-sensory virtual environments, including the design and use of an infrasonic floor to produce a subconscious "emotional score" for the virtual experience, and the invention of a scent collar that was patented in 2004. (Vlahos 2006) Her recent virtual worlds are created for war veterans to provide stress release and to build social relationships. Morie has written several book chapters which include most recently, Morie, J. F. (2013) Avatar Appearance as Prima Facie Non-Verbal Communication. In *Nonverbal Communication in*

Virtual Worlds, Joshua Tanenbaum, Magy Seif el-Nasr, and Michael Nixon, Eds. ETC Publisher and another at Morie, J. F., Chance, E. Haynes, E. and Purohit, D. (2012) Embodied Conversational Agent Avatars in Virtual Worlds: Making Today's Immersive Environments More Responsive to Participants. In *Believable Bots: Can Computers Play Like People*, Philip Hingston, Ed., Springer-Verlag: 99-118. Her website is http://alltheseworldsllc.com/.

Brenda Laurel, American artist, lives in California and works at the Computer Science Department at UC Santa Cruz as an adjunct professor. She is a virtual reality pioneer best known for her work at Atari, Inc and the VR artwork, "*Placeholder*" created with Rob Tow and Rachel Strickland. According to her website, "Placeholder was the first VR project to decouple gaze from direction of movement, provide two hands to participants, support two participants at once, represent multiple traversable locations, capture imagery from the natural landscape, and design content in the realms of art and fantasy rather than training applications" (Laurel 2014). Laurel went on to establish Purple Moon in 1996, a gaming company that specifically catered to young girls in order to be progressive and to encourage girls interested in technology fields. “She wanted to engage and nurture young women positively, address their social, cultural and narrative proclivities, to create popular culture that shaped values and informed citizenship” (Hernandez 2012). Laurel’s books include *“The Art of Human-Computer Interface Design”* (1990), “*Computers as Theatre”* (1991, 2013), “*Utopian Entrepreneur”* (2001), and “*Design Research: Methods and Perspectives”* (2004) and her website is http://www.tauzero.com/Brenda_Laurel/

Sheldon Brown is an American artist and Professor of Computer Art at UC San Diego. His VR work “*The Scalable City*” explores city scapes through the interactive technologies of VR and gaming. He writes,

> “The project neither indicts nor embraces this future, but offers an extrapolation of its algorithmic tendencies, heightening one’s awareness of the aesthetics of the underlying logic as it becomes the determinant of much of our cultured existence. This project makes collages from satellite imagery, morphs the images using algorithms, and mixes the results over a 3d terrain to make new hybrid cities.”

“*The Scalable City*” exhibited at Ars Electronica in 2006, Shanghai MOCA, India International Center in New Dehli, and SIGGRAPH 2007 Another work by Brown, “*Istoria*” is a collection of fabricated sculptures created from computer controlled modeling. Using 3D object data, the sculptures are manipulated using algorithmic and modeling transformations. The sculptures are the result of the intersection between material properties, object data space and constructive processes. Brown is Director of the Arthur C. Clarke Center for Human Imagination whose mission is: "Research to optimize productivity, performance and scalability of applications of hybrid multicore processors to meet the needs of industry and government partners" See http://sheldon-brown.net/index.html.

David Em, an American artist who grew up in Colombia, Venezuela and Argentina studied painting at Goddard College and began to produce digital art in the 1970s (Em 2014). He worked at Xerox Palo Alto Research Center, NASA’s Jet Propulsion Laboratory, and Apple Computer’s Advanced Technology Group. He is the first digital artist to have his papers collected and preserved by the Smithsonian Institution's Archives of American Art. See Figure 3.15. Em writes:

> “I transitioned from the painterly notion of arranging forms on a surfhttp://www.timportlock.net/ace to perceiving pictures as frames that open onto immersive worlds. Composing morphed into spatial exploration. “*Transjovian Pipeline”* came out of that process. Pipeline became my

> signature work and was reproduced in hundreds of books and magazines around the world" (Em 2014).

Figure 3.15. "*Transjovian Pipeline*" David Em 1979. Digital Image.

Diane Gromala, American Artist and VR researcher living in Canada works as a professor at Simon Fraser University School of Interactive Arts and Technology. Her early VR work "*Virtual Dervish*" was co-created with Yacov Sharir in 1990 at the Banff Center for the Arts in the Art & Environments Residency. She describes "Virtual Dervish" as

> "Wearing a head-mounted stereoscopic video display, users feel immersed with in the body and interact with it. Such interactions include touching the text, which then changes, or flying into an organ -say a heart- to find another surreal

world. Three dimensional sound helps user locate themselves in surreal virtual spaces.” (Rush 1999:216)

Jay Bolter and Gromala co-authored the book “*Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency”* which is about the artwork shown at SIGGRAPH 2000 when Gromala was Art Gallery Chair. (Bolter, Gromala 2003) Currently Gromala is the founding director of Transforming Pain Research Group which investigates using technologies to as a form in pain management. Her research interest includes VR and pain. Her TEDxAmericanRiviera talk Curative Powers of Wet, Raw Beauty is online at https://www.youtube.com/watch?v=cRdarMz--Pw and her website is http://www.confrontingpain.com

Myron Krueger is an American artist and one of the early pioneers of virtual reality and augmented reality. He co-created “*Glowflow*” a computer controlled light sound environment that responded to visitors with Dan Sandin, Jerry Erdman and Richard Venezky. Interested most in action and reaction response, he created "*Videoplace*," which was funded by the National Endowment for the Arts and a two-way exhibit was shown at the Milwaukee Art Museum in 1975. "*Videoplace*” also exhibited at SIGGRAPH in 1985 and 1990 and at Ars Electronica in 1990. In a *“cTheory”* interview Krueger states:

> “One of my key contributions was the idea that virtual reality provides a context in which we can interact physically as well as verbally with distant companions. Clearly, it is the relationship that is real, the physical ambience at either end is secondary--as it should be, because it is not shared. In the future, our ability to communicate in virtual reality will be so good that we will choose to use it when we are together. It will be better than being there.” (Turner 2002)

Krueger published the book *“Artificial Reality”* in 1983 and *“Artificial Reality 2”* in 1991 which presents a future where computers interact with our needs, sensing and responding to people in profound ways. (Krueger 1983 and Krueger 1991) For Krueger’s biography see http://thedigitalage.pbworks.com/w/page/22039083/Myron%20Krueger

Jaron Lanier is an American musician, programmer and early VR pioneer who left Atari in 1985 with Thomas G. Zimmerman to found VPL Research. VPL stands for Visual Programming Language and VPL Research was the first company to sell VR goggles and gloves. "*Moondust*" which he programmed in 6502 assembly in 1983 is generally regarded as the first art video game and the first interactive music publication. (Lanier 2014) Lanier's paintings and drawings have been exhibited in museums and galleries in the United States and Europe. In 2002 he co-created with Philippe Parreno an exhibit illustrating how aliens might perceive humans for the Museum of Modern Art of the City of Paris. In 1994 he directed the film "Muzork" under a commission from ARTE Television. In 2010, Lanier was nominated in the TIME 100 list of most influential people. His books include and *"Who Owns The Future?"* (Lanier 2013) and *You are Not a Gadget: A Manifesto* (Lanier 2010:191) where he writes:

"I call this possibility "postsymbolic communication." … In the domain of symbols, you might be able to express a quality like "redness." … I imagine a virtual saxophone-like instrument in virtual reality with which I can improvise both golden tarantulas and a bucket with all the red things. If I knew how to build it now, I would but I don't."

Jaron Lanier's homepage is http://www.jaronlanier.com/

Michael Naimark is a new media artist and researcher who explores places and how they are represented. He taught at MIT from 2011-2014. Naimark has made interactive "moviemaps" of Aspen from the street, Paris from the sidewalk, San Francisco from the air, Karlsruhe from the rail, Banff from hiking trails, and stereo-panoramic movies in Jerusalem, Dubrovnik, Angkor, and Timbuktu. (Naimark 2014) His art is in the permanent collections of the American Museum of the

Moving Image in New York, the Exploratorium in San Francisco, and the ZKM | Center for Arts and Media in Karlsruhe, Germany. His 3D interactive installation "*Be Now Here*," produced by Interval with the cooperation of the UNESCO World Heritage Centre, toured in the ZKM's "Future Cinema" exhibition in 2002 and 2003. Regarding VR headsets, Naimark delivered a keynote at the first International Symposium on Immersive Creativity in Montreal on May 2014:

> "But the clincher, particularly for first time users, is what happens when you move your head and look around. The image updates its viewpoint accordingly: you look left ninety degrees, the image pans left ninety degrees. Words don't do justice to this experience. It feels both magical and so natural that one wonders how we could view images without it." (Naimark 2014)

See Naimark's homepage at http://naimark.net/

Jeffrey Shaw is an Australian artist and early VR pioneer creating installation works since the late 60's. He was the Director of Institute for Visual Media at the ZKM Center for Art and Media Karlsruhe, (1991-2003) and co-director of the Center of Interactive Cinema Research (iCinema) at the University of New South Wales, Sydney (2003-). His publications include "*iCinema digital arts edition,*" "*Future Cinema. The Cinematic Imaginary after Film*," "*ZKM digital* *arts edition*,” “*artintact - Artists' Interactive CD-ROMagazine*” and "*Hardware Software Artware. Confluence of Art and Technology.*" In “*Future Cinema”* Shaw writes:

> “The digital domain is above all distinguished by its broad range of new interaction methodologies. While many traditional forms of expression are also interactive to the extent that they must be interpreted and reconstructed in the process of apprehension, digital interactivity offers a new, immediate dimension of user control and involvement in the creative proceedings.”

Shaw’s 2002 project “*Web of Life*” is about the theory of networks and networking in regards to nature economy and society and uses interactive projection technologies. See Figure 3.16.

Figure 3.16. “*Web of Life*” Michael Gleich, Jeffrey Shaw, Bernd Lintermann, Lawrence Wallen, Torsten Belschner, Manfred Wolff-Plottegg. Captured image from video documentation found at http://icinema.edu.au/projects/web-of-life/project-overview/.

Shaw's latest work is found at http://www.icinema.unsw.edu.au/.

Toni Dove is an American based in New York working in virtual reality and theater using live mix cinema events that utilize interactive media and robotics. In her work, performers and participants interact with an unfolding narrative, using interface technologies such as motion sensing and laser harp to "perform" on-screen avatars. (Dove 2014). Her current touring project is *"Spectropia*," a feature length live-mix movie performance for two players. *"Sally or the Bubble Burst"* was part of the exhibition 'Digital Media' at the American Museum of the Moving Image in New York, 2003 and in the 'Future Cinema' exhibition at ZKM, 2002 that traveled to The Museum of Contemporary Art, Kiasma, Helsinki, 2003. It was also part of the 'Engaging Characters' exhibition at Art Interactive, Cambridge Ma., 2003, at the Pong Festival, Brown University, 2003, at 'Interactive Futures', Victoria Independent Film Festival, 2003, and at the Montreal International Festival of New Cinema and New Media, 2003, Outside the Box: New Cinematic Experiences, Emily Davis Gallery, The University of Akron, 2006. *"Spectropia"* previewed as a work in progress at Lincoln Center in Scanners, the New York Video

Festival 2006, in Cleveland at the Ingenuity festival 2007, and premiered at the Wexner Center for the Arts Nov 1-3, 2007, showed at REDCAT, LA Nov 2007 and at the Zero1 Festival of Art on the Edge, San Jose, 2008, EMPAC, Troy NY, 2008 and at the Kitchen, NYC, Dec. 2010. See Figure 3.17.

Figure 3.17. "*Lucid Possession*" Toni Dove. Performance image from a live mix cinema music performance co-produced by Roulette, HERE and Issue Project Room, premiered at Roulette April 25-27 2013.

The majority of the mentioned artists are documented in the Database of Virtual Art. There are many others including undergraduate and graduate students who have enrolled in courses offering these technologies. United States universities with virtual environment stereo displays include those in Illinois, Iowa, Louisiana, North Carolina, Georgia, New York, Indiana, California, Ohio and more. Many other universities in Europe and Asia also teach the technologies such as those in Sydney, Australia, Linz, Austria, Beijing, China, Stockholm, Sweden, Gifu, Japan and many others.

Recently, web-based techniques such as VRML, or Virtual Reality Modeling Language, Virtools, Second Life, and Facebook plugins, have allowed the creation of online virtual environments, which are much easier to deploy than CAVE-based installations and can be viewed through a browser plugin. Artists well known for VRML work include Nicole Stenger, Melinda Rackham, Mary Flanagan and Tamiko Thiel. More recently artists have explored the used of augmented reality (AR) by combining 3D models with small portable display devices and global positioning information. AR artists include Mark Skwarek, John Craig Freeman, Todd Margolis, Patrick Lichty and Kristin Lucas, Slava Balasanov, Tom Burtonwood, Jack Toolin, Will Pappenheimer, Wafa Borgès, and Lalie Schewadron Pascual.

3.3.7.0 **Exhibition strategies for virtual environments**

Virtual reality is often shown on temporary research beds held at short-term conferences that apply high-power computing and networking to their advantage for innovative research. This is to be expected because scientists and artists develop the technology and build the test beds where much of the research is initially conceived. Such conferences include iGRID, GRID computing, SuperComputing, and Cloud Computing. This creates a limited and privileged viewing audience because the work is displayed in research areas that are not typically frequented by the public. The advantage of these viewing arenas is that the research progress is intense due to the high level of sophistication of both the works' creators and the conference attendees.

Similar in nature to world's fairs and exhibitions, research beds and conferences are alternative viewing arenas. The apparatus defines the virtual environments and positions the visitor in an alternative viewing space. The artist has the ability to "engulf the viewer in a simulated total environment in miniature"--as Benjamin (1999:406) referred to the mediated aesthetic space. Electronic media must take in to account more complex spatial considerations than typical artwork such as painting or photography. The installation may try to make the technology as unobtrusive as possible or reveal the technology as part of the technoaesthetics. Such technical development transforms aesthetic practices. For example, Char Davies' breathing vest controlling movement through osmotic nature, Maurice Benayoun's navigational camera marking the landscape for erasure, and Anstey's multiple tracking systems emulating the body's motion through the mirror of a dancing avatar. Curator Vince Dziekan (2012) writes that in the exhibition of virtuality,

> "Viewing conditions establish new meanings and uses of virtual images, as well as offer alternative constructions of the social space of their exhibition. This situation becomes increasingly complex in new media installations. The predominant way of exhibiting digital media artworks has promoted an aesthetic equated with the highly sensory perceptual experience of 'immersion'" (Dziekan 2012: 75).

In exhibiting virtual environments there are always compromises to light levels, sound levels, available equipment and networks as well as accessibility to the staged presentation. Oliver Grau writes, "Virtual installations diminish the faculty or learned ability to objectify or perceive illusory work as an autonomous aesthetic object" (Grau 2003:202). In this context, the installation plays a significant role in the reception of the work. It is helpful to have someone introduce the work to a visitor, and the best way to view it is to have the artist or someone enthusiastic share the dynamics of the experience in situ.

Virtual reality can be based on projection walls, head mounted displays or computer screens. I consider the best viewing space to be the one that is most similar to the artist's testing environment. Typically, an artist will develop the visual qualities on a computer monitor using simulators and then periodically use the stereoscopic screens for assessing the development of the immersive qualities. As a result, if the artist created the work by testing it in a CAVE, I believe that it would be best to see it in a CAVE. Fortunately, technology is adaptable. Most virtual environments are extendable and can be seen in large projection devices or smaller screens such as HMDs, the web and 3D capable monitors, laptops and hand held devices. In effect, CAVE art is portable and configurable. Virtual environments are viewed on one, two, three, four, five or six projection walls. The best viewing experience of course is the six-wall cube because the artwork fills the field of view regardless of what direction the visitor turns. This provides a realistic opportunity to turn to look backwards or to look up.

Six wall cubes remain relatively rare due to their high cost and space requirements. They do exist in research centers in the US including Illinois, North Carolina, Iowa, Louisiana and abroad in Europe (Sweden) and Asia (Gifu, Japan) as well as other locations. Navigation possibilities and artistic strategies for creating experiences increase exponentially with the availability of six walls. The visitor has six possible picture frames to be turning toward; right, left, up, down, front, and behind. This can be very motivating and challenging for artists who must design for the possibility of the visitor choosing one of six directions to explore. Metaphorically, to turn the attention towards a specific direction can be linked to a particular event, which in turn, presents new discoveries. For example, going up can provide levity while going down can provide grounding. The easiest design strategy comes from presenting the artwork on one wall or projection screen. A single-frame setup is something that we are comfortable with because it closely resembles television, pictures, photography and cinema. Recently, virtual environment researchers have been abandoning the cube and building dome-like structures. For example, Ford Motor Company has developed a type of globe that simulates the experience of driving. The dome is used as an interface to re-create weather conditions and research driving strategies in order to develop safety equipment that responds to traffic and weather (Ford Upgrades. . . 2012).

Once the number of projections is formulated, consideration of input devices becomes critical. Tracking devices and sensors can be hand-held, tethered, unfettered, location based and camera based. Trackers are required to calculate where the body is in space and, often, where specific parts of the body are in space. For example, events can be triggered when the head enters a designated zone while other events are based on hand positions. Each event trigger offers a very different experience and requires a specific sensor to be coupled to the body, head or hand. The artwork is revealed in a way that is dependent on the movements of the visitor. The relationship between the environmental conditions of the actual space and the input devices with the virtual environment is critical to facilitating immersion. In *Virtualities: Television, Media Art and Cyberculture*, Margaret Morse (1998) recognizes that presentation has a critical relationship in its space and in its dependence on the visitor and the resultant effects of the artwork, "Installation implies a kind of art that is ephemeral and never to be utterly severed from the subject, time and place of its enunciation." She continues further,

> "The frame of an installation is then only apparently the actual room in which it is placed. This room is rather the ground over which a conceptual, figural, embodied and temporalised space that is in the installation breaks. Then, the material objects placed in space and the images on monitor(s) are meaningful within the whole pattern of orientations and constraints on passage of either the body of the visitor or of conceptual figures through various modes of manifestation - pictorial, sculptural, kinaesthetic, aural and linguistic" (Morse 1998:157).

Virtual environments are exhibited at universities, museums, galleries, festivals, conferences, outdoor events using generators, dramatic performance theaters, and operatic events. The ultimate effect is to create a sense of perception and immersion for the sensorium. This is reminiscent of Walter Benjamin's discussion of the arcades of visual and imaging technologies, in which he writes, "The arcades are passages having no outside - like a dream" (Benjamin 1999:406). Here we extend the idea that the artwork also exploits a sense of proprioception. Dziekan writes that

> "in the context of the discussion of exhibition space, the proprioceptive relationship involved is a relational sense of 'positioning' in space and self-reflexive awareness in response to sensory stimuli offering narratives, representational spaces and dimensions separate to the subject's immediate spatial and temporal location" (Dziekan 2012:85).

3.4.0.0 **Analogies and Visual Perception**

The next section will discuss some elements for establishing narrative strategies in these art forms. Some of the previous VR artists mentioned such as Allen, Anstey, and Laurel define narratives in their work by referring to other media modalities such as storytelling or dramatic theater. Grodal finds this problematic because narrative refers to and then becomes defined in terms of relationships to other media,

> “not by their relation to unmediated real-life experiences and those mental structures that support such experiences. This raises special problems for describing mediated activities such as virtual reality and video games because these activities are in several dimensions simulations of real-life activities. Media representations are better described as different realizations of basic real-life experiences.” (Grodal 2003:129)

So as film represents different realizations of experiences that we watch, virtual reality is a simulation that puts one through modes of real-life experiences that we actively encounter. As a result, Grodal states that cognitive psychology has an advantage for describing video games (and VR) compared to using a narrative approach because they consist of "seeing, hearing and doing in a simulation of real-world interactions" (Grodal 2003:130).

Grodal defines stories in terms of "a sequence of events focused by one (a few) living being(s); the events are based on simulations of experiences in which there is a constant interaction of perceptions, emotions, cognitions and actions" and believes that they are "body-brain internal processes" that need to be investigated on that platform (Grodal 2003:130). By examining emotional-motivational reaction patterns, "flow is based on the way in which incoming perceptual (story) information … cues emotional activation" (Grodal 2003:131). Moreover, the story experience involves a continuous interaction between perceptions, emotions and cognitions and an action. Grodal states that some types of virtual reality

"are even closer to our core consciousness because not only are we able to see and feel, we are even able to act upon what we see in light of our concerns, our (inter)active motor capabilities allows us to… approach what activates our curiosity. … Thus … some types of virtual reality are the supreme media for the full simulation of our basic first-person “story experience because they allow “the full experiential flow” by linking perceptions, cognitions, and emotion with first-person actions. Motor cortex and muscles focus the audio visual attention, and provide “muscular” reality and immersion to the perceptions” (Grodal 2003:132).

My personal investigation into creating virtual reality art and understanding how artists evoke shifts in perception became an investigation into the immersion of the mind. I began to investigate how cognitive processes help us to assimilate our world into a self-conscious awareness. I began to look at our stream of consciousness and how analogies and metaphors operate.

3.4.1.0 **Analogies Defined**

John Berger, art critic and novelist, writes, “We never look at just one thing; we are always looking at the relation between things and ourselves. Our vision is continually active, continually moving, continually holding things in a circle around itself, constituting what is present to us as we are” (Berger 1972:9).

The research investigates how visual imagery situates the graphical environment, the visitor and the relationships between them. One of the aspects of building these relationships manifests through the notion of 'analogy', or the ways that relationships influence perception and cognition. Douglas Hofstadter's describes analogy as "the perception of communication or essence between two things." His well-known admonition states "analogy is the core of cognition" (Hofstadter 2000:116-144). Moreover, categories are concepts. Labeled categories include simple words, compound word phrases, primordial words, and proverbs. Celebrated for his ability to create word plays, Hofstadter's philosophy also describes unlabeled categories such as fleeting "remindings," "me-toos," political analogies, personal situation mappings and scientific leaps. He acknowledges that analogy exists as a mental property and therefore it is dependent on one's current frame of mind (Hofstadter 2006).

Hofstadter's focus is on how creative analogies occur in decision-making, problem solving, memory, emotion, and communication. The use of analogy is the basis for such tasks as comparing places, objects and people, for example, in identifying friends and acquaintances. In his book *Fluid Concepts and Creative Analogies* (1995), Hofstadter, a computer scientist, lays down the foundation for analogies in mathematical terms. His organization structures rely on the deployment of generalizations, or the ability to reconfigure an idea internally. The following listing explains how 'generalizations' work and is useful in helping to define analogies (Hofstadter 1995:77):

- Moving internal boundaries back and forth
- Swapping components or shifting substructures from one level to another
- Merging two substructures into one or breaking one substructure into two
- Lengthening or shortening a given component
- Adding new components or new levels of structure
- Replacing one concept by a closely related one
- Trying out the effect of reversals on various conceptual levels

A pivotal example of analogy is explained by Hofstadter in his writing about computer graphics:

> "A useful analogy is the image of a ball in a video game, which is neither a genuine physical object nor a group of fixed pixels, but rather something abstract that has its own persisting identity and its own types of behavior, and that floats on pixel hardware but is utterly different from pixels or groups thereof. There is a deep and fundamental level-distinction between such a virtual video object and the 'stuff" on which it floats – and I

> would argue that this same kind of level-distinction holds between these mental letters and the neural hardware that they reside on. This level-distinction is a very deep breach that, it seems to me… that certainly no one has yet grappled with adequately” (Hofstadter 1995:90).

Regardless, Hofstadter believes that categories are not always nouns or visual things. He vehemently stresses that circumstances evoke a particular concept. A category could be the word "please" because a please circumstance evokes a particular mental concept. He says that nouns, adjectives and adverbs represent categories or concepts. His point is that the mental action of analogy is not solely in visual categories or in sensory perception-it is in shared essence. Others claim that such words as 'in' and 'out' are a matter of feature detection but Hofstadter exclaims that those people live on a different planet. He emphasizes that feature detection plays a small part in the words but such analogies are a matter of circumstances. To make this point, he rhetorically quips, "What are the features of a mess? I would like to know which neurons, which feature detectors in my brain fire when I see a mess?" (Hofstadter 2006).

There are many types of analogies and varieties of their manifestations. The concepts of similarity, resemblance, homology, comparison, association, correspondence and isomorphism are closely related to analogy. These types may be useful in discussing art because analogy provides models for many theoretical fields. Logicians employ analogy in order to analyze reasoning as in the case of inductive arguments. For law and mathematics, case-based reasoning is broadly construed as the process of understanding the solutions of past problems in order to solve new but similar problems. In engineering a physical prototype is built to represent, model and test an object or design. In anatomy, two anatomical structures are compared for functional similarities in the study of evolution.

3.4.2.0 **Analogies and Linguistics**

The process of understanding something novel through analogical reasoning includes identifying the characteristics of separate elements, relating that to known quantities and extrapolating the queried relationship. In cognitive linguistics, conceptual metaphor is considered equivalent to analogy. The conceptual metaphor was first explored by George Lakoff and Mark Johnson in their book

Metaphors We Live By (1980). They believe that metaphor is not a figurative language device but the fundamental basis for everyday cognition. Lakoff and Johnson write:

> “In all aspects of life... we define our reality in terms of metaphors and then proceed to act on the basis of the metaphors. We draw inferences, set goals, make commitments, and execute plans, all on the basis of how we in part structure our experience, consciously and unconsciously, by means of metaphor” (Lakoff, Johnson 1980:5).

Here, a conceptual domain is considered and is understood in terms of another conceptual domain. For example, "money doesn't grow on trees" or "love stinks." A conceptual domain can be any coherent organization of human experience.

This has given rise to the study of embodied meaning and a neural theory of language. Traditional approaches to linguistic meaning are challenged through the exploration of the importance of embodied perception and the action in peoples’ understanding of words phrases and texts. They emphasize that behavior emerges from the interplay of brain, body and world. This is referred to as embodiment and embodied meaning. There is strong evidence that significant aspects of thought and language arise from and are grounded in embodiment (Gibbs 2003:1).

Feldman and others have studied different languages to record the frequency of using the same metaphors that appear to be perceptually based. For example, there are several metaphorical uses of the word "grasp": grasp an idea; grasp an opportunity; grasp at straws. This has led to the hypothesis that the mapping between conceptual domains corresponds to neural mappings in the brain (Feldman, Narayanan 2004).

3.4.3.0 Analogies as Visual Relationships

Perhaps the way that we look at visual relationships could influence our understanding of the world we navigate. A number of scientists and researchers have argued that the structure of a language affects the ways in which people conceptualize the world. This worldview subsequently influences all other cognitive processes (Hill, Mannheim 1992). Sapir (1929) and Whorf (1956) argue that culture and language strongly influence thought and perceptual processes (but do not govern it). Bruner and the "New Look" school of psychology in the '50s and '60s argued that cognitive scientists should not simply study responses to stimuli. They argued that a person's interpretation - motivation, knowledge, and experiences -shape perception (Bourgoin 1997). Interestingly, there are a number of researchers, like Goldstone and Hendrickson, who are interested in how people learn new visual concepts, and what influences these newly learned concepts have on people's behavior (Hendrickson, Carvalho et al. 2012).

Today psychologists, cognitive scientists and neuroscience experts are looking at evolutionary, biological and philosophical models to explain behavior and consciousness (Naccache 2005, Edelman 2000, Baars 1988). The study of consciousness was of importance and initial exploration during this research because our thinking allows us to succumb to the immersive nature of the virtual reality theater. By creating art for achieving a sense of immersion in virtual reality, the artist must consider how art operates on the visitors' thoughts and perceptions. Artists expound on the basic Kantian notion that an object is not a visual phenomenon in external reality but rather it is integrated part of our personal reality. This could indicate, in part, the need to establish a personal visual consciousness.

The disconnect between language and visual imagery is aptly illustrated by surrealist Rene Magritte's painting "*La trahison des images*" or "*The treason of images*." It is colloquially referred to, as "This is not a pipe." The painting portrays an image of a smoking pipe with the words below it "*Ceci n'est pas une pipe*." Magritte stressed that the painting was not a pipe but rather an image of a pipe: "The famous pipe. How people reproached me for it! And yet, could you stuff my pipe? No, it is just a representation, is it not? So if I had written on my picture "This is a pipe," I'd have been lying!" (quoted in Torczyner 1979:71).

Magritte's image exemplifies the discourse between what cannot be pictured and what cannot be known: the gap that exists between the image and the word. This research investigates how artists attempt to illustrate thoughts and ideas using visuals that the visitor engages with through navigation. Rather than drop down menus and folders, the objects themselves become elements that denote the hierarchical structure of the computer system. In a virtual environment, it is the act of navigation and interaction with the visual objects in the environment that exposes a place within a time context. The process of looking in order to find a direction and a sense of space immediately changes our perception, mood and patterns of critical thought. Art is a powerful vehicle for the expression of abstractions. Virtual environments have the possibility to situate a visitor in an uncomfortable situation -one that is familiar yet may look unfamiliar. In this way the visual imagery may reflect the striations of our inner discourse by offering computer graphical objects that visually range from the concrete to the abstract. By identifying objects and establishing relationships with those objects, the visitor is able to move through the space and develop a narrative of the world.

When looking at an art object or a virtual environment, meaning comes because of an invitation to look at the environment and to reflect on the surroundings. Meaning does not result from an explicit order to make sense of the space. Meaning is the result of two types of images. The first type of image opens us up to the existing world and helps us to accept it and our place within it. The second type of image opens us up to our thought processes to consider possibilities and, in effect, to extend our world and realize other possible worlds (Mulder 2010:18). Images inspire thoughts and an ensuing discussion occurs. The presentation of imagery affords the opportunity for a conversation to be directly experienced. We have the potential to feel the artwork for ourselves, using our own intuition. These thoughts are shaped as a result of forming the related analogies to harness our enthusiasm or rejection. Subsequently new images and ideas can also occur. An aesthetic conversation is a direct result of the images carrying on through our feelings and situating themselves in a structured analogical or conceptual framework.

3.4.4.0 **The Significance of Analogies for Virtual Environments**

In order to go beyond the mere capture and printing of images as conceived in photography, the VE artist combines many different types of media software, programming and computational tools for building, transforming, combining, altering, and analyzing images and ideas. These tools are as essential to VE artists as brushes and pigments are to the painter. The understanding of them is the foundation for the craft. In virtual environments, the images are projected, updating in real-time. The essential characteristic of the digital information is the ability of the pixels to be manipulated easily and rapidly. As we move through the environment, the pixels move in response, configuring themselves in order to update the first person perspective. This malleable processing is reflective of the type of neural activity that occurs in the brain. The rapid firing of pixels to shape the environment and the rapid firing of thoughts to assimilate our place within the environment is an analogous situation. The artwork is situating the environment while the brain reacts, situating consciousness.

States of mind are successive and William James identified four characteristics of consciousness in his 1892 book, *Psychology*:

> 1) Every 'state' tends to be part of a personal consciousness.
> 2) Within each personal consciousness states are always changing.
> 3) Each personal consciousness is sensibly continuous.
> 4) It is interested in some parts of its object to the exclusion of others, and welcomes or rejects -- chooses from among them, in a word -- all the while" (James 1892:152).

Each personal consciousness is continuous in that there are no cracks or divisions or breaches other than interruptions or breaks in the content of thought. James states that his proposition that consciousness is continuous means two things (James 1892:158). The first is that even when there is a time gap, consciousness feels continuous in that it belongs with the consciousness before it and with the consciousness after it. In effect, consciousness is a series of conscious moments that is part of the same self. The second is that the changes from one moment of consciousness to another are never absolutely abrupt in terms of quality. James describes consciousness as something that is not chopped into bits or jointed like a train, but rather that consciousness flows like a river or a stream. He equates subjective life with the stream of consciousness (James 1892:159).

The world appears to the mind as a series of objects and events within space and time and these appearances cause us to define a phenomenal world which causes us to act and react within it. My artwork simulates this stream of ever presented objects and events by creating a type of reality that is growing in the way that thoughts and memories grow and compel us to move forward.

In my own work the visuals carry us through the stream of consciousness. The art begins with a method that relies on an active imagination to elicit spontaneous images that are created without deliberation or planning. The images are extrapolated and reconstructed into 3D models, texture maps and video clips to be used in virtual environments. Often these images are of faces or portraits. Faces offer an immediacy in terms of the visitor's response. The visitor must recognize the objects, size them up and deliberate an interaction. The object becomes a call to action which is met with an action/reaction response loop that can guide the visitor further through the environment. The visitor has the ability to choose which symbols, emotables, characters and objects they will interact with and which objects to ignore. This encounter of choices is similar to the stream of consciousness where we deliberate and can stop to acknowledge particular events, objects and others in the environment or we can choose to continue moving through our deliberations.

In my virtual worlds, the objects become the indicators or navigation points that encourages visitors in moving through the scene. An object can help a visitor establish their location and determine their subsequent direction. As these events are tightly coupled, the visitor continues along a path building connections between objects and events to create a continuous flow of traveling.

In my environments, this flow occurs in terms of perceptual stimulation where the qualities of color such as their volume, temperatures, and shades can transform the mood of a space to become whimsical or threatening while the scale of objects can situate expanse or limitations and audio signals can encourage or discourage directions. For example, in "*Figuratively Speaking*" the objects all have the same treatment, a single flat color that situates a styling of characters and objects that unify the landscape. The color motif situates the visitor in the space both locally and globally. Wherever they travel in the world, they recognize a continuum whether they are indoors or outdoors, on the land or on the sea. Near the mountains in "*Figuratively Speaking*" there are guards that discourage the visitor from continuing forward and if the visitor does continue forward, the landscape appears to collapse all around them until they reach the zenith where an altar is revealed. This progression of unexpected events is meant to encourage the visitor to contemplate their risks and inhabit a dynamic space that flows alongside their decision making process. There is no right way or one way but rather it is the direction that the visitor chooses that is appropriate. The design attempts to offer many possibilities that can be repeatedly investigated. The environment changes because the visitor is living in it.

Howard Rheingold, in his book *Virtual Reality*, summarizes VR's ontology in terms of three interdependent aspects: "One is immersion, being surrounded by a three dimensional world; another one is the ability to walk around in that world, choose your own point of view; and the third axis is manipulation, being able to reach in and manipulate it." (Rheingold 1991:34) He goes on to describe VR as a theatrical medium and suggests, "I think that properly done, a virtual reality experience will have a greater sense of mimesis and of participation in the events." In effect, being surrounded in a VR environment situates us within information and the objects and events in the VR environment create a mimesis for a world to relate within. This is particularly important for creating virtual environments when using a stream of consciousness method to create imagery and creating a stream of consciousness type of navigation for visitors. In an effort to create this stream, building up analogies between the images and events in the VR space will foster a flow of thoughts and decision making processes.

As the visitor in the VE flows through a stream of computer graphics, their brain flows through the stream of perceptual responses and establishes the sense of immersion. The stream of consciousness activity incorporates the unique amalgamation of real world events with the internal world of thought progressions and produces an experience.

In the process of seeing and looking, we are assimilating analogies, building on cognitive awareness and facilitating the establishment of new information and new relationships with that information. Digital images reduced to the lowest common denominator are comprised of information called pixels. Processing our visual world or bits of pixels operates in a similar analogy building fashion. The grouping of pixels privileges fragmentation and heterogeneity in a way that emphasizes process and performance. Each of us brings a unique insight and interpretation of space and time as data spheres approach us and we internalize the information.

What is important is the way in which we process the world. The process of creating allows an artist to project (un)conscious thoughts onto paper, canvas and other surfaces. Computers are a given. We cannot propose a future for art without technology. As the computer becomes ubiquitous, ‘digital’ is not important; rather, what is truly interesting is how we find ourselves in this world at this interim stage. My endeavor is to find where speculation is occurring through my own creativity, to understand how I can use the VR technology to discover what it is that compels my artwork and to assist my process in ways to create new metaphors.

Art historians Stafford and Terpak (2002) describe how people throughout time and all over the world have created objects to entrance us through immersion and simulation in order to stimulate wondering. She writes, “Putting distant things in contact with one another in order to make connections obliges the collector’s five senses to converge in a kind of synaesthesia." These connections are reminiscent of medieval scrying in the forms of hydromancy or crystallography where destiny was sought in reflective surfaces such as in bowls filled with water or in organic bodies of water, or in mirrors or in polished gems. These types of transparencies and reflections captivate viewers who explore similar surfaces in interactive 3D computer graphics. The connection of seemingly disparate analogies culminates in a type of digitally induced synaesthesia.

This research intimates that aesthetic theories work across cultural domains, people, time and places to exercise a methodological observation into consciousness and analogy making activity that enriches and stimulates our lives as well to share our discoveries with others. Philosopher and cognitive scientist Andy Clark extends the continuity debate by taking into account the notion of cognitive niche construction. He defines cognitive niche construction as the process by which our inventions and interventions modify or sculpt our social, symbolic and physical environment in ways that alter our abilities to think and reason (Clark 2003). The evolutionary arrangement that is being suggested is that it is crucial for our science and species to realize that it is the looping interactions that occur between our minds, bodies and our cultural and technological environments. Our world baffles us and we in turn baffle the world to create supportive environments, which in turn create us as well.

In terms of aesthetics, this discussion must point to Dissayanake's insights into art as a behavior rather than as content or as an object (1992, 1999). Art is an evolutionary behavior in which we are compelled to "making special" in a way that is differentiated from non-arts behaviors. The arts depend on such activities as "embellishing, exaggerating, patterning, juxtaposing, shaping and transforming" in order to appeal to our perceptual and cognitive faculties. Art making activity extends our minds and our lives to enrich others and the environment as well as to provide an opportunity for reflection and improvement. This is a vehicle whereby art situates consciousness and in some cases, immersion.

Art making is particularly emphatic in the process of analogy making which is the core of cognition according to Hofstadter. Creative behavior has been an active part of engagement for both humans and animals since we began to embellish our bodies, homes and tools. These consciousness-making systems bring us to a discussion of how digital art can be used to illustrate and integrate our biological selves and aesthetic beings through experiential phenomena. In effect, art is part of biological evolution.

Art situates consciousness. More importantly virtual art actively situates human consciousness while simultaneously illustrating the hallucinogenic as agent provocateur of consciousness. The syncretism between biological self and technological world is deeply rooted in the consciousness of arts. Allen (1999) suggests that the ingestion of hallucinogenic plants have fueled feelings of dreaming, ecstasy and the building of metaphors in our waking life and our relationships with others. These activities may have been a result of natural selection where ingesting semi-poisonous plants in times of scarcity and surviving their ill effects. Digital projections are modern day technologically produced hallucinations. The digital arts provide a dynamic for mind upgrades supplied in the form of projections, virtual environments and high-end virtual reality display systems.

Virtual art extends the private research laboratory of social awareness and intimate interaction by resituating the personal in experiential time based modes of aesthetic experience.

Understanding conceptual metaphors and their relationship to embodiment is useful for understanding the visual relationships of art while physically interacting in a virtual space. An immersive VE could establish a space for embodiment through the use of immersion (Taylor 2002). Another method to investigate the elements of the virtual environment, besides the structure of analogies, is to consider visual perception.

According to Arnheim, his purpose is to "re-establish the unity of perception and thought." (Arnheim 1969:294) The integration of the perceptual process, especially the visual, with the cognitive process supports the arguments that perception involves thinking and that thinking makes use of visual imagery. The eye registers objects in terms of shape, distance, color, brightness and its relation to the observer, other objects, light sources, and moving objects. The mind interprets that stimulus and provides a context based on previous knowledge, perception, and inductive conclusions through the senses (Arnheim 1969:37-39). Arnheim describes the basic principles of visual perception as balance, shape, form, growth, space, light, color, movement, dynamics and expression. They indicate the simplest structures that combine, develop, and differentiate to display dynamically without words into manifestations of a coherent medium. Language is insufficient for expressing all the qualities in a work of art. Words can be created to describe artistic elements and their final summation but they still do not capture "intuitive creation and comprehension" (Arnheim 1974:3).

Language cannot do the job directly because it is no direct avenue for sensory contact with reality; it serves only to name what we have seen or heard or thought. By no means is it an alien medium, unsuitable for perceptual things; on the contrary, it refers to nothing but perceptual experiences. This experience however must be coded by perceptual analysis before they can be named. Fortunately, perceptual analysis is very subtle and can go far (Arnheim 1974:2-3).

Shapes are concepts and concepts are thoughts. Percepts indicate perceptions, they are the sense or kinds of things, and are more related to the experience of something. Therefore, a shape perception is concept formation. The roundness of an orange or the moon can help to identify the object because the object can only "be perceived only to the extent to which it is fitted to some organized shaper." (Arnheim 1969:27).

Creating relationships between forms, especially forms that are hidden, deformed or obscuring the underlying structure may require the context of other situations in order to interpret the current one. Abstraction is cognitive performance of high complexity. In 3D computer graphics, one develops imagery in a 3D space displayed on a 2D screen. As the artist creates from one viewpoint, she has to visualize and be cognizant of the entire object on all the sides, which are simultaneously being shaped, regardless of visibility. Many software programs have a "four top" or four camera viewpoints displayed in a square configuration. The screen is divided into four viewports: top, front, side and perspective views. The first three viewports are orthographic and their cameras are limited to moving on two of the Cartesian axes (left / right and up / down). The fourth viewport is a perspective window that allows the camera to be tumbled and the scene rotated in any direction as well as zoomed in and out.

Consider the example of the multi-walled stereoscopic environment such as the CAVE (CAVE Automatic Virtual Environment) or MoVE (Multi-purpose Virtual Environment) or similar configurable theater settings. The CAVE is a cubic room with rear-screen projections so that each wall becomes a perspective viewport. The beams of lights form a 3D VE that can be navigated so that the viewpoint can be manipulated in real time. In effect, as the navigation control is manipulated in a particular direction, the screen also updates. CAVE art is a predominately visual and kinesthetic form of 3D computer graphics that reacts to the viewer-participant as she manipulates her head, hand and body movements.

The CAVE offers a psychological proximity whereby the participant is physically located inside the art, however the final piece cannot be realized without an active engagement to form and shape it. For the active participant in the CAVE, the boundaries begin to blur between the self, the virtual environment and where the real world is. Immersion occurs. The visual display is determined and updated by the computer in its code, screens, mirrors and projections while the visitor mediates the environment in negotiation within the artwork. In effect, we live in the "virtual reality" constructed by our knowledge and use linguistic strategies. In a virtual environment it is the programming code that constructs the viewing perspective and technologically reconstructs our knowledge. This phenomenon happens in computer display devices such as the CAVE and can occur in interactive projections and augmented reality devices.

Key characteristics of immersive virtual environments are stereovision and sound with head and hand tracking. The display also requires that the field of view is filled and a person's input effects the environment. Typically virtual environments are used for data visualization and scientific research in astronomy, chemistry, geology and mathematics. These visualizations are generally used for educational purposes, information or data display and research purposes to illustrate scientific concepts. The main criterion for such visualizations is to extend knowledge from mathematical and empirically verifiable concepts. As a result, the major focus in virtual environments is limited to a 3D data display that does not need to explore the full potential for composition and design while being immersed in a dimensional medium. This research is provoked by an interest in building analogies as visual navigation structures in 3D interactive immersive virtual environments where the aesthetics (shape, form, texture, sound, mise-en-scene) become the guide for the participant.

As a result, this investigation turned to how the arts can facilitate immersion by allowing others to explore an unfamiliar reality through subversive confrontation in the CAVE. For example, the 1996 CAVE piece "*Dream Grrrls*" created in collaboration with computer scientist Grit Sehmisch and audio designer Joe Reitzer, explores the metaphysical through movements in a dreams-based virtual reality (Dolinsky 1997). The unfamiliar, yet somehow recognizable, digitally projected images establish a space: a labyrinth with 3D objects that act as points of transition to other worlds and suggest an episode of dreaming. Moving through these 3D worlds, the visitor navigates the spaces as if captured in a stream of consciousness. The worlds appear and disappear as rapidly as thoughts occur while negotiating a shopping mall - every store offers its own delights. The several different worlds refer to dreams of childhood (surreal see-saw in the clouds), synaesthesia (a world of color and sound flooding the senses) and isolation (a desert island of vessels and ethereal music), nightmares (a darkened room where the CAVE navigation wand becomes a flashlight). See Figures 3.18 and 3.19.

Figure 3.18 “*Dream Grrrls*” M. Dolinsky 1996. Virtual Reality Still. Symbolic icons in the labyrinth encourage travelers to see other worlds. At the Light World, the visitor hears “Don’t go up there!” Upon entering the head, the CAVE turns dark and the wand becomes a flashlight in a world of nightmares.

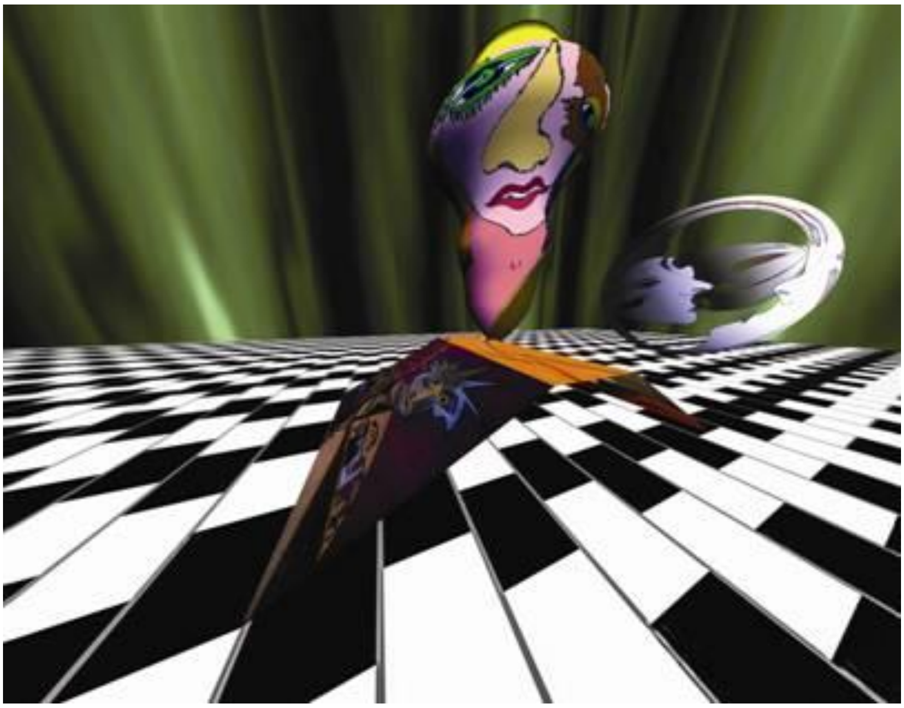


Figure 3.19 “*Dream Grrrls*” M. Dolinsky 1996. Virtual Reality Still. Inside the Labyrinth World, 3D objects lead to other worlds. This 3D symbol leads to the Vessel World which is a desert island of loneliness filled with hollow pots and hollow sounds made from actual primitive instruments.

In virtual environment artworks as I construct them, a triad is formed between the artwork, the real time update display system and the visitor's movements. The action and reactions flow from these three vantage points, shaping one another through interaction devices such as event triggers and proximity sensors. The artist establishes a visual symbolic narrative for the participant who apprehends the artwork according to the choices (actions/reactions) they make during their own experience.

VEs generate a phenomenon whereby the actions in graphical experiences are driven by both sequential image construction and human-computer intervention. This action-reaction loop simultaneously activates the navigation of the visitor and the organization of the stream of consciousness experience. Viewers are integrated as a component in the computer feedback system because the tracking system knows the visitor location and reacts or updates its display accordingly.

This action-reaction concurrence is used in this thesis to demonstrate how sequential image construction in virtual environments builds up in parallel with the organization of conscious experience. Virtual environments that exploit a stream of analogies navigation demonstrate that art works can actively illustrate how the aesthetic experience occurs and how we shape aesthetics as it shapes us.

The actualization and manifestation of consciousness organization occurs as an artwork unfolds itself and as it in turn unfolds the viewer during the art experience. This aesthetic experience is an evolving construction of personal phenomenon. The process of art making is re-enacted through the viewing moment as the participant reveals the artwork through navigational participation. This cooperative engagement results from an ever-flowing interpretation of the art, the self and the relationship the two establish as an ensemble to become a newly found consciousness.

Virtual environments as personal theatrical events situate projection technologies as a private research laboratory of social awareness and intimate interaction. Virtual art resituates the biological self in time-based nodes of aesthetic experience. Virtual art acts as a technological scaffolding united with our brains, bodies and culture to establish the result of who we are in that moment. Our exclusive dimensional reality was once our primary foundation for self-construction. Now virtual environments can provide a revelation in that they rely on the similar action-reaction connection of our day-to-day living while simultaneously actively illustrating the moment-to-moment construction of real world reality.

3.5.0.0 **Summary of key points made in this chapter**

Artists setting the groundwork for using virtual environments include Monika Fleischmann and Wolfgang Strauss, “*Home of the Brain*” (1992), Char Davies, “*Osmose*” (1995), “*Ephémère*” (1998), Maurice Benayoun, “*World Skin*” (1998), Christa Sommerer and Laurent Mignonneau, “*The Living Web*” (2002), Rita Addison, “*Detour*” (1994), Benjamin Britton, “*Lascaux*” (1995). Collaborative virtual environments allow remote visitors to meet in a shared space over the network to explore art. One such collaborative event “*V_Hive*” occurred in Brazil at the Virtual Worlds Festival 2004 where the display in Sao Paulo was connected to three cities in the United States. Collaborative events network VR displays so that the computer graphics is generated in real time at each computer’s location. Collaborative VR is not a streaming video event. Some of the artists involved in “*V_Hive*” included Josephine Anstey, Dave Pape and Dan Neveu with “*PAAPAB*” (2000), Jackie Matisse with “*Kites Flying In and Out of Space*” (2001) and Margaret Dolinsky with “*Beat Box*” (2001).

Many artists create interactive arts, including virtual environments such as Luc Courchesne, Knowbotic Research, Rebecca Allen, Perry Hoberman, Jacqueline Ford Morie, Brenda Laurel, Sheldon Brown, David Em, Diane Gromala, Myron Krueger, Jaron Lanier, Michael Naimark, Jeffrey Shaw, and Toni Dove. Refer to the chapter for details on their work, exhibition venues and publications. Further documentation of artists and their work can be found online at the Database of Virtual Art http://www.virtualart.at/.

Art in virtual environments is driven by the visual and auditory cues that provide visitors with a sense of agency. The methodology for using visuals and audio design has no prescribed language specific to virtual reality. Therefore navigation and wayfinding for each virtual environment will be different for each artist's work. Visitors must establish a sense of self in these environments by assimilating the circumstances and responding accordingly in a process that simulates real world circumstances. In the real world, navigation or wayfinding is dependent on building analogies between mental events. Douglas Hofstadter states "analogy is the core of cognition" (Hofstadter 2000: 116-144) and making analogies is what drives our stream of consciousness. As the real world is dependent on our frame of consciousness, the virtual world is dependent on our frame of analogies. The visual and auditory cues provide the framework to discover, explore and experience virtual environments.

The major points in chapter include:

- VR art is not played back but generated in real time.
- VR art uses action and reaction to transform a visitor's perception and consciousness.
- Subjects as diverse as "collective consciousness," diving, bodily functions, human skin, historical art works, car accidents/brain injuries, Russian folk tales have inspired interactive art and virtual environments.
- Collaborative virtual environments allow visitors to feel "teleported" or a sense of "telepresence" with others by connecting the visual displays of remote locations.
- Analogies are the method in which conceptual relationships are established that influence perception and cognition.
- Analogies can be used to describe how VR art establishes aesthetic experiences.

Chapter 4: Methodology

Chapter 4: Methodology

Analysis of virtual environment technology, the fundamentals of visual analogies, visual thinking and virtual environments aesthetics and a description of artistic practice

4.1.0.0 **Introduction**

The purpose of this chapter is to discuss a practice-based methodology for creating art experiences in virtual environments. The chapter examines the technical context in which the research occurs by briefly describing the use of computer science technologies, the fundamentals of visual arts practices, and the importance of aesthetics in new media and provides a description of my artistic practice. The aim is to investigate how combining these approaches can enhance virtual environments as artworks. The computer science of virtual environments includes both hardware and software programming. The resultant virtual environment experiences are technologically dependent on the types of visual displays being used, including screens and monitors, and their subsequent viewing affordances. Virtual environments fill the field of view and can be experienced with a head mounted display (HMD) or a large screen display. The sense of immersion gained through the experience depends on how tracking devices and related peripheral devices are used to facilitate interaction.

Following this short examination of the technical context, the next section discusses visual arts practices with a focus on how illusions shift our cognition and perception in the visual modalities. This discussion will include how perceptual thinking is the foundation of art experiences, how analogies are the foundation of cognitive experiences and how the two intertwine in art experiences for virtual environments. This is followed by an examination of the aesthetic strategies used by artists and new media critics to discuss new media art. This research investigates the visual elements used in virtual environments and prescribes strategies for creating art for virtual environments. Methods constituting a unique virtual environment practice that focuses on visual analogies will be discussed. The artistic practice that is discussed as the basis for this research also concentrates on experiential moments and shifts in perception and cognition.

4.2.0.0 **Computer science technologies: technical context of the research**

Through my research I create artworks using state-of-the-art technologies and high performance networks for gallery and museum installations, dramatic theater events and operas. This includes projection displays that incorporate 3D computer graphics, real-time animation, real-time video processing, facial detection, stereo audio, stereo video and real -time interaction. The real-time interaction includes some type of tracking system integrated into the graphics output. Such systems could include a Flock of Birds tracker and transmitter or a video camera tracker or a facial detection tracking system. The artwork requires the ability to display the visual graphics in real time using many processor-intensive programs running simultaneously. The artwork does not require a playback device; it requires the artwork to be generated during the time of the visitor's interaction. The work is realized as the visitor moves, manipulates, navigates or in some way alters the reality of the art experience.

This creative activity requires a high-end computer graphics machine that can perform the necessary processing at a high rate of speed. The final artwork requires multiple software packages that are not typically used together, so my research has included the development of ways to make these programs work together. The software includes 3D modeling packages, video editing software, paint programs, real time interactive animation engines, and various visual programming interfaces including Cycling ’74 Max/MSP and 3DVIA Virtools. Hardware requirements include computers, projectors, cameras, and printers.

This amalgamation is necessary for the unique fusion of art and technology I realize in my work, which is highly individual. It is exceptional in the field of virtual environment research for its prominence in both computer science and art communities. The work has been shown at computer conferences such as IEEE Super Computing, ACM SIGGRAPH, and IS&T /SPIE Electronic Imaging, as well as at international fine arts museums for technology such as Ars Electronica in Austria and the NTT InterCommunication Center in Tokyo.

Typically, one computer will drive all of the software and hardware devices. This requires a customizable workstation that includes a high-end graphics card, a robust six core single Xeon processor and enough RAM for 3D computer modeling and real time 3D animation and rendering. I work with a dual monitor configuration because I need multiple programs open simultaneously. Those programs require a full screen space to be displayed properly. In addition, the deployment of the artwork often requires a dual monitor display so to have the basic test set up requires two monitors. The machine has a wireless keyboard and mouse because it is important to keep these separate during performances and gallery exhibitions where the machines are hidden and access is required. I use large disk drives because the video and image files are very large and take up a lot of data storage space. Often the artworks will capture video in real time and store it locally to the machine while simultaneously sending it to the display monitors.

In summary, I have three requirements for the technology I use in my research: first, processing power necessary for acceptable frame-rates; second, two high-end video GPUs for high quality rendering of

3D graphics; third, enough memory to meet the needs of these demanding applications.

4.2.1.0 **Hardware**

The hardware requirements for developing virtual environments are specific to the type of virtuality the artist wishes to achieve. The term “virtual reality” is often used to refer to any computer-based environment. These may include text-based social networking websites, image-based websites and 3D-based websites as well as shared environments on the network, video games, single user screens, installation art, performance art, dramatic theater and opera events, head mounted displays (HMDs) and large virtual reality theater displays. For the purposes of this research, it is acknowledged that the term virtual reality is widely used; however, the virtual environments that I am discussing are those that use large screens in order to fill the field of view and tracking devices in order to control navigation and progress through the world. These virtual worlds are enhanced with stereo vision, stereo audio and other peripheral devices that facilitate immersion and engagement.

4.2.2.0 **Screens and visual displays**

Various systems have been developed for the display of virtual environments, including theaters such as the CAVE, head mounted displays, domes, large single screens and smaller monitors.

4.2.3.0 **Screen displays**

The screen is of primary importance for the artist because it is the canvas to display the work and it is where the artwork meets the visitor. It must be large enough to fill the field of view and to allow the visitor to stand at a comfortable distance, focus on the screen and be without distractions. The objects surrounding the screen must be neutral and unobtrusive or compliment the display situation. Screens can be either front projected or rear projected, with or without passive polarization. In order for stereo vision to occur actively, the screen must be polarized to transmit and function with the tracking glasses. The size of the screen, its material and quality will affect the display, influence the hardware options to use and dictate the necessary budget for the artwork.

The screen's display brightness will depend on the projectors. Varieties of projectors are available, with various options that determine their limitations for use in virtual environments. If the display will be in stereo, it requires two projectors. If the tracking is an active tracking, the projectors will require polarization. If the display is not in stereo, two projectors can be mounted side by side to create a larger field of view. More recently, a single projector will throw a stereo image. These are typically cost effective and easier to transport but often have the trade-off of being low resolution and having a low brightness; however, the technology is improving and becoming more affordable.

If the screens are configured in a theater setting such as the CAVE Automatic Virtual Environment then not only does a larger screen need to be purchased but also a space must accommodate the scaffolding to hold the screen permanently. This is a tremendous commitment on the part of any institution and can cost upwards of half a million dollars depending on the size of the display, location and throw distance of projectors, computing power and the type of peripheral devices being used for tracking and input.

4.2.4.0 **Monitor or monitor type displays**

Many virtual environments are displayed on monitors for transportability. This includes computer screens, high-end laptops and televisions. Often the display is done in mono rather than stereo so that the work can be seen. However, many new consumer grade screens are 3D compatible and the stereo viewing requires passive stereo glasses. The upsurge in 3D cinema has made the technology more appealing for the masses in both theater and home settings. This advantage for the display of virtual environments is that it increases the options for portability, deployment and provides more choices for hardware specifications. A recent technology for virtual environment display is a high-resolution wall that is constructed using a grid of tiled LCD panels and high end graphics machines daisy-chained together to drive the display. Even more advanced is the use of autostereocopic LCD panels that are tiled and do not require the use of stereo glasses.

4.2.5.0 **Viewing conditions**

The type of screen display will dictate how the visitor will experience the overall setting of the artwork. Whether the artwork is seen in a CAVE, HMD, Virtusphere, theatrical stage event or opera, it is the location and invitation to that location that sets the arena for the viewing. This type of artwork is often equipment intensive so it exists during specific dates and times due to access constraints of equipment and location availability. A piece will be designed differently if it is being created for a large audience to enjoy an event in comparison to a single person visitor who enjoys a singular experience. Various examples are shown in the Figures 4.1 and 4.2. A good example is the HMD display that is limited to a single user. Only one person can wear the HMD and so only one person may engage in the virtual environment at a time. To extend the experience, the graphical environment can be projected on a separate wall to be displayed in real time and shared with an audience. However, the visitor in the HMD is separated from the audience. There is no communication between the two entities as they are disconnected in time and space. An example is Char Davies' *Osmose*, which is viewed simultaneously in an HMD and a theatrical setting though the two audiences do not interact. The CAVE and typical theater settings are shared experiences where people may or may not engage with one another.

4.2.6.0 **Virtual environment with HMD**

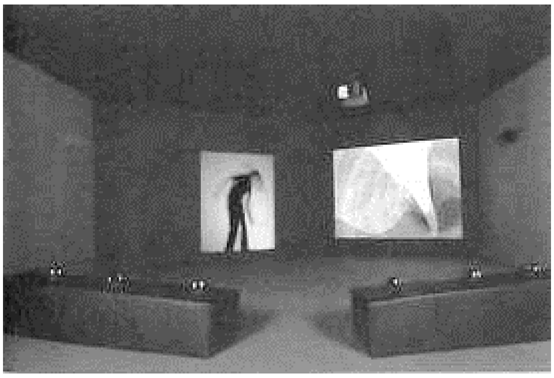


Figure 4.1. A theater has two viewing screens so that an audience can watch the visitor wearing an HMD and experiencing a virtual environment.

Figure 4.2. The person behind the left screen is being tracked in a virtual environment that is simultaneously broadcasted on the right screen.

Virtual environment theaters come in many sizes and shapes. In Figures 4.3 and 4.4 are shown a spherical VirtuSphere and a cubic CAVE. The VirtuSphere uses walking for self-propelled navigation, with screens embedded in the HMD glasses. Navigation through the computer graphical environment of the CAVE is facilitated by the use of a tracking device and navigation wand. Unlike the VirtuSphere, the CAVE screens are set apart from the visitor and the CAVE can accommodate multiple visitors at one time. Opera, dramatic theater stages and outdoor happenings have also used projections to immerse visitors in a computer graphical space (Figures 4.5 and 4.6).

Figure 4.3. The Virtusphere, at the 2010 Games Developer's Conference, was advertised as the ultimate immersive-gaming experience. Visitors hold a fake gun to shoot polygonal creatures and win points (Ralph 2010).

Figure 4.4. A typical cube shaped virtual environment theater called the CAVE. Here, Dave Pape navigates his Crayoland art world with a tethered tracking device and a navigation wand.

Figure 4.5. Happening at Black Mountain College in 2010 uses projections in theatrical events to help immerse the audience in the narrative (Baker 2011).

Figure 4.6. Visitors in a performance theater that is outdoors are surrounded on all sides by performance art, musicians, dancers, and various other art ‘happenings.’

4.2.7.0 **Screen based immersion**

Figure 4.7. Paul Pfeiffer, Dutch Interior, 2003, installed at the MIT List Visual Arts Center. A viewer looks through the peephole in the projection screen at the miniature set reconstructed according to the scene in the film *The Amityville Horror,* 1979 (Coulter-Smith 2006).

Figure 4.8. Sculpture by San Francisco artist, Alan Rath. He created a pair of eyes that look around and blink. Rath used two 13” cathode ray tube TV monitors to display the eyes and they are controlled by an internal computer.

4.2.8.0 **Tracking devices**

Tracking devices track the head and hand positions of the visitors.

The computer must register the location of the head and hand according to the Cartesian coordinates (X, Y, Z) for position and angle of rotation. It must also register the direction the tracked visitor is facing. These positions allow the computer to generate a visual display in the proper orientation in order for the visitor to see from a first person perspective. The locations of the head and the hand also trigger events based on a pre-determined coordinate location. For example, a bounding area may be designated at a specific location by a ten-unit sphere, and the sphere connected to a head trigger. If the bounding area of the sphere is entered by the head that is wearing a tracking device, the trigger will be enabled and cause subsequent events to occur.

The significance of the tracking devices is that they afford first person perspective so that the view is updating according to the tracked visitor's movements. The display responds to body positions and the speed of navigation through the scene. The speed is controlled using a pressure sensitive joystick. The use of an avatar or some type of graphical intermediary such as a gun or menu system can be integral to the design of some virtual environments but it is not required.

4.2.9.0 **Peripheral devices**

Many displays are configured with specific devices based on the type of research being conducted at the lab. For example, the six sided cubic CAVE at the University of Illinois at Champaign Urbana (UIUC) allows the visitor to walk into what is essentially a room. The visitor wears a tracking device belted around the waist and manipulates a hand held wand to input navigation controls. UIUC also has a separate circular or 360' panoramic stereo display and the middle of the room is outfitted with a real automobile. The visitor actually sits in the car and moves through the environment using the steering wheel and acceleration and brake pedals. The circular display uses several cameras within an eye-tracking apparatus. The tracking system updates the display in response to the visitor’s actions, creating a realistic sense that the visitor is driving a car. It is surprisingly effective and immersive because the visitor looks out all of the windows and sees the simulated virtual environment. The University of North Carolina also has a projection space that is configured specifically in order to enhance the visitor's perception during their cliff experiments. The floor is built to have a center drop of 1.5 inches in order to simulate standing at the edge of a cliff or pit. Other input devices for navigation include an airplane cockpit, bicycle, various types of chairs including car seats and wheel chairs, earth-moving equipment with multiple levers for controls, etc. The Ford Motor Company in Detroit has a full sphere with an automobile inside to test under various weather simulations. The idea is to get a physical sense of 'being there.' Much of these input devices are dictated by companies who are funding the research and are typically permanent fixtures for the duration of the research. These types of displays limit development for artworks because their conditions may not be easily replicated and the work becomes site specific which limits portability, show-ability and the longevity of the piece.

4.2.10.0 **Software**

Virtual environments are not created with one dedicated software package. Rather, the development requires several software programs to be used together. These include modeling, painting, drawing, animation, a programming environment to position the 3D objects, animate the scene and trigger events as well as programs to configure the stereo visuals, audio, tracking and the stereo display device. The result needs to be versatile enough to be able to use a variety of display systems and platforms. For example, a four-wall CAVE, a two-wall CAVE, a single screen, monitors and/or web browsers with the appropriate peripheral devices.

4.2.11.0 **Artists in visualization facilities**

Artistic virtual environments are typically developed in conjunction with computer research labs that are focused on science and engineering visualization challenges. The equipment is difficult to access, the programs are difficult to develop and the artworks are difficult to exhibit. However, many artists alongside scientists have developed virtual environments with attention to aesthetics. In order to work effectively in creating purely artistic environments, there must be access to the equipment, funding for personnel and supplies and the support for art in a technical and scientific research workspace. The artist must appreciate the programming environment as a whole, blend into the surroundings and focus on the creative mission. The limitations of the artwork depend on the technical context where the work is developed. All of the above-mentioned equipment and its related maintenance is typically handled by high end visualization facilities either in a university or research corporation that have limited access for artists. Access is secured through generous funding streams, availability of the facilities and the expertise of the artist in terms of being self-sufficient.

4.2.12.0 **Virtual environments and computer science**

The computer was originally built as a calculator and primarily regarded as a cognitive device. Ivan Sutherland's (2003) work in computer graphics led the way to its becoming an interactive device and a sensory and perceptual medium. Typically, scientists develop virtual environments for analyzing data, discovering mathematical visualization, practicing surgical procedures or directing training task analyses (Regian, Shebilske et al. 1992, Satava 1992,1993). These application areas are not always concerned with an aesthetic or artistic appearance because they focus on the requirement of the visitor's ability to identify visual objects and to manipulate those objects. For example, the visual display is important pragmatically -

the mathematical formulas or constructions of the body parts must be identifiable and the display should avoid any aesthetic provocation external to the relevant data. The ability to view such data in 3D becomes a visual passage in itself. Recently, the visualization of science as an aesthetic phenomenon has become recognized and exhibited in galleries and museums. However, from speaking with such scientists the color-coding of things like high microscopy scans are typically due to dyes or random decisions. As of yet, the results do not have consistent color-coding and only recently has there been an attempt to impose limitations in order to accommodate those who are color-blind.

Artistic choices have not always been important for VEs that are simply directing visitors to perform eye-hand coordination tasks and simulated training tasks. Many times these environments are built in order to determine a visitor's physical agility in virtual worlds in order to avoid having to train them in the real world. It has been shown that a strong focus on tasks within the virtual environment is enough to establish a sense of presence for the visitor (Witmer and Singer 1998:225-240). For example, the focus is on muscle training and reaction time in VEs for training purposes such as flying a plane, driving a tractor, working the line in a factory or facilitating production in a steel mill (Pota, Katupitiya et al. 2007, Bruno, Caruso et al. 2009, Yisa, Terao 1995). Pragmatically, scientists did not need to slow down their development time by consulting artists during the process of creating VEs. Research with user studies for training in VEs concluded that the environments were effectively immersive without attention to aesthetic details (Brooks 1999).

Many of the challenges that are facing information visualization and scientific visualization could pull from such fields as art and perceptual psychology. Large data sets have such a huge number of data points that they yield a variance in the types of information that can be interpreted as a result. During the interaction process, often only one parameter is being viewed at a time or a few parameters are being compared. Scientists agree that knowledge from art and perceptual psychology can help define effective VE experiences but the rendering of the graphics themselves can be problematic.

For example, Van Dam explains that

"Many visual cues can be used to map data. Some of the most obvious are color and texture. Within texture, density, opacity, and contrast can often be distinguished independently. At a finer level of detail, texture can consist of more detailed shapes that can convey information. What makes the problem complex is that the human visual system takes cues about the shape and motion of objects from changes in the texture and color of surfaces. For example, the shading of an object gives cues about its shape. Therefore, data values mapped onto the brightness of a surface may be misinterpreted as an indication of its shape." (Van Dam, Forsberg, et al. 2000:26-52).

Computer rendering time has its limitations when creating real time computer graphics. Additionally, novices in the field will find some difficulty with interpreting a medium that they may be unfamiliar with, or they may try to develop a VE as though it were a computer game or interactive video. Because the artist is trained to pay attention to perceptual and sensory details, their work is valuable as a creative way to understand and develop novel approaches to VE interfaces. Art expands the world to visitors through the act of sensory perception and aesthetic awareness. VEs extend the cognitive act to become sensory and interactive. Together they work in tandem towards exploration, emotion, sensation and physicality.

4.3.0.0 **The fundamentals of visual arts practices: How illusions shift our cognition and perception in the visual modalities**

Margaret Boden says that "…no computer could "really" be creative: the creativity lies entirely in the programmer." (Boden 2009:23) She defines creativity as the:

> "…ability to generate novel, and valuable, ideas. Valuable, here, has many meaning: interesting, useful, beautiful… Ideas covers many meanings too: not only ideas as such (concepts, theories, interpretations, stories but also artifacts such as graphic images, sculptures, houses, and jet engines. As for *novel*, that has two importantly different meanings: psychological and historical. A psychological novelty, or P-creative idea, is one that's new to the person who generated it. … A historical novelty or H-creative idea is one that is P-creative *and* has never occurred in history before." (Boden 2009:24)

Boden describes creativity as happening in three different ways: by exploration, by transformation or by combination. (Boden 2004:xi) Exploratory creativity depends on existing structures and stays within the bounds of that system which could be a theory of molecular models, a style of painting or music or a type of ethnic cuisine. Transformational creativity occurs when the style itself is altered by definition so that the new idea is dependent on the old one for its inception as for example, fashion or aromatic chemistry. (Boden

2009:25) Combinational creativity occurs during unfamiliar combinations of familiar ideas and it works by making the associations between ideas. (Boden 2009:24) Analogy is the form of combinational creativity that this thesis will explore because it exploits conceptual structures and my thesis involves shifts in perception. In computer based interactive art, Boden writes that it is not just the images and sounds that produce aesthetic interest but it is in the nature of the interaction between the computer and human beings because the participant is elemental in the creation of the artwork. (Boden 2009:32) In effect, I began to investigate combinations of conceptual structures occur to think about how the images and sounds are combining with the actions and reactions of the visitor to create an aesthetic experience.

4.3.1.0 **Perceptual shifts**

There has been a historical tradition in art towards altering perception, promoting what I call a “perceptual shift” for the viewer. I define a perceptual shift as the cognitive recognition of having experienced something extra-marginal, on the boundaries of normal awareness, outside of conditioned attenuation. Perceptual shifts are often provoked by artwork such as *trompe l'oeil,* Cubism, Cornell boxes, labyrinth gardens, and Brecht's political theater. These devices for wonderment have a magical quality that requires a specific interaction unique to the particular device and its functions. Once the participant realizes his or her role within that interaction relationship, possibilities open for cognitive and perceptual shifts. In my own work, I am not necessarily attempting to shape emotion in particular, but I do hope to shape perceptual possibilities within virtual environments, interactive animation and augmented reality. Action is key. The action enhances the sense of immersion and the efficacy of the graphics (Rosen, Bricken, et al. 1994:496).

4.3.2.0 **A turn to perceptual thinking**

In an effort to describe shifts in perception while in an art VE, the research led to an investigation about art and consciousness and perception. Many areas proved either too broad or too esoteric. These included, for example, the understanding of action/reaction theories, Buddhism's sense of ephemeral reality, paranormal spirituality and types of hallucinations. In an effort to understand this practice based research, it became important to investigate cognitive science and the study of analogies as well as perceptual thinking. The research lent itself to Hofstadter's interpretation of concepts and Arnheim's theories of visual thinking. This research is by no means a definitive look at their theories and years of research, an exploration that would be beyond the scope of this dissertation. However, their work is used as a foundation for developing strategies for creating VE art worlds and discussing how their components shape immersion and navigation.

4.3.3.0 **Analogies and their formation**

Looking at analogies is pivotal to understanding how virtual worlds shape experience. VEs set up a relationship between the virtual and the real, between our self and our self-being-immersed. Analogies progress through the use of generalization and abstraction. One of the methods for understanding relationships between ideas and creating new concepts from comparing those relationships is generalization. An admirer of mathematics, Hofstadter discusses generalization, which is the basis of how computer programs substitute variables for numbers. However, real world generalization is much more complex than computer mathematical models. In the book, *Fluid Concepts and Creative Analogies: Computer Models of the Fundamental Mechanisms of Thought*, Hofstadter describes the features of how 'generalizations' occur. (Hofstadter 1995:77)

- Moving internal boundaries back and forth
- Swapping components or shifting substructures from one level to another
- Merging two substructures into one or breaking one substructure into two
- Lengthening or shortening a given component
- Adding new components or new levels of structure
- Replacing one concept by a closely related one
- Trying out the effect of reversals on various conceptual levels

Hofstadter and his students design programs that model creativity and analogy-making in order to study artificial intelligence. The rules or models behind these programs that drive their logic can be studied to how analogies apply to situating visitors in art in virtual environments. The rules that help us determine our place and directives for the real world can help us to discover the virtual world. Virtual environment art has no set tropes or defining language that specifies the genre. Most of the environments are described using terminology from books, cinema and video games. Therefore, when looking at their construction it is important for me as an artist to understand how the visitor moves through the imagery. Many of my environments are creating a non-linear no-hierarchical type of narrative so the navigation resembles a stream of consciousness type of movement. This is important because the original imagery is derived from stream of consciousness or spontaneous drawings. I aim to preserve the immediacy of the drawing process with the immediacy of discovering a novel artwork in virtual reality. An approach to understanding the stream of consciousness is to understand how cognition is established. Hofstadter says that analogy is the core of cognition, that is, when we encounter new information and relating that information back to what we already know, we are making analogies. It is a method of scaffolding our understanding based on knowledge and experiences. By unpacking our experience in terms of our previous experiences we can look for new information. For example, when we move from one room to a hallway, we approach a hallway and the surrounding space narrows and lengthens in front of us. We dismiss certain features that we are familiar with such as the narrow door opening or that the walls are wide and flat and realize unfamiliar features such as the sconces on the walls delineate the space and mark a unique feature of the location. We are constantly moving through a stream of information, accepting, dismissing, codifying and integrating. These codifications and integrations or analogies occur through generalizations that involve the ability to reconfigure an idea.

Hofstadter writes: “in Seek-Whence, such remedial actions are called for whenever a theory is cast in doubt, which can happen in a number of circumstances, such as these:

- -when one’s current theory clashes with a new term, and thus is proven to be wrong;
- -when one’s current theory, despite never making wrong predictions for new terms, is unable to account for terms at the sequence’s very beginning;
- -when one’s current theory is judged esthetically unappealing.

Besides these, though, there is another very different reason for wishing to generalize theories in the Seek-Whence domain-namely, the fact that coming up with interesting new sequences is an important type of goal in itself, and a goal that is of course on a completely different level from that of solving extrapolation puzzles.

After you have sought whence a given sequence comes, a new and higher level of activity can occupy you-namely, finding whither your sequence leads you.” (Hofstadter 1998:77-78)

Hofstadter continues by discussing examples of variations in Chopin’s music. (Hofstadter 1998:78) Hofstadter explains much of the theories about analogies in complex mathematical forms in his 518 page book Fluid Concepts and Creative Analogies which is quite densely packed and whimsically written. Hofstadter also refers to the JUMBO word puzzle as an example of looking at something unfamiliar and making sense of it through these types of generalizations. I will describe my process of solving a familiar JUMBO or Jumble puzzle and where these types of generalizations might describe a point in the task analysis. By looking at how analogies are used in a word game I hope to parallel the process of generalizations and how they support the navigational strategies in the visual game or event of virtual reality. The process of moving through mental generalizations fuels the ability to consider movements in virtual environments. First the word puzzle in order to get our bearings in a language process.

If we examine Figure 4.9, we see a fresh Jumble puzzle as offered online on at http://jumble.com/games/info/13.

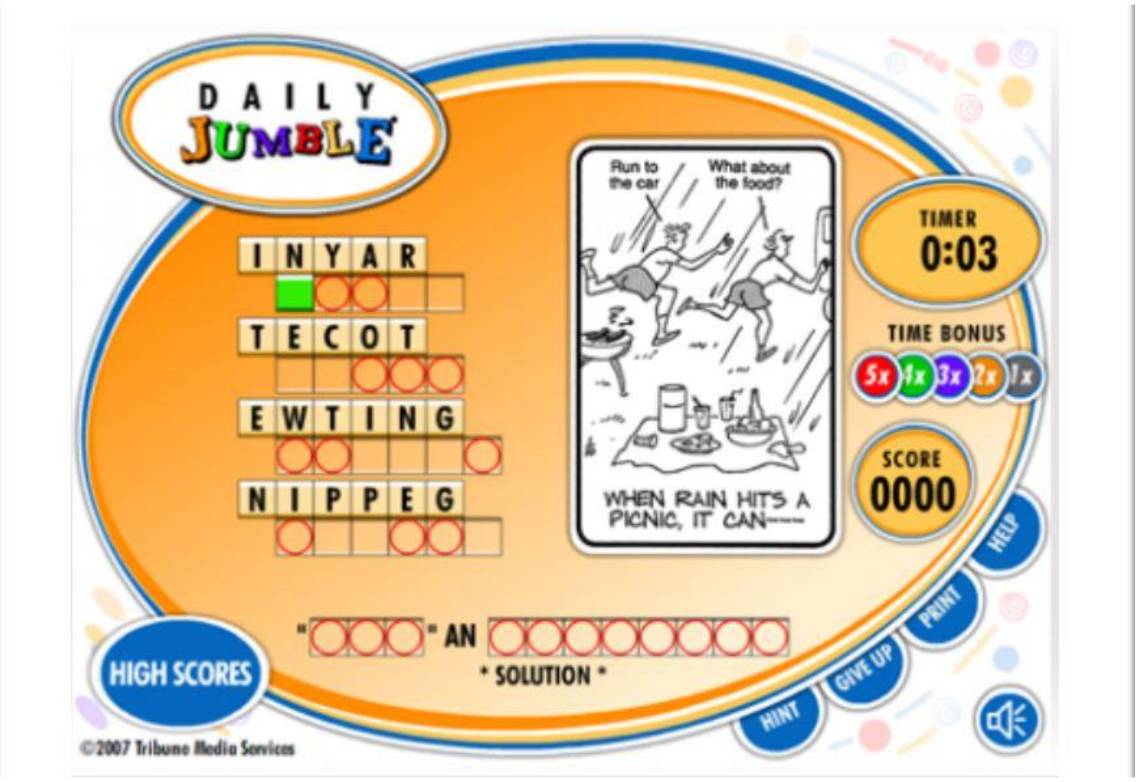


Figure 4.9. Jumble Puzzle: A brain teaser or word puzzle solved by rearranging letters to form words and using the key letters in those words to solve a riddle presented through a cartoon.

The Jumble word puzzle is found in newspapers and online. The goal is to rearrange letters in order to solve scrambled words and phrases that reveal a pithy saying or joke. We rearrange the letters by making generalizations between the letters. Success with the puzzle can lead us to feeling a sense of accomplishment or new understanding of the cartoon's riddle.

This method is also familiar to us if we think of the Jumble word puzzle. In the puzzle, a random configuration of a word is presented to the viewer who must reassemble the letters in the correct order to spell a common word. We move our internal boundaries back and forth when we realize that a given jumble of letters in the Jumble could and should spell a recognizable and readable word. Each group of letters, whether they are jumbled or solved are the same group of letters just presented in a different way. Both groups ultimately translate to represent and codify the same word.

Mathematically we can think of this type of generalization in a relational way. For example, the sequence (3, 4… can also be presented as (n, n+1…). We can move back and forth between the boundaries of the value presented in similar but distinct forms where one is numerical and the other is a variable.

- Swapping components or shifting substructures from one level to another

In the Jumble puzzle, letters are swapped back and forth to see which ones would commonly or logically fall next to one another. For example, TH, DY, and SS are common combinations of consonants. They appear as a subset of a word and can be easily placed either at the word's beginning, middle or ending and thereby anchor the word. This process narrows the possible positions of the remaining letters.

- Merging two substructures into one or breaking one substructure into two

If we continue with the example of the aforementioned Jumble word puzzle, we can quickly see how this method of generalization works. In the puzzle, several words are jumbled into a random configuration of letters. When the letters are written in the correct order, the boxes that house them are either square or circular. The letters in the circles are merged together to form another level of the puzzle using the same theme. The circled letters form a phrase or string of words. The circled letters provide a new instance of another Jumble Puzzle. So the substructures of the words are merged together to form a new substructure. See Figure 4.10.

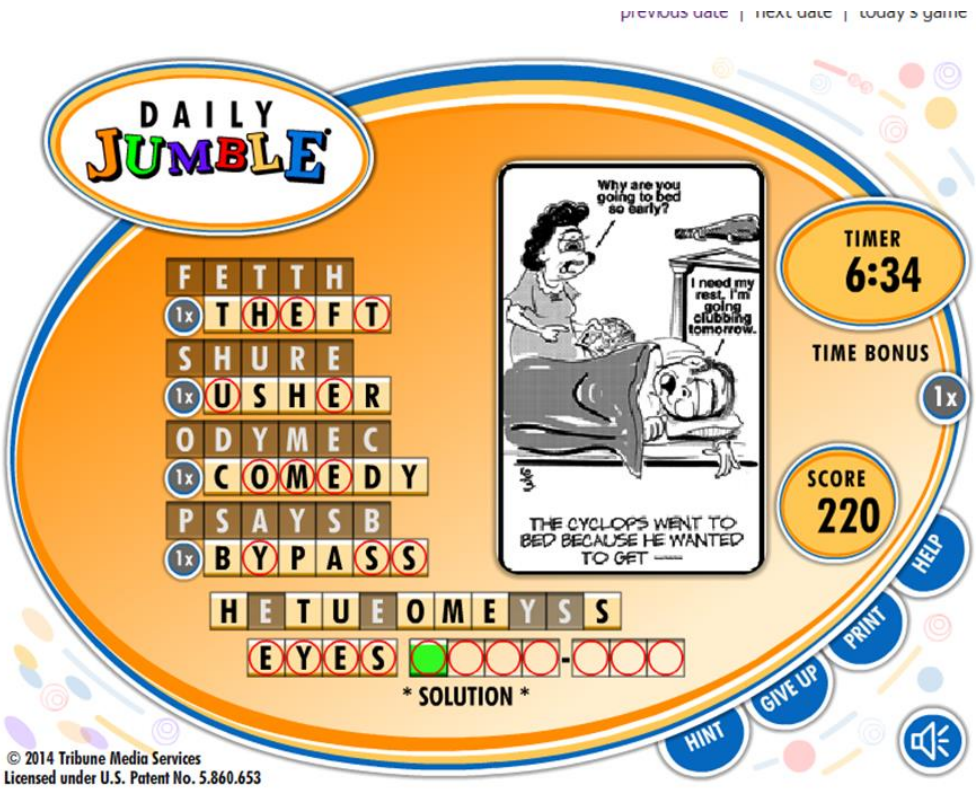


Figure 4.10. Jumble Puzzle in the process of trying to solve the puzzle. Once the word list is solved, some of the letters are encapsulated by red circles. Those letters arrange to form another level: the final phrase or solution at the bottom portion of the puzzle.

- Lengthening or shortening a given component

In the process of solving the Jumble puzzle, the initial strategy might be to begin using subset of the letters to form anything familiar. Sometimes the word does not solve the puzzle because it is short a letter, other times the word is too long and does not fulfill the requirements of the original configuration. These exercises in generalization help us to set up a relationship with the letters, get us invested in the words and possibly immersed in the puzzle¬.

- Adding new components or new levels of structure

Jumble consists of four jumbled words and all four words need to be solved in order to reach the next level. Although the words have no direct relationship to one another either metaphorically or semantically, they relate as far as they comprise that instance of a Jumble puzzle. Together they constitute a space or location to play in. See Figure 4.11 where key letters are presented for further rearrangement.

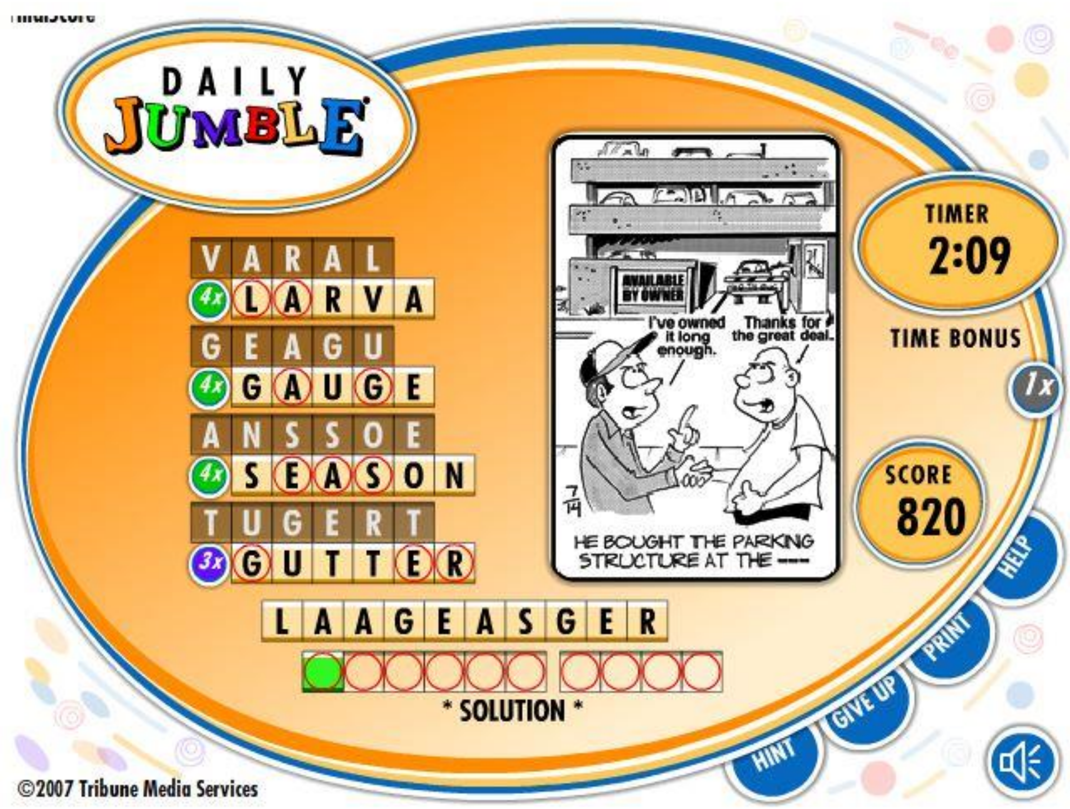


Figure 4.11. Jumble puzzle offers key letters in the list of words to solve a final phrase.

The circled letters combined together offer a new level of the puzzle by presenting a configuration to be solved as a phrase.

- Replacing one concept by a closely related one

The Jumble provides a comic with a clue to the final phrase.

The comic is the illustration of the final phrase so in essence if you can grasp the thinking behind the cartoon comic, you can see where the letters might be formed. See Figure 4.12.

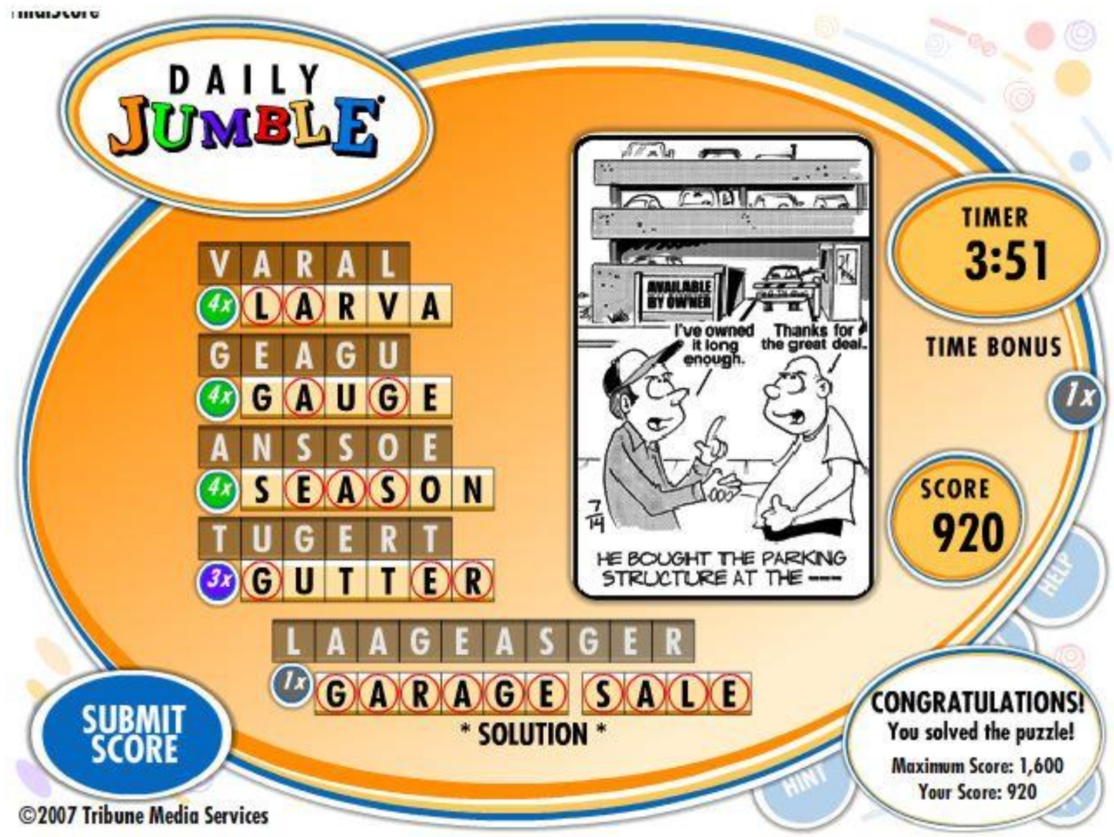


Figure 4.12. Jumble puzzle's final solution solves a riddle presented by the cartoon visual.

- Trying out the effect of reversals on various conceptual levels

The cartoon focusses on a Cyclops both in the drawing and in the topic of discussion. As a clue, we begin to think about the distinguishing feature of a single eye. Consequently, the final phrase is relevant to an eye and sleeping. The solution or configuration indeed contained the word EYES so it was a good start to the finish of the puzzle. See Figure 4.10.

The uncovering and discovering process is very similar to navigating virtual environments. The process goes beyond the fundamental components be they letters or colors or shapes. The fundamental components begin to relate to one another on a variety of levels and generalizations are made back and forth so that ideas are continually swapping between familiarity and unfamiliarity, action and reaction.

The generalizations will use the examples of virtual environments that I have created and provide some illustrations to clarify the phenomena.

- Moving internal boundaries back and forth

In the Jumble, we can establish letters as having a relationship whether they are in sequence in not. Eventually, we can put them into sequence and make sense out of them and use them to navigate further in the puzzle towards the solution. In virtual environments, we can think of how being immersed in a graphical world offers representations of objects in our field of view without presenting actual tangible objects. This is similar to being presented letters without the final words. The letters are pointers to the words and the 3D objects are pointers to the virtual worlds. We build relationships between the objects and create a semblance of the virtual world. Although the objects or their configuration looks unfamiliar we begin to construct relationships between the objects and establish a world. VR artists can exploit this by allowing visitors to stand in spaces that they may have difficulty otherwise doing, such as medical arenas, fighter plane cockpits, cultural heritage sites, and in the case of visual art, enter the theater of an unfamiliar virtual reality space. See Figure 4.13.

Figure 4.13. “*Figuratively Speaking*” M. Dolinsky 2012. Virtual Environment Still. VR offers the ability to swap boundaries from reality to virtuality and to see unfamiliar objects as environments. This can be exploited even further when the visitor can see the virtual world from various vantage points that are easily traveled compared to the real world.

Moving internal boundaries can also be represented by the choices of directions that are presented for travel. Blue Window Pane II’s ‘Stairwell room’ offers a height vantage point in the environment that allows you to move along a spiral staircase. And if you jump off the staircase it enables you to fly. See Figure 4.14.

Figure 4.14. "*Blue Window Pane II*" M. Dolinsky 1999. Virtual Environment Still. Here the 'Stairwell scene' is made up of staring emotables and stairwells. The visitor can follow the spiral stairwell or jump off the stairs which enables flying. We can move internal boundaries from one method of travel to an alternate method of travel.

- Swapping components or shifting substructures from one level to another

In the virtual environment Beat Box, many audio sequencers populate the environment. The predominant feature of the sequencers is that they appear as a row of faces. The visitor toggles through sound selections to position the audio selection at the "mouth" of a face in the form of an instrument. When the audio is determined, it paired to a face and an instrument appears in front of the face so that it in effect plays the instrument at the appropriate interval. The visitor shifts the audio from a selection of choices to an interval in the audio sequencer where it plays a role in a created melody. See Figure 4.15.

Figure 4.15. “*Beat Box*” M. Dolinsky 2004. Photo. Here a CAVE visitor is placing sound selections represented by necklaces on an interval of the audio sequencer, represented by an emotable.

- Merging two substructures into one or breaking one substructure into two;

In the Jumble we saw how many of the letters contributed to different levels of the puzzle. In Beat Box, there are three audio sequencers which can be played individually or heard in unison. The sequencers control different components of the melody such as rhythm, bass and ambient sounds. A free form percussion section is played in the moment and does not set up sequences with intervals. All these substructures can be combined in many ways.

In the virtual environment, Blue Window Pane II, the window appears as single pane of glass. When approached closely as if to see beyond the room, the window slides away to expose a wall of colorful bricks. These rows begin to recede one at a time and form a stairwell out of the main room. However, the wall is impenetrable; the stairwell can only be witnessed. It represents the possibilities in your mind for continuing in different directions. You may not be able to always move forward at that moment, but you can always imagine possibilities.

- Lengthening or shortening a given component;

The lengthening or shortening of a component translates visually in terms of how to set the fundamental properties of arts such as shape, color, texture, size and so on.

Beat Box, when it is the appropriate interval for a sound to be heard, the head of an emotable swells up and the instrument elongates and the mouth appears to meet the instrument and sound out the appropriate audio. The animation of size and shape forms a fluidity of function that appears to be an active playing of music.

- Adding new components or new levels of structure

Icon on the wall swells open to become a passageway to an inner sanctum. The icon appears religious and is made of layers of faces that appear as veils. When the icon becomes life size it becomes a door way. As you enter into its hallway, the veils become doorways that slide to the left or to the right and allow you to pass further into the inner sanctum. Inside you are confronted with another face that represents your inner psyche.

• Replacing one concept by a closely related one

Figure 4.16. "*Blue Window Pane II*" M. Dolinsky 1999. Virtual Environment Still. The '*Living Room*' has the emotables watching a projection screen with different frequencies selected by pressing a navigation button that corresponds to a small head below the screen.

A perfect trope for virtual environments is to relate an object in the virtuality with an object that is familiar. The one to one correspondence does not have to be completely obvious, but the subtlety can enhance the environment by anchoring it in relation to the real world. For example, when the navigator is given a wand with buttons that seem to have no function except when in a particular scene. That scene is the 'Living Room' in "Blue Window Pane II". See Figure 4.16. We see the emotables are sitting on a type of couch (left side of image) looking at a type of projection screen (right side of the image). The screen appears as if it has static displayed on it. Below the screen are three small heads that represent the channels. The three buttons on the navigation wand correspond to the three heads. By pressing one button a head is activated and changes the projection on the screen. In effect, depending on which head is chosen, that is the view afforded. It is a metaphor for getting into a particular head space.

- Trying out the effect of reversals on various conceptual levels

When navigating backwards up a ramp in "Dream Grrrls," it provides the visitor a method of viewing a scene in reverse – instead of approaching the bottom of the ramp, the visitor ascends and sees the same view but with a sense of levitating, as if playing a memory in reverse. The heightened physical sense of place in space advances alongside the memory of the recalled experience and strengthens the location and repeats its viewing of it.

“Dream Grrrls” also has in the ‘Stairwell Scene’ a variety of music that can be changed to other tunes. By choosing a stairway the music will change according to the location. All the emotables or characters are audio activated to the new sounds in the environment. Each set of emotables represents a different clique or culture and has a dedicated musical preference. Each emotables’ shape and gyrations change according to the frequency and loudness of the sounds. The emotables adapt culturally depending on which music is playing because each audio selection distinguishes a social milieu that is chosen for their orientation and visual integration.

When we are extrapolating a concept into a new direction, it involves using generalizations to reconfigure an idea. The strategy involves a seeking modality that establishes where a theory is and in what directions it might evolve. Hofstadter refers to this as the 'Seek-Whence' domain of conceptual thought where we are 'Seeking Whence' or 'Finding Whither.' He writes,

"...there is a very different reason for wishing to generalize theories in the Seek-Whence domain -- namely, the fact that *coming up with interesting new sequences* is an important type of goal in itself, a goal that is of course on a completely different level from that of solving extrapolation puzzles. After you have sought whence a given sequence comes, a new and higher level of activity can occupy you - namely, *finding whither* your sequence leads you." (Hofstadter 1995:78)

Upon reading Hofstadter, initially a question occurred: can the features of generalization provide a basis for considering a rubric for describing visual strategies in VEs? In VEs, it is possible to draw a comparison between virtual worlds and real world occurrences. However, the discussion becomes esoteric very quickly. It must consider how the visitor is cognitively progressing through virtuality and how the elements with the world shape the visitor's actions and perceptions. The virtual world's visual design relies on visual elements as categorized by Arnheim—balance, shape, form, growth, space, light, color, movement, dynamics and expression. Examining these elements alongside the dynamics of generalizations could be a combinatory strategy for discussing how art can shape a VE, which in turn shapes experience. These fundamental visual elements are manipulated artistically for purposes of design, development and discussion during the realization of a VE. During the design phase, it might be compelling to consider how an environment would take one of the visual elements, infuse it with one of the concepts of generalization and to exploit it for computer graphics purposes. For example, a shape could move its boundaries back and forth, either through scaling, moving its position or morphing its form. This would situate the shape in the environment and then develop an understanding of the shape as it takes on a uniqueness or personality through its internality being modified. The internality here would be defined as an aesthetic approach or embedded characteristic concept that is intrinsic to the object. The internality would determine the objects shape and purpose within the environment.

In order to understand cognition in a computer environment for art, the research examined how a cognitive scientist uses a computer calculator for the basis of his descriptions of cognition. Hofstadter devises simplified computer programs to model what is in effect artificial intelligence. Like Hofstadter the research is seeking to uncover the features of cognition in the most simplified terms by creating programs that investigate experience. Cognition is such a complex phenomenon that no one pithy slogan like 'Finding Whither" can characterize its mechanisms. Moreover, Hofstadter's lab considers the following list the most important themes in the study of cognition for modeling mental processes:

- The *inseparability of perception and high-level cognition*, leading to the idea of a perceptual architecture being at the heart of cognition
- The fruits of high-level perception being *easily reconfigurable multi-level cognitive representations* held loosely together by bonds of different types and different strengths
- The idea of *subcognitive pressures* – namely, that the more "important" a concept or a representation is, the greater an influence it should be allowed exert, in a probabilistic sense, on the direction of the processing
- The *commingling of many pressures*, both context-dependent and context-independent, leading to a nondeterministic parallel architecture in which bottom-up and top-down processing co-exist gracefully

- The *simultaneous feeling-out of many potential pathways* at differential rates governed by quickly-made estimates of degree of promise

- The *centrality of the making of analogies and variations* on a theme in high-level cognition

- The possession, by cognitive representations, *of deeper and shallower aspects*, with the former remaining relatively immune to contextual pressures, and the latter being more likely to yield under pressure (to “slip”)

- The crucial role played by *the inner structure of concepts and conceptual neighborhoods* in all these goals, particularly context-dependent conceptual overlap and proximity, and context-independent conceptual depth

These themes begin to describe the very complexity of understanding how our perception and cognition is embodied. An argument could be made that virtual environments can document how an artist is feeling or thinking by the experiences that are created for the visitor to negotiate. The artist must create a path for traveling through a virtual environment. The artist must construct a methodology to validate and establish relationships between the visitor and the virtual world. The artist can facilitate that travel of negotiation and interpretation by setting up various vantage points. The creation of objects as metaphors for ideas the artist allows a unique philosophy to come into view.

This viewpoint or vantage point is not a given. It must be constructed by the artist to provide meaning to the experience. The visitor is held in a space of seeing and in an act of active creative engagement. The visitor realizes the artwork through their thinking and feeling. As a result, there is no one definitive meaning that results from the engagement (Burnett 2005:13). The visitor must meet the artwork by facing the challenge of a new situation: they have to orient themselves and they have to find a structure that will lead the mind to the artwork. This meeting point between the visitor and the virtual environment occurs when the visitors situates themselves in the display theater, constructs a system of recognition, integrates their own analogies into the visual imagery and establishes a consequential connection. The result is that the visitor integrates their personal experience into a meaningful virtual environment experience.

4.3.4.0 **Dewey: art as experience**

The perceptual processes are inseparable from other cognitive processes (Chalmers, French et al. 1992:185-211). Experience is the collaboration of personal interaction -the self- with the environment and the changes that occur during this exchange. There are times when this exchange leads to a sense of fulfillment and there is a dynamic flow of intellectual and emotional responses which evokes an aesthetic experience. Art is the experience of gradually –both intellectually and subjectively– coming to meaningful terms with and reaching a decisive conclusion from an interchange with artist, material, form and visitor. Referring to the aesthetic experience, philosopher John Dewey writes, "Art is an immediate realization of intent" (Dewey 1934:89) and

> "The conception implied in the treatment of aesthetic experience ... is, indeed, that the work of art has a unique quality, but that it is that of clarifying and concentrating meanings contained in scattered and weakened ways in the material of other experiences." (Dewey 1934:87)

4.3.5.0 **Processing perception as experience**

Cognition includes perception as a mental operation. It is part of the receiving, storing and processing of information whether it be sensory, memory, thinking or learning (Arnheim 1969:13). Perception goes beyond what is merely being received by the senses because we can look at visual imagery with our eyes open, closed and dreaming. We sense things through a visceral reaction and can act based on intuition or a hunch. This type of knowing and intuitive sensing is critical for navigating in virtual environments. The visitor relies on their perception of the environment and determines the next choice or direction, "…it makes no difference whether cognitive processes are carried out consciously or unconsciously, voluntarily or automatically, by the higher brain centers or by mere reflexes (Arnheim 1969:16).

In an investigation specific to the arts, Arnheim describes the basic principles of visual perception as balance, shape, form, growth, space, light, color, movement, dynamics and expression (Arnheim 1974). He demonstrated his principles using works of art, but he made it clear that these elements apply to all visual experiences -

from 2D painted images to exploring within graphical environments (Munsterberg 2009:19).

4.3.6.0 **Processing composition in aesthetic experience**

Gestalt psychologists in the late 19th and early 20th centuries researched the properties of visual perception in order to understand how the mind perceived visual information. Perception and cognitive processes work in tandem. The composition is the first recognition of an artwork before its meaning takes on something else:

> "When the eyes meet a particular picture for the first time, they are faced with the challenge of the new situation: they have to orient themselves, they have to find a structure that will lead the mind to the picture's meaning. If the picture is representational, the first task is to understand the subject matter. But the subject matter is dependent on the form, the arrangement of the shapes and colors, which appears in its pure state in "abstract," non-mimetic works (Arnheim 1982:71)."

To further understand composition in terms of color integration during aesthetic moments, the research looks at how patterns occur during color recognition both visually and photographically. These visual phenomena help to establish further the idea of concept building through aesthetics. Moreover, they illustrate instances of shifts in perception, which is what art ideally promotes. A brief example of each phenomenon found in photography and in color theory is illustrated below.

4.3.7.0 **Color Shifts**

Color takes on various appearances depending on its surroundings. In Figure 4.17, the word ‘COLOR’ in all three instances is the same color but it loses its visual uniformity as it moves onto another background. Likewise, Figure 4.18 appears to contain four colors whereas in fact it only contains three. In the four squares in Figure 4.19, the colors in each palette are the same but they appear differently depending on the background. Colors are a product of retinal/neural functioning and subjective interpretation. This is why colors and their properties are so important to the aesthetic moment; they are a direct experience of perceptual, cognitive and subjective interpretation working in tandem.

Figure 4.17. "COLOR" in all three instances is the same color but it loses visual uniformity with different backgrounds.

Figure 4.18. The image contains hues that appear as multiple shades.

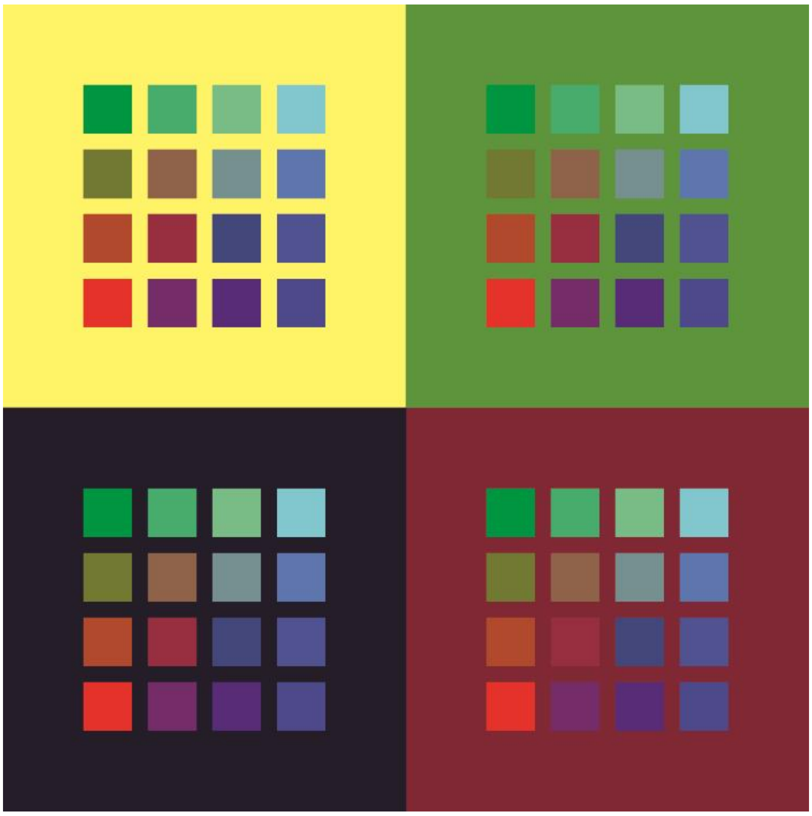


Figure 4.19. The color squares are the same in all images, yet their appearance is altered by the background color. This provides four different types of interpretation of the original squares.

4.3.8.0 **Color Shifts in nature**

Nature provides patterns, colors, and textures that are intrinsic to identify the balance, shape, and expression of our environment. By looking at how nature shapes its objects, the VE can use similar analogies to shape its landscape and establish a sense of presence for its inhabitants. Animals are able to disguise their location by blending in with their surroundings. Art Wolfe's book "Vanishing Act" (2005) artistically presents the phenomenon of animal mimicry in nature. Figure 4.20 is a photograph of the Von Hohnel chameleon on a tree in Kenya, Africa. Figure 4.21 is another Wolfe photograph of a giraffe standing among the trees. These photographs illustrate fluidity of appearance, variable discernments and the interpretations that an appearance or positions offer. The world appears malleable, primed for discovery, investigation and participation.

Figure 4.20. Von Hohnel chameleon on a tree in Kenya. Photograph: Art Wolfe.

Aesthetics promotes awareness in nature through form, shape and color. In VEs, objects take on multiple roles while they construct the environment. They blend in and work together and when they are approached, they show their individual strengths, much like an animal confronted in the wild. They recognize, blend in and react in confrontation with their surroundings.

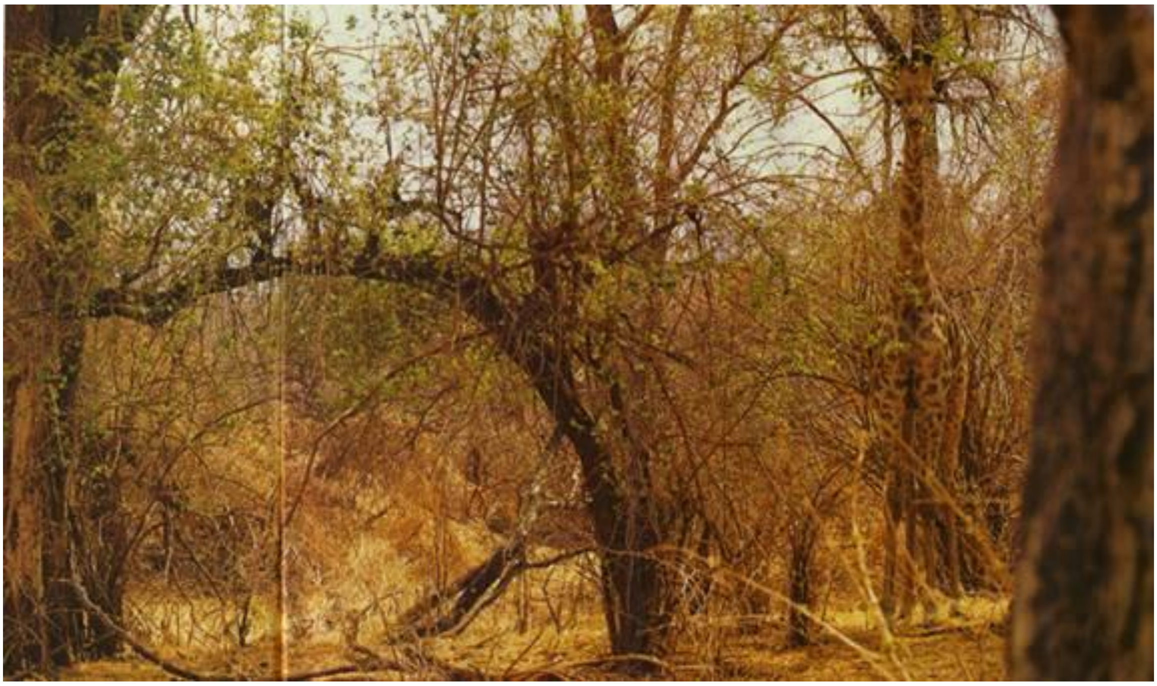


Figure 4.21 A giraffe standing among the trees in Kenya, Africa. Photography: Art Wolfe.

4.3.9.0 **Color Reception**

Hues can be discriminated in both color patterns and photographs but it is the proximities and shading variations of the hues that cause objects to appear as hidden or moving objects. Moreover, to varying degrees, the aesthetic effect may increase for some people with the color patterns or for the animals hidden in the photographs. Changes in color appearance, light intensity and object position depend on the visual and neural system. In another example, an image of uniform grey stripes appears to produce a line where two grey colors meet (Figure 4.22). There appears to be a lighter color to the right of a line and a darker color to the left. It does help to squint to see the light and dark bands that appear along the lines of the color change. These Mach Bands, named after physicist Ernest Mach, are due to receptive fields that control the neural activity of excitatory and inhibitory synapses. What interests me most is that when the lines are close together, banding causes parts of the image to appear to be curved inward and/or moving or vibrating. This is called the fluting effect, named after the fluting shapes of columns in ancient architecture.

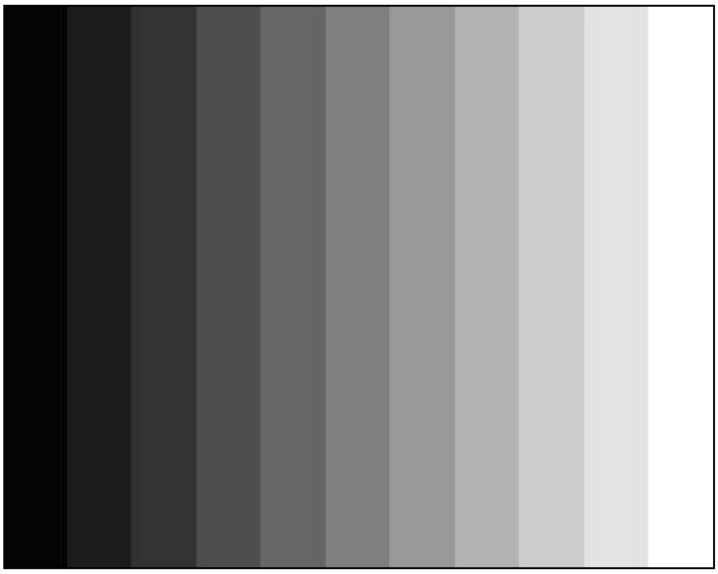


Figure 4.22. These Mach Bands illustrate how lines emerge within color stripes. There appears to be a darker color to the left of a line and a lighter color to the right. When the lines are close together, banding causes parts of the image to appear to be curved inward or to be moving or vibrating.

Figure 4.23 illustrates the phenomenon of lines appearing to rise upward and to fall downward as if creating the illusion of a topographical map or landscape. See also “Enigma” (Figure 4.24) by French painter Isia Leviant where the Mach Bands are configured concentrically and the resultant blue circles appear to turn.

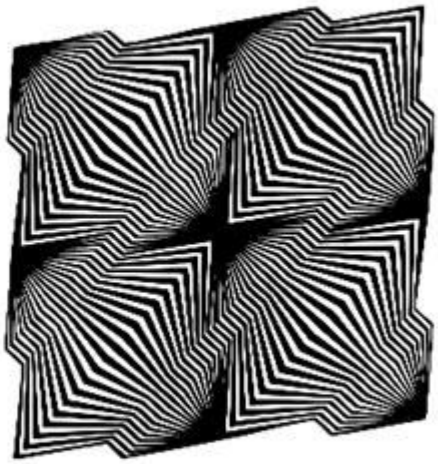


Figure 4.23. An example of the Mach Bands effect that causes the black lines to appear to rise and fall as if creating the illusion of a topographical landscape.

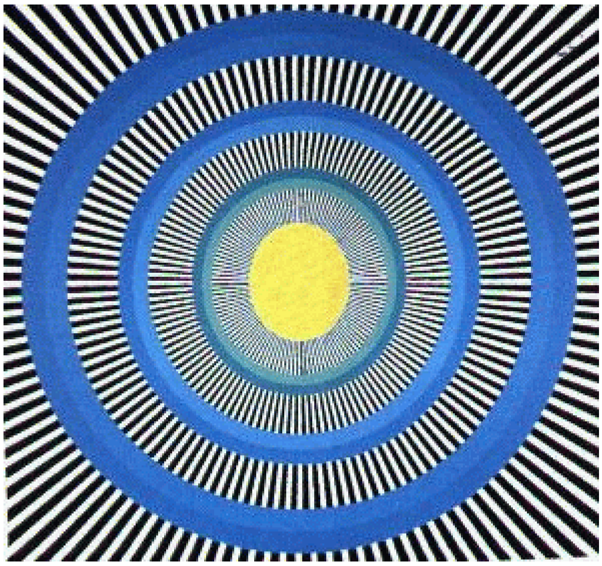


Figure 4.24. "*Enigma*" by French painter Isia Leviant – where the Mach Bands effect causes the blue circles to appear to turn.

4.3.10.0 **Illusions through inattentional blindness**

All manners of changes occur in our visual field throughout the day but we have been acclimated to acquire an inattentional blindness (Mack 2003:179-85). For example, when looking at a crumpled piece of paper that is laid flat, its folds create areas of advancing lights with receding shadows that create a quasi landscape of image possibilities. If bright light is introduced, the paper's appearance is altered, hiding the quasi landscape by changing the perception of the embedded shapes. However, in our day-to-day activities, these changes of light and shadow and the subtleties that occur from this phenomenon may be lost to other seemingly more important life circumstances. This type of inattentional blindness occurs with blatant stimuli as well shown by the famous 'gorilla in our midst' experiment by Simons and Chabris (1999). Subjects were asked to watch videos and count the number of basketball passes between two groups of people wearing black and white t-shirts or simply to report if anything unusual was seen. A person in a gorilla suit walking among the players went unnoticed in the video by 50% of the groups, despite what they were asked to report.

VE art changes in real time and provokes illusions in order to promote engagement and cultivate the sense of immersion. With the awareness of these extra-marginal moments, could the VE experience be designed for exploiting a heightened aesthetic effect? As an artist, could the most compelling effect of the VE be the fact that its navigation can be delineated via shifts in awareness, shifts in perception? By looking for changes in surfaces, how shapes and shadows are moving, and the effect of lines juxtaposed against one another, elements of the imagery may reveal themselves and then disappear.

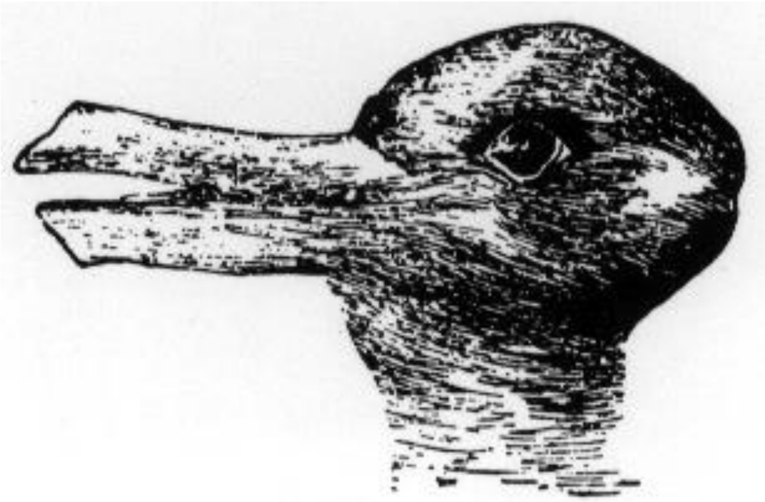


Figure 4.25. Duck-Rabbit Illusion.

Often, the view presents itself with a dual type of interpretation that depends on recognition. An instance of this circumstance occurs with 2D images such as the duck/rabbit phenomenon (Figure 4.25). Both a duck and a rabbit are depicted simultaneously but only one can be discerned at a time. Recognition depends on attending to the dual imagery in the drawing. The active cognition of each image intermittently also possesses a type of movement or vibration. Many of MC Escher's drawings illustrate this as well.

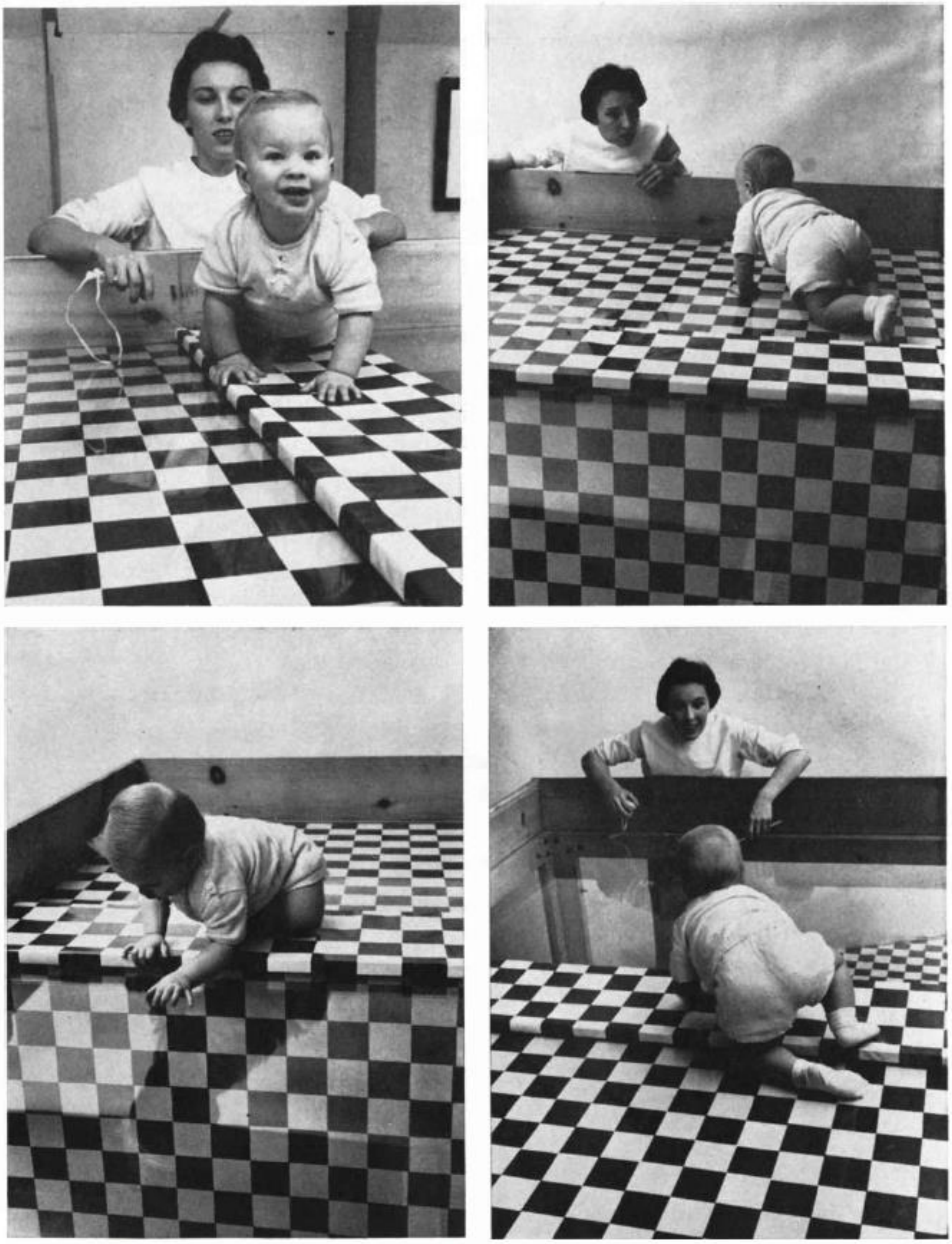
Signs are indicators and have multiple meanings. The following sign read quickly is easily understood:

Figure 4.26. An example of a sign that incorporates the phenomena of inattentional blindness. These phenomena point to the power of assumptions and our ability to take knowledge for granted rather than explore the reality of a situation.

However, reading the graphic more carefully in Figure 4.26 it reveals a different interpretation. Words become so familiar that when we read quickly we do not register a second instance of word 'the'. This inattentional blindness results from a distracted or presumptive attitude. Art has the ability to illustrate these types of perceptual shifts and VE has the ability to cultivate their discovery. Design for VE art may require an extra level of attention in order to guide visitor navigation and engineer experiential phenomena while acknowledging the existence of multiple pathways for multiple viewpoints.

4.3.11.0 **Illusion through virtual version of a stimulus**

This type of awareness of changes in visual phenomenon is critical to this research because the VE experience affects the visitor on a perceptual and psychological level. While it would be difficult to measure the perceptual and psychological effects of an artwork, it has been shown that VEs produce very real effects. Indeed both human and animal subjects will respond to a virtual version of a stimulus as if they are responding to the actual version. This has been demonstrated by Gibson and Walk's famous visual cliff experiment (Gibson, Walk 1960). Here a cliff is simulated by placing a sheet of glass one foot from the floor. A board dissects the glass and creates a cliff position (Figure 4.27). One side of the glass is covered with a checkerboard pattern. The other side of the glass is clear with the checkerboard pattern continuing under the board, perpendicular to it, and extending below the glass on the actual floor. The pattern creates the appearance of a cliff but the glass prevents the cliff from actually existing. Babies and animals that are placed on the board are reluctant to cross to the clear side of the glass, even when touching the clear solid glass and with encouragement from their mothers. As a result, the ability to be mobile causes depth perception to override physical knowledge. See Figure 4.27 for an illustration of the visual cliff.



CHILD'S DEPTH PERCEPTION is tested on the visual cliff. The apparatus consists of a board laid across a sheet of heavy glass, with a patterned material directly beneath the glass on one side and several feet below it on the other. Placed on the center board (*top left*), the child crawls to its mother across the "shallow" side (*top right*). Called from the "deep" side, he pats the glass (*bottom left*), but despite this tactual evidence that the "cliff" is in fact a solid surface he refuses to cross over to the mother (*bottom right*).

Figure 4.27. The visual cliff experiment by Gibson and Walk demonstrates that mobile infants and animals will recognize a virtual stimulus as an actual cliff and avoid a clear glass floor despite touching the glass and knowing it is solid and a mother's encouragement to cross the glass.

A related experiment was done in a VE by constructing computer graphics to simulate a ledge surrounding what appears to be a room sunken by twenty feet. The graphical sunken room or pit was projected onto scaffolding built with an actual ledge that surrounds a short drop (one and one half inches) to the actual floor. The head mounted display caused the visitor to perceive the floor to be significantly lower than its actual position. Visitors were tested for physiological changes during their viewing experience and given questionnaires. The responses were significant enough to conclude that the cliff, although physically very small, produced enough visual stimuli to establish a sense of presence or immersion in the VE. Visitors experienced physiologically and reported the same perceptions as if they were standing at a traditional cliff or in a corresponding real world space. (Meehan, Insko et al. 2002)

Perhaps more shocking are experiments that simulate body parts such as those involving phantom limbs - the sensation of an amputated limb remaining attached and moving in cooperation with other body parts. Ramachandran has done extensive research into phantom limbs and has demonstrated that the virtual simulation of the missing body part can rewire the brain to perceive that the amputated limb continues to be present and functioning normally (Ramachandran, Hirstein 1998). In an experiment with an amputee, a mirror reflected the healthy hand in position of what was the amputated hand. By moving the healthy hand, the pain from the amputated hand was relieved and the sensations began to mimic those of having a healthy hand. The patient reported the amputated hand to be perceived as healthy with five fingers operating normally when the patient was born originally with a deformed hand and missing fingers. It has remarkable implications for how the brain constructs a "body image."

Dr. Mel Slater's lab has experimented with VEs and body issues, most notably issues surrounding presence, including phobias, weight perception and phantom limb perception (eventLAB 2011). Kilteni reports that participants using a head mounted display saw a virtual body that coincided with the location of their actual body and felt visual and motor congruence with simulated but distorted body parts (Kilteni, Normand et al. 2012). For example, in one experiment the real arm held textured fabric while the virtual body had one very long arm holding a similar looking fabric. Participants reported that the virtual arm, even up to four times longer than their real arm felt as if it were the person's own arm. This extended arm also affected the perception of body size and consequently the peripersonal space. The peripersonal space is the perceived space surrounding our body that is deemed intimately personal. Depending on the context, anything that enters the peripersonal space is perceived as an act of intimacy or as a threat.

4.3.12.0 **Visual illusions in virtual environments**

In the VE, the effects of visual illusions are dynamic - updating in real time- the objects within the environment are subject to constant change. The color, texture, size, arrangement and placement of an object depend on a frame-by-frame update. The visitor's world can change as dynamically as the real world around him can change. There is no frozen moment for aesthetic consideration. The world is not limited to a set point of view and the visitor's concentration cannot be fixed. The artist must help visitors to navigate the world as they assimilate the design and experiments with the possibilities of the world. In an environment where the key to interaction is the ease of the experience, it becomes important to understand how visual aesthetics are being discussed within a more contemporary context of new media and more specifically to develop an understanding for artistic 3D interactions.

4.4.0.0 **Interfaces and virtual environments**

This section will discuss creative approaches to new media art and aesthetics for virtual environments, and their use in science, humanities and the arts.

4.4.1.0 **Elements for creating virtual environments**

One of my objectives is that meaning has to arise from a sustained sense of immersion. When I think of my painting, it allows the eye to wander across its surface and jump from image object to image object until a translation is reached to form the whole - an idea that the art manifests through paint on canvas, color in suspension, and direction or flow of time. The frozen moment in time that comprises my paintings are usurped in time based media. Rather than controlling the single frame of a painting, I expand to control the viewpoint. Some of the concerns for me as a new media artist include those listed by artist and critic Margot Lovejoy: mise-en-scene, context, metaphoric associations, movement, sound, acting, viewer integration, breaking open old boundaries, constructing work where there are pathways, nodes, links, networks and connecting loops between visual, sonic, textual and graphical elements (Lovejoy 1996). As I am creating a theater for the visitor, I am concerned with personal histories and mythologies as well as the psychological effects of the context that I am presenting.

Virtual environments are interactive theater spaces, gone is the WIMP - Windows Icons Menus Pointing (Van Dam 1997). There are no formal structures for interactions. There are no drop-down menus or icons to click on. The visitor becomes an integral part of an immersive virtual environment. Thus the environment must lead the visitor and in turn, the visitor must lead him or herself.

VEs require a type of multi-modal interaction that includes interface, content, environment, performance, perception, and plasticity (Gigliotti 1995:289-95). These components work in unison, often overlapping their functions.

The interface unites hardware, software and the visitor in a common space for action and reaction. My primary sense was that scientists were creating CAVE applications for evaluating action based on application goals rather than on screen displays. My goal became decidedly artistic in that the VE experience should have a dynamic structure in which the visitor navigates with a variety of choices, experiences and interactions for enjoyment, exploration, decision-making and learning.

The artistic content of my virtual environments is based on imagery and experiences that I have experienced while drawing that is similar to a dream-state. Fueled by this connection with the unconscious, the interaction in my virtual environments is often indulgent, whimsical, and self-reflective. The VEs introduce the visitors to the computer in an environment where s/he will confront imagery, tasks and kinesthetic sensations in order to learn to meet new challenges.

The Environment or physical space will have familiar qualities in unfamiliar settings. For example, the visitors may navigate through a space to find brightly colored glass vessels to explore. The most engaged or adventurous explorers will interact with these objects and find themselves thrown into other challenging worlds. The visitor's role becomes very important in accepting the challenge to discover objects, paths, navigational strategies and the computer's responses.

Perception will guide the visitors to follow the line of sight through the stereoscopic tracking glasses. The glasses and navigation wand allow interaction with objects and create a virtual sense of movement through the space. The computer provides "clues" with sight and sound.

The Performance is based on the visitors' action and reaction with the computer and the ability to suspend disbelief. VR artist Brenda Laurel emphasizes action in her book, *Computers as Theater.* (Laurel 2013:29) She writes that a rudimentary measure of a visitor's performance is that they simply feel the ongoing action or they don't:

> "successful orchestration of the variable so frequency, range and significance can help to create this feeling, but I can also arise from other sources – for instance, sensory immersion and the tight coupling of kinesthetic input and visual response."

In order to optimize the performance, objects represent and lead to other scenes rather than presenting one world in its entirety. The program contains a set of multiple drawing functions that are executed depending on position. The visuals become critical to achieve a smooth and unified experience.

The Plasticity of the artwork is represented in its malleability or the ability to give back and forth between the visitor and the artwork. Visual design is not to be underestimated. It is an indispensable aspect, representing and providing tasks. The design must consider structure, graphics, sound, and tactile and kinesthetic effects. This provides sensory, cognitive, and emotional stimulation that shapes actions.

Each visual element within the VE represents a moment of experience—a door, a stairway, an object at the end of a long tunnel—that requires further investigation. The role of the artist is to establish the possibility for narrative by transforming the structure and architecture of the space into a series of projected metaphors that guide the participant. The environment is a navigational structure of visual elements that indicate the possibilities for interaction and, in turn, guide the overall experience.

Artists work with new creative forms such as the CAVE because it helps them build their artistic language. Like reading lyrics and singing them, each process informs the other. 3D modeling informs the CAVE space that then informs the human experiential space, which in turn fuels the imagery of the paintings/creating marks. Each stage in the process informs the entire process. The challenge is that virtual reality needs to be developed as a perceptual medium, partly because it is the first redefinition of perspective since the Renaissance (Sandin 2001).

4.4.2.0 **Recognition of other artists' works**

Fields using virtual environments include science, math, arts, education, humanities and data visualization. A short survey is included in Chapter Two of this research. Examining the field of virtual environments for art, many artists have taken to interpreting the philosophies and mythologies of our histories through their work (Fleishmann, Strauss, Hegedus, Bizri). Others have explored narrative storytelling and folk tales (Morie, Tsoupikova, Anstey). Others explore their medical situations and psychological struggles (Addison, Gromala).

The instruments we choose to employ in our work and our lives suggests our desires, and points to our intentions. We only need to point to the work of Velasquez, Mondrian and Man Ray to understand that the instruments of painting and photography re-contextualize our interpretation of the world. The artist is attracted to the manner in which the medium re-interprets reality. In turn, the results of their artistic endeavors shape the way we perceive and construct our reality. In a comparison of tools and their purposes for various media, such as microscopes, telescopes, and Egyptian reliefs, we see that the tool has a specific purpose. The tools such as cameras, lenses, tripods, filters, film, flashguns and lights have a specific purpose to register and reproduce reality to afford a perspective consistency, a tonal fidelity and an acuity of detail if only to capture a single aesthetic moment.

4.4.3.0 **Visual elements and affordances of virtual environments**

In order to understand all of the various consideration for developing virtual environment art, I began to list the elements that impact decision making during the creative process and what impacts hardware and software have on the methodology. The following is a list of some of the tools used in virtual environments and the visual elements that they enable (Figure 4.28):

Tools for Virtual environments	Purpose
Stereo screen and projectors	Visual display of stereo viewing and determination of display resolution
Head tracker	Monitors head position and viewing perspective
Hand tracker	Monitors hand position and rotation
Joystick on the wand	Navigation using pressure sensitive joystick
Buttons on the wand	Directs event input for triggering events
Interaction software	Create bounding areas for triggers, set delays and timers
3D modeling software	Create models that will define the environment
Interaction engines	Places models in space and locates sound and events
Paint programs	Allows appearance of models to be uniquely modified for viewing
Sound and audio programs	Enhance immersion through a sound atmosphere, enhance path finding through aural directions, queues and updates, mise-en-scene
Tools for virtual environments	Visual elements/Perceptual and cognitive awareness
Stereo screen and projectors	Simulates normal stereo viewing to enhance dimensionality of environment, full color immersion
Head tracker	First person perspective, trigger for events 3D viewing allows visitor to look above, under and around objects, environment responds in real time to the visitor's movements as if to simulate "being there"

Hand tracker	First person navigation, trigger for events Allows the use of menus, objects such as guns, and picking up and placing objects in various locations, changing sound and audio controls, triggering events, playing musical instruments, environment responds in real time to the visitor's movements as if to simulate "being there"
Joystick on the wand	First person control of direction and speed of travel
Buttons on the wand	First person control to trigger events and button presses in environment, this can be tightly coupled to the objects in the scene
Interaction software	Allows the visitor to have a purpose, their presence changes the environment and allows it to respond to their input
3D modeling software	Allows the environment to be created, to set the stage, mise-en-scene
Interaction engines	Creates a world to explore in real time and positions events
Paint programs	Creates a visual atmosphere for emotional investment Allows a wide variety of visual styles to be incorporated into the scene
Sound and audio programs	Creates an aural atmosphere for emotional investment Allows a wide variety of audio styles to be incorporated into the scene

Figure 4.28. Tools used in virtual environments and the visual elements.

The tools have a wide variety of technical properties for simulating experience in the virtual world. By exploiting these purposes and their perceptual results, the artist can create a scene and capture their visitor in the scene. The visitor can navigate with first person perspective and stereo viewing to turn their head to see the world from nearly any point of view. This medium allows for shifting perspectives and shifting light conditions as well as shifting objects in order to change the visitor's perception. These different shifts in scene, sound and objects can change the outcomes of events for visitors depending on which way they navigate through the environment.

4.5.0.0 **Situating the artistic practice in virtual environments**

4.5.1.0 **What is missing: how perception and cognition are ignited through navigation strategies**

In developing art for virtual environments, it is important to identify how the visitor is situated in the hardware, how the visitor will be immersed, and how interaction is created through strategies for navigation. In comparison to the desktop which has folders and icons to click on, virtual environments do not have a dedicated language for how they are read or how things function. Each virtual environment can have its own navigation strategy that is dependent on the contents of the world. For example, halls will constrain navigation in one direction and stairs can constrain navigation in another but they do not need to be incorporated into the virtual environment in order for the visitor to be able to move in a similar direction. There are multiple user interfaces such as CAVEs, HMDs, domes and 3D capable monitors. Each interface can be coupled with a variety of input devices for navigation such as a wand or a joystick or a head tracker. Environments can need the developer or related person to facilitate the navigation or the environment can have signposts with instructions, drop down menus with choices, or a character or voiceover that narrates the way (Bizri, Johnson et al. 1998, Anstey, Pape et al. 2000). Others artist navigate the environment with devices such as cameras, bicycles or breathing vests that constrain the navigation to a particular mode (Benayoun 2012b, Shaw 1989, Davies 2008a). If the virtual environment is to ignite the perception of the visitor and to encourage their agency in the immersion, the artwork itself must be an explanation or a bridge to understand it. In environments that I am creating, I am interested in promoting a sense of immersion by "being there" and having a perceptual shift occur, something extra-marginal and outside of ordinary events. The environment must be developed with its own language that is defined by the objects themselves coupled with the audio design.

4.5.2.0 **Art Practice**

Painting situates my practice. The philosophies and methodologies of such researchers as Hofstadter, Arnheim, and Gigliotti inform the investigation into my work by providing frameworks for thinking about visual analogies, visual perception, and aesthetics for virtual environments, respectively. Their sets of rules and intentions are uniquely suited for use in analyzing the organic development of my art.

The research runs counter to the new media approach that emanates from a film and animation or cinema culture. In the animation dialogue, drawings become animations and the visitor moves through the frames, each of which is dictated by the physical gestures of drawing. In film, the visuals are separated from the visitor's control. (Manovich 1997, Sorenson 2000, Sorenson 2011). None of these modes was satisfactory for the immersion I wanted to achieve. It became important to me that the organic quality of my artistic process be incorporated in the dissertation development and the subsequent research. It is in the unique evolution of the imagery from paintings that the virtual environment as an art form becomes the compelling stage for immersion. The dissertation is a fusion of painting and 3D computer graphics using a stream of consciousness method of creation with analogic reasoning and art fundamentals.

Carl Jung describes art, like any other activity deriving from psychic motives, as a psychological activity that can be approached from a psychological angle. (Jung 1966:65) He states: "The true symbol … should be understood as an expression of an intuitive idea that cannot yet be formulated in any other or better way." (Jung 1966:70) Jung describes two modes of artistic creation. (Jung 1966:72) The first is where the artist is entirely subordinated to the artistic process. He has a goal in mind and makes decisions back and forth in total involvement of a process which is mastered by conscious intentions.

The second mode of artistic creation described by Jung is work which flows more or less as complete, as if it forced itself upon the artist who watches with amazement. The artist, Jung states, is

> “forced to admit that it is his own self speaking, his own inner nature revealing itself and uttering things which he would never have entrusted to his tongue. He can only obey the apparently alien impulse within him and follow where it leads sensing that his work is greater than himself, and wields a power which is not his and which he cannot command. Here the artist is not identical with the process of creation; he is aware that he is subordinate to his work or stands outside it, as though he were a second person; or as though a person other than himself had fallen within the magic circle of an alien will (Jung 1966:72-73).”

Jung’s comments recalls the intuitive manner that artist Paul Klee executes his work which emphasizes the object growing in appearance through our exploration and in effect, gaining a knowledge of its inner being:

> “There is a non-optical way of intimate physical contact, earthbound, that reaches the eye of the artist from below, and there is the non-optical contact through the cosmic bond that descends from above.“ (Klee 1961:66)

Klee’s notebooks encourage intuitive exploration through drawing exercises in order to extend the intuitive act into a spiritual process:

> “Something has been made visible which could not have been perceived without the effort to make it visible. Yes, you might see something, but you would have no exact knowledge of it. But here we are entering the realm of art; here we must be very clear about the aim of ‘making-visible’. Are we merely

> noting things seen in order to remember them or are we also trying to reveal what is not visible? Once we know and feel this distinction, we have come to the fundamental point of artistic creation." (Klee 1961:454)

Klee's intuitive style is illustrated in the example of his painting on burlap "Mask of Fear" (1932). See Figure 4.29. The painting is considered to be Klee's attempt to bridge the psyche of primitive man and modern man. (Conrad 1999:149) The painting is reminiscent of a tribal mask that appears to have an antennae and an arrow pointing upwards from the top of the head. The face resembles an armored vehicle with two pairs of legs that are running for cover. There is a fragility to the head's eggshell demeanor.

Horizontal lines alternately dissect the painting and the face. Klee uses lines to denote gravitational forces and to emphasize the movement and relationships of objects to those forces. He uses arrows to denote the psychology of phenomenon:

> "I strike with the arrow, the observer is struck. The productive individual strikes "with the arrow, the

receptive individual is truck by the arrow."
Klee 1961:412)

Klee's work resonates for me and my work because his process links a type of representational and not completely abstract style with social commentary and the psychological awareness of our consciousness. In my own work I am trying to illustrate psychologically intimate moments.

Figure 4.29. "*Mask of Fear*" Paul Klee 1932. Painting on burlap depicting a mask-like face with two pairs of legs and an arrow pointing up from the top of the head.

In my own work, I begin by drawing lines without a specific intention. My hand directs the drawing implement as it creates marks. I respond to the marks as if it I were building a scaffolding. The marks become a drawing that brings a message in the form of an image closer to my world and this reality. The lines appear from seemingly nowhere to create shapes and then an object. The marking lines situate the image and delivers it as an object in relation to the page. As the object occupies the space, the wholeness of the lines become an entity which claims ownership of the page, finds itself at home and rests alive, in its aesthetic existence.

Cubism, a range of art produced in France during 1900-1930, also appeals to my aesthetic because its pioneers, Pablo Picasso and Georges Braque's became engrossed in the problem of how to represent the complexity of reality. (Apollinaire, Eimert 2012:29)They perceived reality as an amalgamation of knowledge –that objects are composed of multiple relationships and change their appearance according to the point of view that they are seen from. Moreover, they believed that the cubist object comprises both our thoughts and representations of the object as well as our feelings and sense impressions about the object. In effect, they were concerned with art as representation of the environment alongside the experience of understanding that environment. In order to depict this perception of reality, the pictorial space became shallow so that the object was represented from multiple viewpoints simultaneously which allowed the painter to move around an object and combine its various views. (Saunders 2014:133) Not only did the Cubists want to experience three dimensional reality in a new way, they wanted to reconcile the intellectual knowing with the intuitive experience and discover an art with a coherent psychological conception of life with all its paradox.

I admire all Cubist works, painting, collage and sculptural objects, particularly portraiture. An example from the Ukrainian-American artist Alexander Archipenko is "*Medrano II*" *(*1913-1914). See Figure 4.30. Archipenko's composition is created with iron, wood, glass and oilcloth. His use of color to distinguish the forms is particularly appealing to me. His goal is to emphasize the difference in material and to expand the boundary between painting and sculpture through the use of color.

Archipenko states that his painting and sculpture:

> "…represent a reciprocal connection between the form and colour. The one stresses or diminishes the other. They are unified or contrasted on the visual and spiritual plane."
> (Apollinaire, Eimert 2012:177)

His use of color with material is a powerful example of the shifts in perception that can occur between 2D and 3D space. He plays with the hollowness and convexity to master emptiness and human figuration. In my own work I am crossing the lines between painting and sculpture as I draw and paint and create 3D computer models from those images. I use bold colors in terms of the fundamentals of color theory in order to maximize an object's sense of presence and use color to create a subversive confrontation towards experiencing shifts in perception.

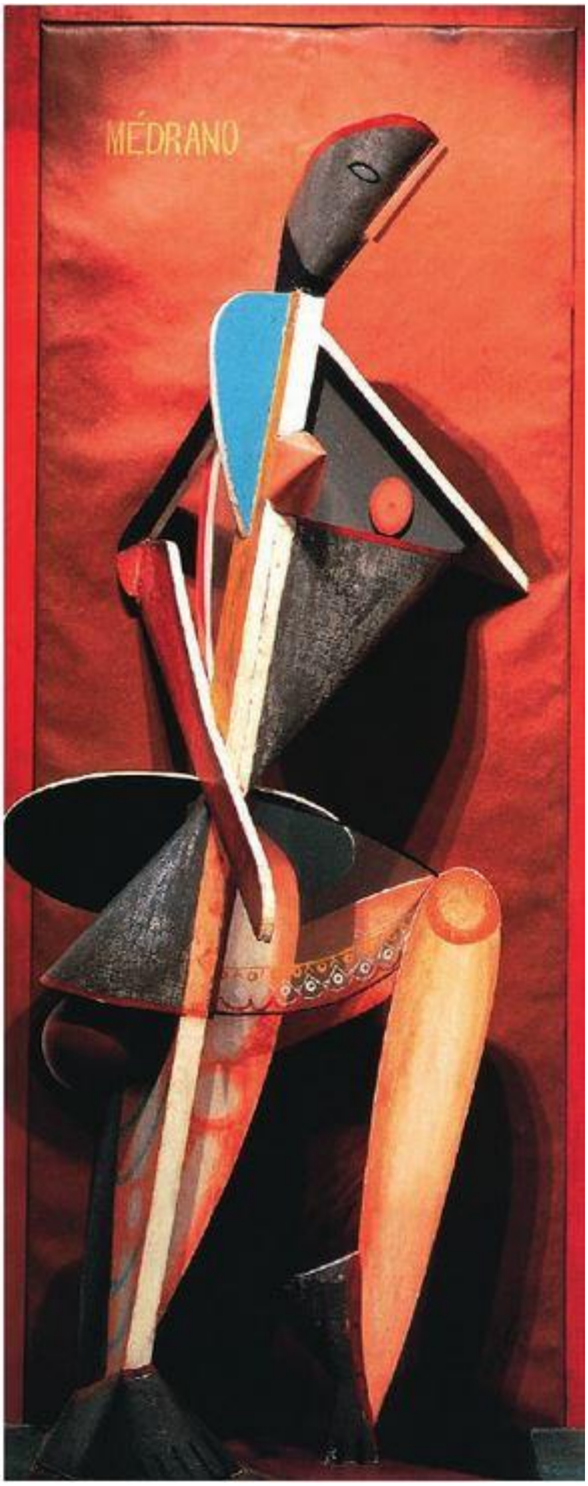


Figure 4.30. "*Medrano II*" Alexander Archipenko, 1913-1914. Iron, wood, glass and oilcloth, 126.6 x 51.5 x 31.7 cm. Solomon R. Guggenheim Museum, New York. Archipenko's use of strong colors on a variety of materials emphasizes hollowness and convexity.

My practice is based on a personal method that I have developed in an effort to evoke images directly from the pre-conscious or at a sub-level of consciousness that occurs without active attenuation. I have set out to identify the specific process by which drawings and paintings made in this state become 3D environments. The goal is to discover how artistic elements facilitate a visitor's sense of immersion.

Dreams, memories, and streams of consciousness have captivated me since I began to think of the world around me. I remember the letters on the TV when they were splotches, knowing someday that they would be recognizable and realizing when they were. I remember trying to understand how long a minute or an hour is and knowing my perception of time was always changing. I realized long ago that the world is filled with inconsistency. In a quest to understand, I turned to the study of science and anatomy. I dissected until I could name every muscle of the chicken on my dinner plate. I performed pathology experiments on laboratory mice. I assisted in the inducement of strokes on dogs and with their subsequent autopsies. I know pain, anesthesia and lives before and after surgery.

I know that science can be as inconsistent as the measurement of time. In my art practice I realize that every situation can reveal meanings, and every minute in time unfolds potentiality to process, envision and become.

As an artist, I am building a language for the expression of truth based on an individual way of knowing the world. Art, like science, occurs through observation, identification of the world and understanding experience. However, I do not limit myself to items of statistical significance. My drive is to understand the unquantifiable anomalies, the occurrences that fall away from the norm. I understand life as I read poetry: without complete sentences, without rhyming couplets, without deliberating on the full dialogue until I read the last line. In life, it takes a long time to get to the last line. Our mind works the oscillating wave of deliberation running from stream to stream of consciousness. The words in a poem can generate metaphors and images that unfold revelations and weave reasons to reason. My art making is like the shaping of words when one tries to recall a dream. The dream is the inner processing of reality, our brain trying to make sense of the day's journey. The spoken recollection of the dream generates narrative and form. My art is the manifestation of unconscious processes, recollection and ultimately, form. It is the creative manipulation and expression of my observation and identification of the world. My dreams and memories become my art.

My artwork explores the intimate dialogue that occurs during everyday activities and personal dilemmas. I am investigating how art situates consciousness when the artist constructs the viewer as a subject in an experiential encounter. For example, the artist Joseph Cornell constructed small boxes that resemble dollhouses, store windows and toy theaters which encourages the visitor to discover its elements as if a drama were unfolding in their midst. (Cornell 1993) Cornell's boxes frame his imagination and are described as works of great beauty and strangeness. (Dailey 1997:616) Another instance of experiential strangeness occurs when someone becomes the participant in an unfamiliar magic trick. Each situation has the capability to sustain attention and generate multiple questions. By yielding to a situation, absorbing an image and constructing metaphors, one can lose the recognition of the previous moment and gain the potential for a shift in thought towards fresh perceptions. The shift in recognition can propel the inquisitive visitor towards another realization where they may shift their thinking and recognize the multiplicity of existence. In my work, I try to situate consciousness toward an unfolding of contemplation, which evolves over time.

Here I will describe my creative process. In order to create virtual environments I create automatic drawings, produced between moments of consciousness. I am able to shut out the world and sketch very quickly as if in an out of body experience. The peak time for this type of drawing for me is just as I am waking up. I do not use a radio or alarm clock. Instead, next to my bed I keep a sketchbook, a computer-drawing tablet and various traditional drawing implements. As I wake up and look over to the table next to the bed, I seem to know which implement to choose for that session. I begin to draw without words, before the day begins with date, place, time and expectations. I simply draw intuitively. Later these drawings become digital paintings. I do not lay out my drawings, rework them, and then transfer them. I position the marks as I draw and I apply the colors as

I paint. They are both scanned and cleaned for digital preparation or the computer images are enlarged to a specific resolution and cropped to a desired format. The paintings are executed in the same manner. There is no color layout and overall color themes created. The base painting is pure white and color is directly placed onto the digital canvas without regard for overall color scheme. It is as if the lines tell my hand where to draw and the colors tell my fingers which way to hold the digital paintbrush. The content of the paintings and drawings reveals itself much later, over time, as I live with them and become familiar with their expressions. I begin to learn their language. The paintings that are most unusual or enigmatic are built in 3D and created into virtual environments.

Following this stream of consciousness process is the method that I use for producing the whimsical and colorful characters of my visual environments. As I am able to shift my perception to a quiet non-verbal mode, I can produce capricious drawings and paintings that do not resemble the real world. Ultimately, the paintings become visual landscapes of wide-open spaces that are ripe for exploration.

Working with the virtual environment, the process is very similar. The virtual environments are not planned out. Instead, they grow organically. The drawings become a motivation for creating 3D computer objects but are not used a template for a character. The first objects to build are the characters - what I now call emotables, which will be explained later. The emotables are shaped in Maya, the 3D modeling and animation software. There, they are assigned texture maps that are portions of the original paintings. The emotables are then placed in an empty camera space. Seeing the emotables as they are hovering in 3D space helps to motivate the environment's aesthetic direction. As more emotables are placed near one another, a type of visual conversation begins between them that allows me to paint a picture of the necessary environment in my mind. The emotables are built at the desktop screen while the landscape is visualized by seeing the emotables in the virtual environment technology. It is important to stand in the world physically next to their life size shapes in order to understand how the environment should be progressing and to anticipate what the visitors' needs will be. This phase is an extension of the active imagination technique used to produce the drawings. The placement and animation of the models seems to come from the emotables themselves. Attention is given to the type of display device where the work will be exhibited. On one hand, if the CAVE will be a primary exhibition venue, the floor is available to exploit. The visitors will be able to look at the projection underneath them and gain a sense of height. On the other hand, if the display device is a wall or John-E-box display type, the sensation of looking into and through a window will be exploited. Here it is important for the visitors to keep moving forward or to interact with what is directly in front of them. The development of one environment takes years with exhibitions in between the various iterations. Each exhibition seems to unfold more of the narrative and this motivates further development. Some of the additions have included networking the piece for CAVE-to-CAVE interaction, or the environment is changed or extended or new forms of interactions are created. This occurred very often in Beat Box where new instruments were being built and new placements for the instruments were designed so that there were essentially different floors or interaction platforms.

4.6.0.0 **Summary of key points made in this chapter**

The methodology is a practice-based research that is informed by visual illusions, visual perception, awareness of analogies and an artistic practice using active imagination. In order to develop an investigation of how analogies are working in approach to art in virtual environments, this research recognizes the need to create strategies for navigation. These aesthetic moments act as patterns that guide the visitors through the experience. Analogies, or concept building, require the use of pattern recognition to build bridges between disparate objects. An aesthetic experience is a circumstance that allows us to build concepts and investigate relationships. In both its execution and its investigation, art challenges us to solve puzzles. The image making practice begins with a stream of consciousness process that situates a flow of drawings that become paintings and eventually virtual environments.

The guiding elements or principals of my art practice include

1. A relaxed and determined approach to thinking mindfully of drawing by allowing imagery to flow freely while making marks

across the page. It is important not to label the objects and make an attempt to finish the image, rather allow it to complete itself as a drawing.

2. Add explosive color that is meaningful in terms of its saturation and its ability to define aspects of the object both in a representational way and in a sensing/feeling way to incite perception and immersive interaction.

3. Allow the direction to proceed naturally across all software mediums during development and test constantly in the actual CAVE or projection environment that the work will be eventually displayed in.

4. Be conscious of the various components of the virtual environment that work in tandem and on various levels with the artistic components including the hardware and software. In particular, pay attention to the multi-modal interactions that develop through the interface, content, environment, performance, perception, and levels of plasticity.

5. Augment the practice with theoretical knowledge from various disciplines by looking at what is being written in the humanities, art journals and online blogs about various approaches to expressing information and discovery in both the arts and sciences, especially in what people are finding new about fine arts and computer graphics.

I will discuss the works of art I have created using this production method, including virtual environments and other artwork motivated by creating the virtual environments.

Chapter Five: Metamorphosis

5.0.0.0 **Introduction**

In this chapter I will describe the virtual environments and related projects I have created in the course of this research. The research methods originate in a painting and drawing practice rather than in cinema, animation, or new media. The research develops from the ability to channel a stream of consciousness drawing and painting method as the materials to create art. The resultant imagery suggests emotions by situating the viewer's mental perception and physical action with imagery related to portraiture. The visitor experiences a body of virtual environment artwork that is unique in both style and affect by making generalizations and analogies between the real world and the virtual one that I create.

Intrinsic to my art practice is the need to understand how my mind perceives information, how it turns that information into imagery and how that imagery can become pointers to various levels of perception. My marks are produced in a stream of consciousness method that results in drawings and paintings and imagery of people in communication. To begin making, I occupy a place where my mind is quiet and the images appear through a deliberate drawing technique that is not directed towards a specific image goal but rather the image is accepted as it is produced. The creative progress is nurtured, there is no prescription for the specific direction of events. I develop and nurture my art by allowing a particular reflective awareness of my life to stream which often results from discussions with other people that formulate my relationships to the world. I am also aware of how people situate themselves in space and the colors in the space become important. I try to be aware of and respond to color pallets and how and why colors are working in tandem. Colors have the ability to situate moods, hide objects and create a feeling of expanse, as in the green of nature. I am interested in how objects and people live and hide in colors through their positions, movements, and habits. In particular how colors assist in making things visible and invisible. Color shifts patterns and shapes visual illusion. As an artist I make the suggestion of emotional expressions by using the stream of consciousness drawings as construction materials. I ask the visitor to open up an active imagination, begin to recognize elements of the work and formulate their own level of understanding. Much like a turtle negotiates a country road, our eyes move across a painting to explore, move about and find a resting place to contemplate the presentation. Exploration and assimilation is a natural phenomenon that occurs on the macro and micro level that I exploit through artistic confrontation. Andrei Cordrescu, cultural critic, writes that artists are “duty-bound by their art to sabotage the familiar in order to express an unsurveyed and, hopefully, unsurveyable personal reality.” (Cordrescu 2012:133) It is as if the world is being put on trial and held in invocation of the illusive. In my investigation I look for shifts in perception not only visually through spatial changes, color changes - how color theory works- as well as how visual illusions occur daily. I use color to saturate the imagery in order to invoke a confrontation – I want your attention and the message is loud. The images are illusions that serve multiple functions simultaneously. They situate the environment and signal a moment in the experience. The art results from an interpretation of reality that is infused with a sensing feeling of whereness that depicts emotional states. Emotions are constructed through suggestion using color, shape and illusion in order to promote the ability to see objects and circumstances from multiple angles.

My readings and personal experiences have informed a specific approach to the design and delivery of the virtual environment work. I first include a brief illustrated explanation of how intuitively-created drawings and paintings, produced during the hypnopompic state between sleeping and waking, provide the basis for the virtual environments. In these drawings and paintings, faces and figures from my subconscious that inform the situations I create in projection-based environments, theatrical and operatic performances, and other interactive works.

Next I will discuss each virtual environment created during the research and provide illustrations. Building on the discussion of how objects in my paintings serve as analogies for emotional situations, I will describe how each of the objects in a virtual environment becomes an analogy for a situation that typically involves some kind of psychic dilemma. Throughout the work, themes of the face and the figure aid in the creation of these dilemmas, providing analogies that situate cognition and perception for the visitor. The theories of Douglas Hofstadter and Rudolf Arnheim, as discussed in Chapter

Three, have been influential in forming the conceptual framework that supported the creation of these worlds.

In these environments, objects serve both as analogies for real-life mental states and as ways of indicating how the visitor might move through the environment. To explicate the function of objects in my environments I include a detailed chart of how specific objects and other visual devices have been used as analogical and navigational strategies. I include a description of the kinds of analogies each may suggest to the viewer and how each suggests paths to explore in an environment where there is no avatar to follow, no gun to shoot, no narrator, and no signpost.

5.1.0.0 **Case Study Materials**

The data includes drawings, paintings, virtual environments, interactive installations, video and sculpture. The imagery manifests through a technique that is deliberate and spontaneous, evoked from the unconscious. This section will explain the nature of the imagery and its manifestation. The imagery appears because of a type of thought process or meditation that is generated from hypnopompic imagery, which occurs during the time that we are waking up from our dreams.

5.1.1.0 **Paintings**

The paintings have a style that establishes the direction that is key to the imagery. The paintings are moments of contemplation or confrontation. They typically have a central figure intertwined with other figures and involve some type of emotional or subversive encounter.

Figure 5.1 “Morning Rituals” M. Dolinsky 1995. The painting depicts the moment of transition between sleeping and waking, referred to as the hypnopompic state when images from the unconscious occur.

The painting *“Morning Rituals”* (Fig. 5.1), depicting the ritual of waking up to the day, is the cornerstone of my work. In particular, it captures the moment of transitioning between a dreaming state and a waking state. This moment of transition is referred to as the hypnopompic state and is similar to the hynagogic state, which occurs when we are falling asleep and may see imagery before we are fully asleep. During the hypnopompic state, images can arise from the unconscious, similar to what occurs when we are dreaming. One person in the painting lies on a blue sea of dreams, floating in bed. A shamanic figure stands over the bed, trying to wake the person by shaking a large rattle. Under the cloak of the shaman, carrying a gold shield, is a figure who symbolizes "belly strength." The character on the right represents the people and things that need your attention during the day. The image on the left represents the "window to the world" and all the unconsidered possibilities yet to be formed. Considered together, the objects and characters in this painting represent my technique for manifesting images and the moment when those images are created.

A second example of my paintings, before I began to work with virtual environments, is "*You make my heart go baboom baboom*." An essential aspect of my painting style is that it situates consciousness around a particular event or emotion. *"You make my heart go baboom baboom"* celebrates the feeling of falling in love. Playing with drawing perspectives, intense colors, and imaginative expressions of faces and figures, it serves as an analogy for how a powerful feeling of love generates new ways of seeing (Figure 4.2).

Figure 5.2. “*You make my heart go baboom baboom*” M. Dolinsky 1995. This painting depicts the feeling of falling in love.

The significance of this painting is that it captures a state where perceptions are shifted because of the way that we feel. Our emotional state changes our experience of the world, and in turn our experience of the world continues to change our emotional state. This painting is an illustration of this action/reaction relationship that occurs when personal emotion within a space changes that space, turning it into an emotional landscape. An emotional landscape is a mental point of departure from the real or physical world.

These paintings, by increasing our awareness of our emotions in the context of vision and the mode of seeing, foreshadow my virtual environments, in which the visitor becomes even more immersed in these landscapes using not only vision but other modes of perception as well.

5.1.2.0 **Drawings created during the hypnopompic state**

The research begins with drawings, hundreds of which fill notebooks and disk drives. These images are the basis for the paintings, which are in turn the basis for the virtual environments. I draw early in the morning during the transitioning moments between being asleep and being awake, which is known as the hypnopompic state. Next to my pillow, there are sketchbooks, drawing implements, and a computer tablet and stylus. I wake up without the use of a radio or alarm clock in order to avoid inducing or intensifying verbal thought patterns. I facilitate my drawing method by focusing my awareness during this transition. I have no intentions of what to draw because I try to remain without words. That is, I do not formulate a verbal plan such as 'I will draw a bird or a house'. Hand drawn sketches are created spontaneously in a paper bound sketchbook or on a digital computer tablet. I draw the sketches quickly and try to avoid any rumination or need for modifications. The layout of the images is typically one image per page unless I am at an alternate location and without my sketchbook. While in the hypnopompic state I typically produce one to three images. I may continue to produce drawings as I become fully awake. When the practice is done consistently each week, a pattern emerges in the imagery. People, buildings and plants emerge. The people in the drawings come in a few distinctive types; some that are composed of fluid lines and others that look like blocks with cutouts. I often find archways, spirals and spikes in the drawings.

See Figures 5.3 - 5.18 for examples of some of the imagery I have developed through this process. The drawings pictured here were completed immediately upon awakening. Though I also draw on paper in bound books using pencil, pen or fine marker, all of these images were created using a computer tablet and stylus. Occasionally the images are done in full color, drawn with a brush and watercolors or a digital canvas. I also draw at various points during the day when I am waiting for something or when I need to be quiet. The dates of these images range between 2007 and 2012 and most of the images are 16 x9 inches at 72 dpi.

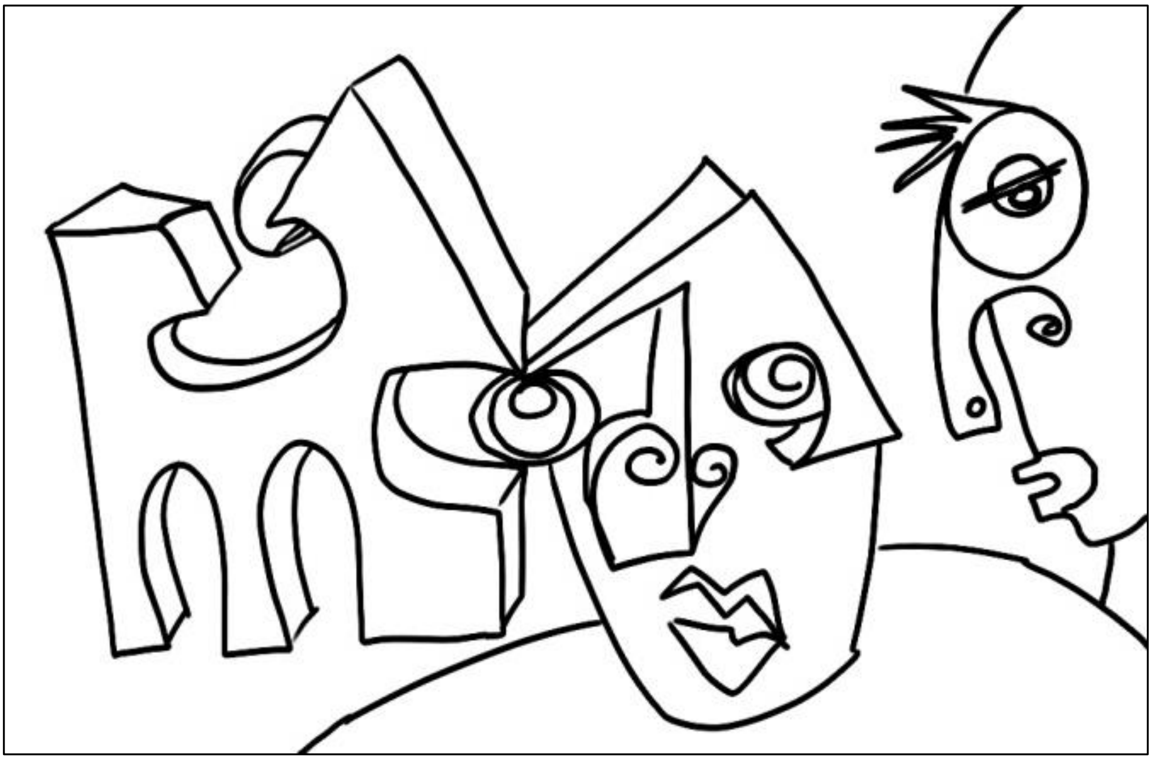


Figure 5.3 "*What are you saying*?" M. Dolinsky September 15, 2012. Hypnopompic drawing.

Figure 5.4 "*The unconscious speaks*" M. Dolinsky January 2, 2010. Hypnopompic drawing.

These drawings are a typical sample of my quick black and white sketches. The first image, "What are you saying?" (Fig. 5.3), was created with very bold and definitive strokes. The drawing came easily and when it was done, it evoked the thought "What are you saying?" which became the title. The picture suggested that I might be looking for an interpretation from someone or an answer about something, but at the time nothing in particular came to mind. A week later, I tried to match the characters with people that I had interacted with over the past week and I came up with several interpretations. While initially I thought to dismiss the title, I realized after consideration that it belonged. This is an exception to the rule, however, because the drawings do not typically title themselves. I often struggle with titles and refer to the drawing by an emotion that the image relays to me, only discerning a full title much later.

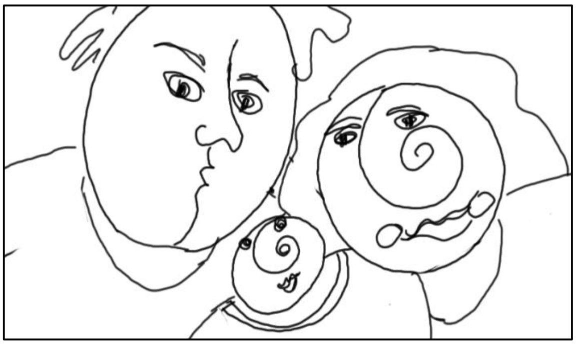


Figure 5.5 Drawing M. Dolinsky December 31, 2009.

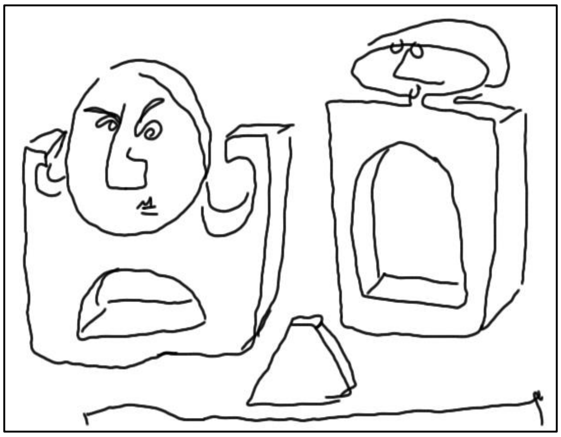


Figure 5.6 Drawing M. Dolinsky Tuesday, May 12, 2009, 5:37:11 AM.

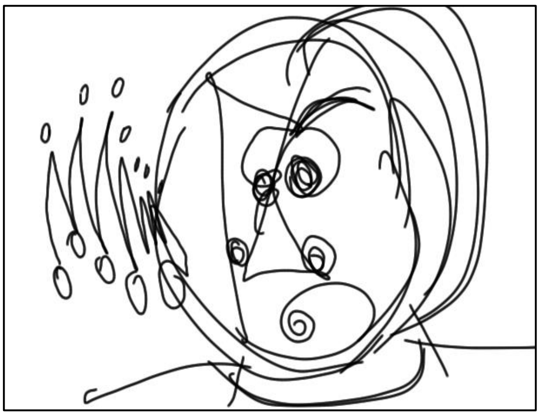


Figure 5.7 Drawing M. Dolinsky Sept. 8, 2009.

Figure 5.8 Drawing M. Dolinsky Dec. 26, 2008.

Figure 5.9 “*Sun*” M. Dolinsky Nov. 04, 2007. Drawing.

Figure 5.10 Drawing M. Dolinsky Oct 12, 2007.

I also executed the digital watercolor drawings in Figures 5.11-5.18 immediately upon awakening, again using a small digital canvas with a digital stylus that is placed next to the pillow on my bed. These full color drawings are done less frequently, since there is only time to create one per day, if at all, and even then the color application sometimes needs to be finished in a later session.

I determine which sketches to paint through a process of discrimination that is based on emotion. It is as though certain drawings insist on color treatment. The drawing program is crude and is not as robust as Adobe Photoshop or Corel Painter, so the color choices tend to be limited. The colors are chosen and applied intuitively, in the same manner as the lines. The drawings are not color blocked and there is no pre-planning of color schemes. In the more detailed paintings the colors efface the line drawings altogether.

The sketches become paintings that are realized using digital tools. They inform my virtual environment work but to some extent, they can also be considered virtual environments in themselves, as they only exist via the computer screen.

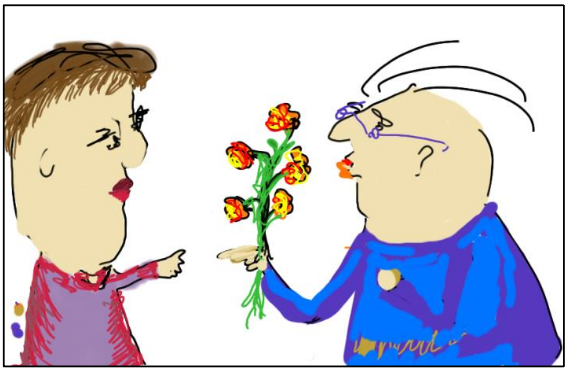


Figure 5.11 Drawing M. Dolinsky Sunday, December 23, 2007, 3:28:39 AM.

Figure 5.12 Drawing M. Dolinsky Monday, September 10, 2007, 11:36:29 PM.

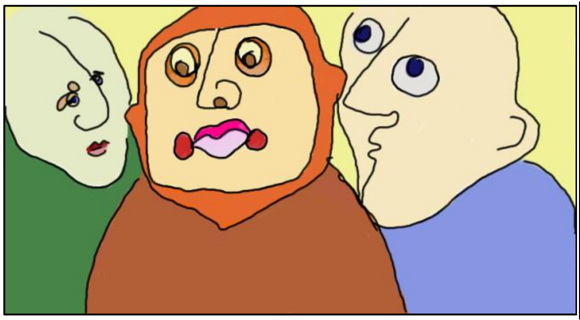


Figure 5.13 "*Gossip the outsider*" M. Dolinsky Saturday, December 08, 2007, 11:45:35. Drawing.

Figure 5.14 Drawing M. Dolinsky Tuesday, December 25, 2007, 12:10:10.

Figure 5.15 Drawing M. Dolinsky Saturday, December 22, 2007, 9:55:16

Figure 5.16 Drawing M. Dolinsky Wednesday, December 31, 2008, 3:53:17.

Figure 5.17 Drawing M. Dolinsky Sunday, October 18, 2009, 2:27:01.

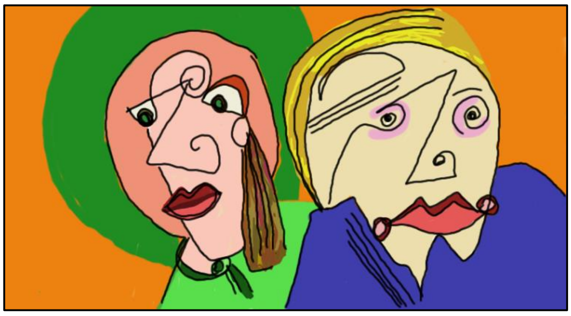


Figure 5.18 Drawing M. Dolinsky Saturday, December 22, 2007, 12:23:38.

5.1.3.0 **Virtual Environments**

5.1.3.1 **Introduction**

The research included virtual environments for CAVE VR, installations and dramatic theater. The displays included large projections, monitors and sculpture. The majority of the pieces were interactive in that the large screens were tracking visitors and reacting according to their behaviors. The interactions were typically generated by more than one person at a time. For example, the CAVE was a multiple person system where one person could wear the tracking glasses while another person navigated the environment. See Figure 5.19.

Figure 5.19 Indiana University Bloomington campus CAVE Automated Virtual Environment.

The following is a summary of several virtual environments created between 1996 and 2012. The goal of each artwork was to extend the imagery from the paintings to create immersive art environments.

5.1.3.2 ***Dream Grrrls***

Dream Grrrls (1996) is CAVE virtual art created to develop an aesthetic navigation with simplified interaction that focuses on moving through an abstract, yet somehow familiar world. See Figure 5.20. Similar to the dream-state, *Dream Grrrls* is a journey through five worlds that present an opportunity for exploration and self-reflection. The main environment is a labyrinth of 3D objects that act as portals or doorways to other worlds that feature childhood play, nightmares, desert islands and synaesthesia. The visitors' movement from one surreal environment to the next is a visual fantasy. As if caught in a dream, the visitor discovers paths that lead to whimsical worlds - to ride a see-saw in the clouds or use a flashlight to escape a nightmare. Visitors can follow the disembodied voices or let experience be the guide in a place where one can only expect the unexpected.

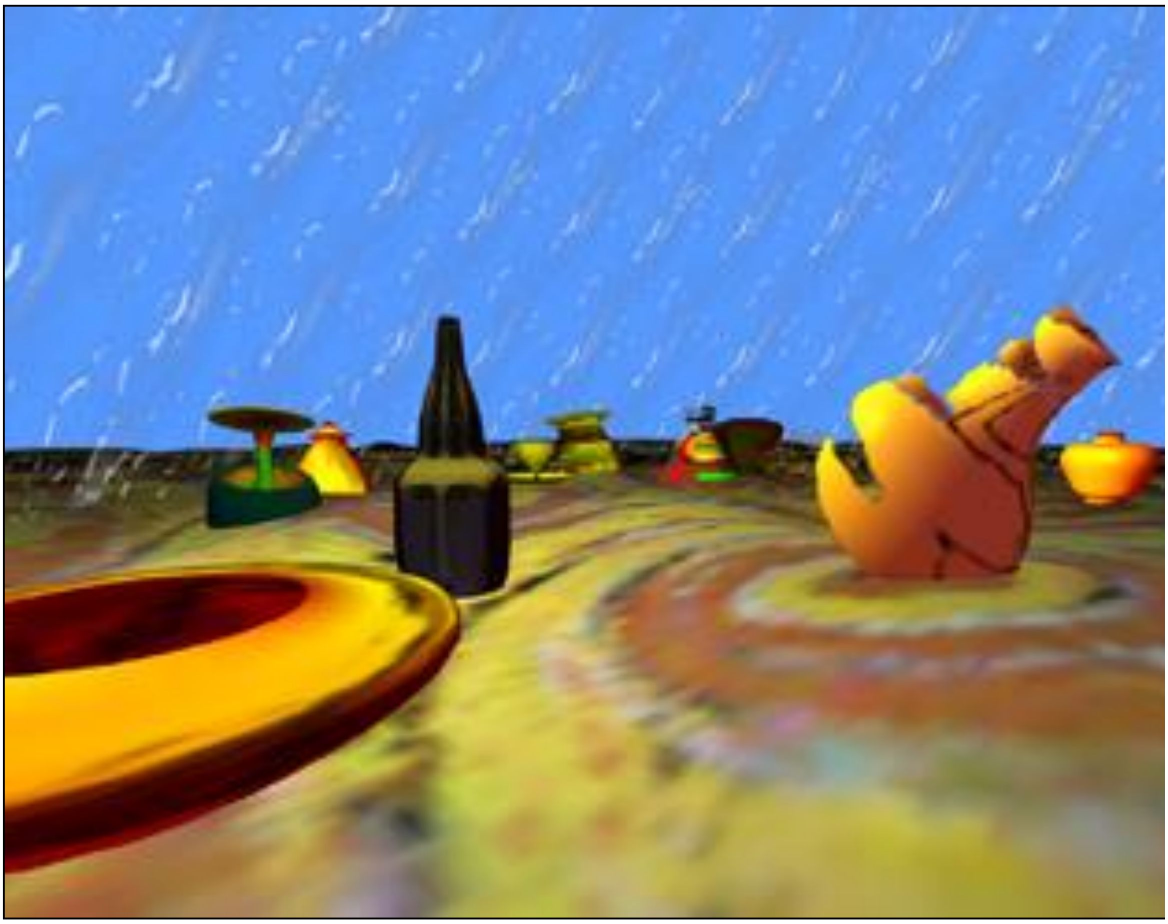


Figure 5.20 “*Dream Grrrls*” M. Dolinsky 1996. CAVE Still. Visitors explore brightly colored glass vessels.

Dream Grrrls was ideally suited to illustrate moments of consciousness through non-linear, non-hierarchical movement through abstract environments. Objects act as metaphors as they are positioned to reference things in the real world. For example, when a visitor approaches a ramp that leads to a foreboding head, a warning would call out, “Don’t go up there!” Once inside, the visitor would find the environment dark and scary. The design focuses on, but is not limited to, Gigliotti's criteria for virtual aesthetics:

interface, content, environment, perception, performance and plasticity.

The interface unites hardware, software and the user in a common space for action and reaction. The goal is to have a dynamic structure in which the participant navigates with a variety of choices, experiences and interactions for enjoyment, exploration, decision-making and learning. The content is based on imagery and experiences similar to a dream-state. Fueled by the unconscious, interaction is often indulgent, whimsical, and self-reflective.

The environment or physical space will have familiar qualities in unfamiliar settings. For example, the visitors navigate through a space to find brightly colored glass vessels to explore. The most creative explorers will interact with these objects and find themselves thrown into other challenging worlds. Perception will guide the participants to follow the line of sight through the stereoscopic tracking glasses. The glasses and navigation wand allows interaction with objects and creates a virtual sense of movement through the space. The computer provides "clues" with sight and sound. The performance is based on the participants' action and reaction with the computer and the ability to suspend disbelief.

In order to optimize the performance, objects represent and lead to other scenes rather than presenting one world in its entirety. The program contains a set of multiple drawing functions that are executed depending on position. The visuals become critical to achieve a smooth and unified experience. The plasticity of the artwork is represented in its ability to give: is the play effective? Visual design is not to be underestimated. It is an indispensable aspect, representing and providing tasks. The design considers structure, graphics, sound, tactile and kinesthetic effects. This provides sensory, cognitive, and emotional stimulation which shapes actions. *Dream Grrrls* creates a virtual world of dreams for learning how to move through virtual dreams, experiencing different qualitative and listening to communication from virtual characters. The most surprising part is when the wand suddenly becomes a flashlight in a dark room of whispers and faces. The most enjoyable part is riding an invisible ramp to the top of the labyrinth.

5.1.3.3 ***Strait Dope***

Figure 5.21 "*Strait Dope*" M. Dolinsky 1997. CAVE Still. Navigation is non-linear and self-directed through an environment that initially appeals to visitors because of its colorful psychedelics.

In order to extend the idea of dreaming further, constructs of space and time were used in "*Strait Dope"* (1997) to evoke hallucination and fantasy in the CAVE. See Figure 5.21. Navigation is non-linear and self directed through an environment that initially appeals to visitors because of its colorful psychedelics. There are those who consider the characters and their voices to be "frightening." In one part of the scene, a small house on the landscape opens up and becomes a type of garage. Inside, a legless character sits in a chair. As the visitor approaches for a closer look, an old man's voice croaks, "Help me up. Help me up." Such unexpected points of interaction are designed as if to knock the visitor off of his feet and question the time and space that is being negotiated. These dynamics act as a mirror for the real world when we negotiate the unfamiliar and deliberate the unexpected. The navigation depends upon choices made amidst ambiguity and deception.

In one interior scene, a bald character with no legs sits alone in a chair waving his arms. When he is approached, he begins waving his only limbs frantically and shouting Help me up! Help me up! It produces a disconcerting moment that some people find frightening and others laugh uproariously. The piece was featured as a cover story in the first issue of the VRML Developers Journal.

5.1.3.4 ***Blue Window Pane***

Figure 5.22. "*Blue Window Pane II*" M. Dolinsky 1998-2001. CAVE still. The mosque-like setting establishes the navigation and represents the point for returning to the familiar.

Blue Window Pane is a CAVE art experience that stages the virtual environment as performance and projective construction. See Figure 5.22. Participants discover a non-linear narrative through a subversive and confrontational stream of consciousness movement. This non-hierarchical movement is theatricalized in architectural spaces inhabited by surreal characters.

The initial mosque-like setting establishes the scene for navigation towards other scenes and represents the point for returning to the familiar. The "Angels of the Room" line the mosque, standing in columns that guard the large, arched windows. These angels send out warnings and appear ready to take flight when approached. The windows provide an alternate direction and create a point of confrontation with the symbolic ego by presenting a psychic dilemma. Each navigational direction provides choices that unfold as multi-layered events of self-determination: unexpected encounters, passageways, epiphanies and brick walls.

At one end of the mosque there is the masque of a woman's face. As we move closer to her, she opens her eyes and chants at the confrontation. A closer examination of her face transitions the scene to a revolving tunnel that represents the sounds of the inner psyche. At the opposite end of the mosque is an icon on the wall that holds a gold skeleton key. By touching the key with the CAVE's navigation wand, the icon grows very large. The icon opens to become an arched passageway made up of multiple silhouettes which leads into the "Inner Sanctum." Elsewhere in the mosque, windows shatter, walls open beneath shimmering pools of glass and stairways appear. Each event is meant to reflect the unexpected events that occur daily in the real world.

The CAVE is a virtual display theater that presents a visual spatial media of shapes, landscapes and sounds that establish a system for construction and symbolic transformation. Participants are given the stage to exercise the guidance of their cognitive structures and ascertain the meaning and content of the virtual experience. To inhabit the virtual space is to transform the projection. The uncharted and undefined medium of *Blue Window Pane II* requires its portrait to be painted with symbol systems of both virtual reality and art adventure.

5.1.3.5 ***Beat Box***

In order to experiment with a more purposeful activity that would demand more of the visitor, I investigated using the joystick buttons to manipulate, change, and build the virtual environment. "*Beat Box"* (2002) is a multi-level environment with musical instruments that are played simultaneously by multiple visitors from remote locations. See Figures 5.23 and 5.24.

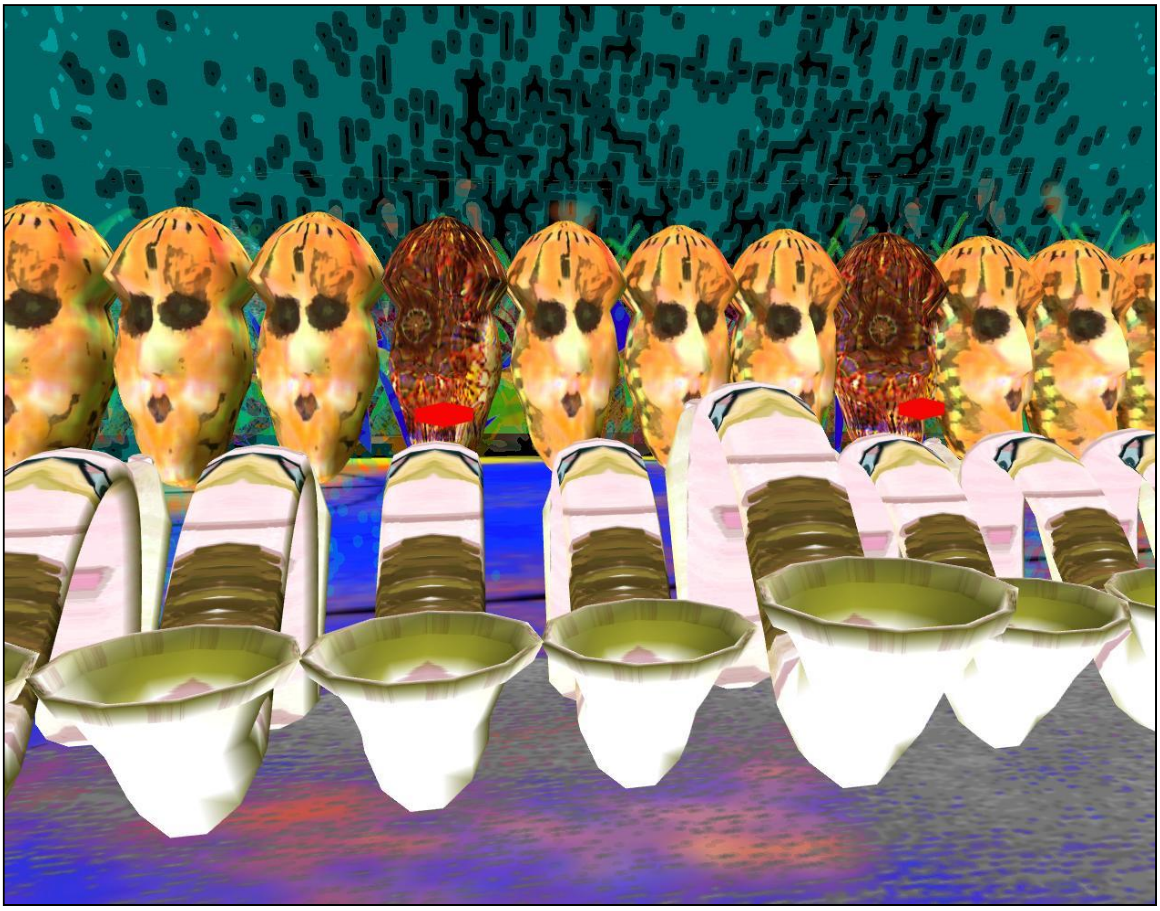


Figure 5.23. "*Beat Box*" M. Dolinsky 2001. CAVE Still. An audio sequencer is depicted by a row of heads, each "singing" in turn. Beat Box instruments include drums, bass and ambient audio sequencers with unique periodic durations and controls.

In "*Beat Box*," an audio sequencer is depicted by a row of heads, each "singing" in turn. These instruments include audio sequencers with unique periodic durations and controls. Visitors use the joystick buttons to choose from sound selections and place a sound at an interval on the instrument. Beat Box presents network collaboration for CAVE visitors in a playful arena of interactive virtual sound instruments. The graphics and sounds continually change with the resultant delivery of the collective instruments. The CAVE wand is also used as a drumstick to play various sets of drums. Beat Box is an activation of harmony, musical dialogue and language between the virtual characters and people collaborating in the network.

The results were to network audio sequencers between different cities and play the instruments in different CAVEs. Each city did have full access to all of the instruments all of the time. The problem was how to teach people to use the environment properly and easily.

In the first installation, as the visitors entered Beat Box, they were greeted by the avatars from the remote CAVE's location who instructed the use of the joystick, its button and how to navigate and negotiate the sound instruments. Using slow network speeds, the audio became disjointed and the sounds were slow to respond to visitors' movements. The internet2 had subtle issues with bandwidth and latency in order to both display the environment in real time and transmit the audio updates.

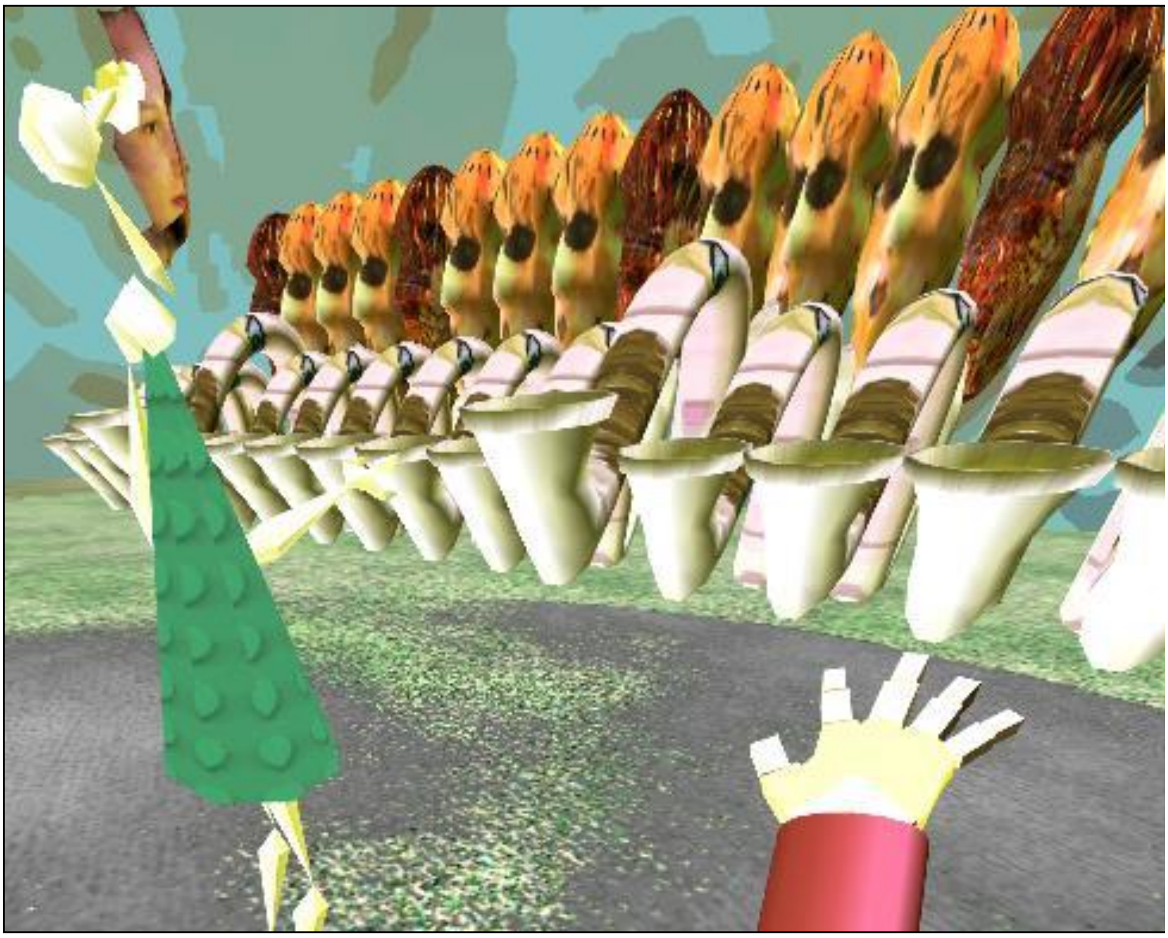


Figure 5.24. "*Beat Box*" M. Dolinsky. CAVE still of the musical instruments and avatars taken during a networked performance at the Ars Electronica 2001 Festival. Photo by Dave Pape.

However, the international Grid to Europe could handle the updates in real time. Visitors could hear and see the results of not only their own movements but also the movements of others in cities on the other side of the world. Together we could share a virtual experience and manipulate the same space. "*Beat Box*" performed more fluidly on the iGrid compared to the regular internet. The technology demands of high-content graphics and audio and support an international collaboration of computers, machines, and participants.

5.1.3.6 ***Cabinet of Dreams***

"Cabinet of Dreams" was a commission for exhibition at the reopening of the Indianapolis Museum of Art in May 2005. The virtual environment highlighted some of the pieces from the museum collection while the Asian galleries remained closed for renovation. One of the objects in "*Cabinet of Dreams*," is inspired by an actual Qing dynasty cabinet made of cloisonné, glass, and zitan wood. The cabinet is the metaphoric center of the installation, reflecting the collection and the virtual reality display device as if it were a modern day *Wunderkabinett.* The display device was the portable VR device invented at IU called the John-e-box. The virtual cabinet is the harbinger of the collection of rarities hidden within the many virtual environments and metaphorically representing the many passage ways of the museum itself. The objects showcased in *Cabinet of Dreams* range in date from 1000 BCE to the mid-1800s and include bronze, earthenware, and wood ceremonial objects.

Figure 5.25 “*Cabinet of Dreams*” M. Dolinsky 2005. CAVE still.

The actual cabinet was in the museum and not too far away from the virtual display device. By combining the actual cabinet with the virtual dreams inspired by the real objects, visitors realize the museum’s objects while navigating with a sense of moving space. See Figure 5.25. The visitors could not depend on written explanations or a docent to guide the way. Therefore, the joystick manipulation required straightforward usage. The imagery guided the visitors and was both educational as well as whimsical in order to encourage exploration and further action/reaction journeying. The objects were repeated consistently and presented in a variety of ways. In the opening scene, they were grouped together and displayed in a cabinet. The cabinet was also repeated in each alcove with a larger version of the object in order to represent the portal to the world that represented its inspiration or dream. In the dream world, the object was on display again and a cabinet acted as another portal to return to the main environment. In effect, the cabinet was the unifying design for navigation and way finding. *Cabinet of Dreams* was also exhibited during the American Association of Museums 2005 Conference, networked between the USA and Beijing for the iGrid 2005, and displayed with the Cleveland Museum of Art.

5.1.3.7 ***Figuratively Speaking* and emotables**

The virtual environment*, Figuratively Speaking*, displays faces as figures that have their own movements and sounds when approached. They exist on a wide-open landscape surrounded by the sea (see). The main characters are based on watercolor paintings, which have been recreated as 3D computer graphic models. The head movements, their expression and the qualities of the face convey social information. Their uniformity with one another, the asymmetry and the quirky movements are coupled with distinctive voices that are recognizable but inaudible. The sound is meant to be attended to, as if it were decipherable, but when it is recognized as undecipherable, the moment is a suspended query of the figures themselves. The work explores new ways of communicating the emotional state of the unconscious. The gestures of the heads enhance the emotion of the faces. In some parts of the environment, the figures crowd together in groups. In other parts of the environment, they are conferring in secret or standing guard in a vain attempt to prevent further exploration.

In one scene a guard tries to dissuade the visitor from approaching by waving its arms and yelling at the visitor that she should move along. If the visitor overcomes the guard and moves beyond them, the world will open up in a new way. Static objects suddenly become mobile and a new pathway will be revealed. This represents overcoming hesitation and forging ahead along an unknown path. If the path is taken, the visitor is rewarded with new adventures and new characters to greet her.

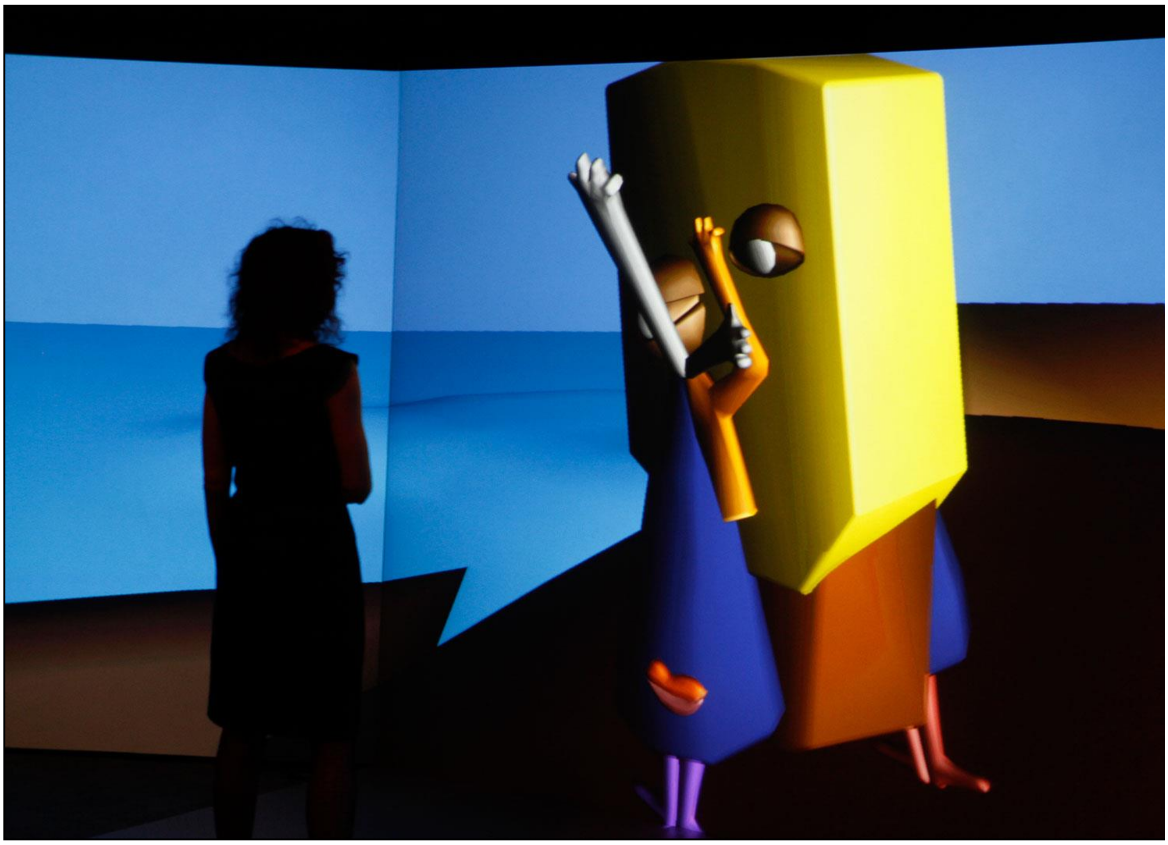


Figure 5.26 “*Figuratively Speaking*” in the Indiana University virtual reality theater. Here, the visitor confronts one of the gendarmes who attempt to prevent the visitor from exploring any further by waving his arms and making threatening sounds.

The guards in this scene are gendarmes or big French generals. See Figure 5.26. The gendarmes are surreal and colorful, and waving their arms as if to explain something in their demanding voices. They seem to say that one should stop. This encounter is meant to provoke anxiety and mimic the trepidation that occurs when one is about to climb a psychological mountain. After moving past the gendarmes, the visitor comes to a mountain that has large movable walls. The walls are thick and appear heavy and stationary. As the visitor approaches them, the walls begin to move and rise above the mountain. When you get very close, they reveal a passageway. This is similar to overcoming a psychological dilemma. You can avoid it, squash it down, ignore it, but not until you look at it closely does it transform itself and become something very different and something that you can move past.

Figure 5.27. "*Figuratively Speaking*" Virtual Environment, "Forest of Knowses (noses)".

The characters in Figure 5.27 inhabit a secluded space alongside a seaside near the mountain. The scale of the two figures and their position to one another establishes a teacher/student or parent/child type of relationshiop. One character is clearly demonstrating dominance over the other in a secluded area surrounded by the protection of tree like objects that represent a forest. The objects are the noses of the characters painted green. The trees represent knowing, so the scene is the forest of the know-ses.

As the characters bob up and down and teeter back and forth towards one another, their lips move in conversations. The sounds of their voices are heard when approaching them. Their audio is reminiscent of dialogue but it is clearly not descernable and not in English. The visitors are left to determine their discussion through the aural qualities of pitch and tone. We can follow the sound's cadence as it becomes heated. Much of the interpretation is deliberately ambiguous in order to allow the visitor to determine the interlude. The visitor is expected to intrepet the objects and their voices much like a patient would discover a narrative in a Rorschach ink blot test.

As the visitors move through the forest of the knowses, they can either abandon the journey and move out to the wide-open sees or face the mountain.

Figure 5.28 “*Figuratively Speaking*” Virtual Environment, “Sailboats on the Sees”.

In the wide-open sees, the sailboats represent ships passing in the night. See Figure 5.28. Some of the boats share the same waters, Some of the boats journey far away from their origin. Some are bolder in their ability to navigate narrow chasms. Some twist, turn and almost capsize. They are entities of and to themselves. They do not appear to be carrying people or any type of cargo. They are ideas incarnating, floating and organizing in a deliberate formation of speed, movement and winding influences, taking in the breezy gales.

Moving through the virtual environments is very similar to moving through a dream. As the visitor navigates, the worlds unfold in a stream of consciousness type of movement. The objects are deliberately and intuitively placed in the scene as if they decide where they belong.

Figure 5.29 This is the navigation device for "*Figuratively Speaking*". The controller is housed in a soft sculpture that resembles the characters in the scene. Moving the eyes changes the viewing space.

One exhibition used a gamepad was housed in a soft sculpture created to look similar to the heads in the environment. See Figure 5.29 for the controller device. The eyes of the head controlled the movement through the space. Visitors wore low cost passive stereo glasses and controlled the environment with a standard gamepad joystick.

Hardware for the virtual environments included the standard CAVE set up described in Chapter two. The exhibition was done in stereo projection against a single gallery wall using two front stereo projectors lined up side by side to create thirty-foot throw.

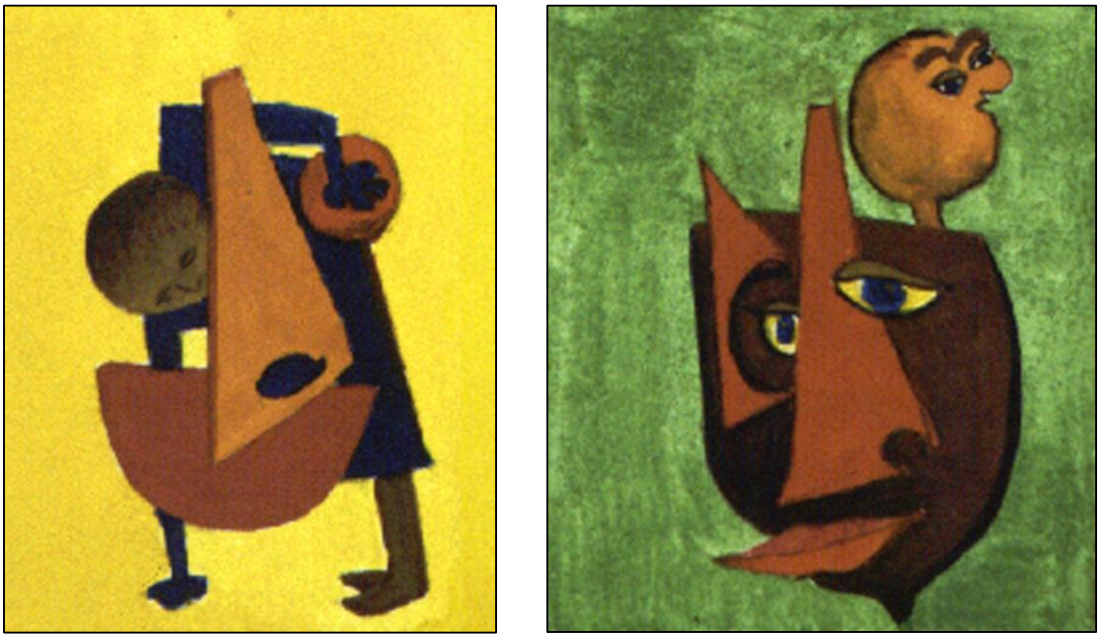


Figure 5.30. This image displays the detail of two original paintings that are the inspiration for the virtual environment, "*Figuratively Speaking*".

Small gouache paintings are the inspiration for the immersive environment, *"Figuratively Speaking*." See Figure 5.30. The paintings capture small emotional moments where the faces express what the bodies are feeling. The face is the culmination of the body's state of perception. The images are meant to be simultaneously read as faces and full body characters in and of themselves. The limbs represent parts of the nose, mouth and eyes. The figures are bulbous to give them a robust sense of character, as if they are full of life. The parts of the faces move to animate their emotions further for interaction and confrontation in the virtual environment.

The next image, Figure 5.31, demonstrates how one of the paintings appears as a 3D computer graphics model. The intention is to capture the general form of the image and the resultant object stands on its own as a separate piece of art because it undergoes a very different process based on the Cartesian coordinate system and geometry in 3D space. This allows the image to be rotated in space rather than having a singular point of view as in a painting.

Figure 5.31 This image demonstrates the comparison of the original painting with the 3D computer graphics render. The model was created for the virtual environment, “*Figuratively Speaking*.”

The ability to move around the object in the virtual environment allows for a different type of immersion with the object. The visitor must compare their own body with the bulk of the virtual body in front of them. The movement of the face/body is meant to be an emotional moment that involves the recognition of another entity within a shared space.

The comparison between the paintings and the 3D computer renderings and models are noticeable. See Figures 5.31 and 5.32 to see the difference between the paintings and the renders of the corresponding 3D model. Figure 5.32 shows the original painting in the background with the lower right painting of a head in green. That green face is depicted in a 3D computer graphics model that is composited on top of a scan of the original painting. The painting has a textural quality of the paper and the brush strokes while the computer graphics has a cleaner type of solidity. The presentation offers conditions that establish new meanings and uses of personal images. The alternative constructions represent very different types of social space. The presentation offers various aesthetic intentions depending on the resultant installation form.

This research has determined that the virtual character within the environment is not an avatar because avatars typically represent a person who is controlling a character within the environment. In my work, the computer characters are their own entities and do not purport to speak our language or even expect us to speak theirs. The characters and their design and function I have termed as "emotables." I use this term to convey a culmination of characteristics including emotion, motility, ability, motion, and malleability. The emotables can have a variety of functions within the environment depending on their personality. They remain independent of the visitor or any networked visitors. For videos, see disc for Video 1 and 2.

Figure 5.32. The virtual environment, "*Figuratively Speaking*" began with a matrix of small paintings of abstract portraits.

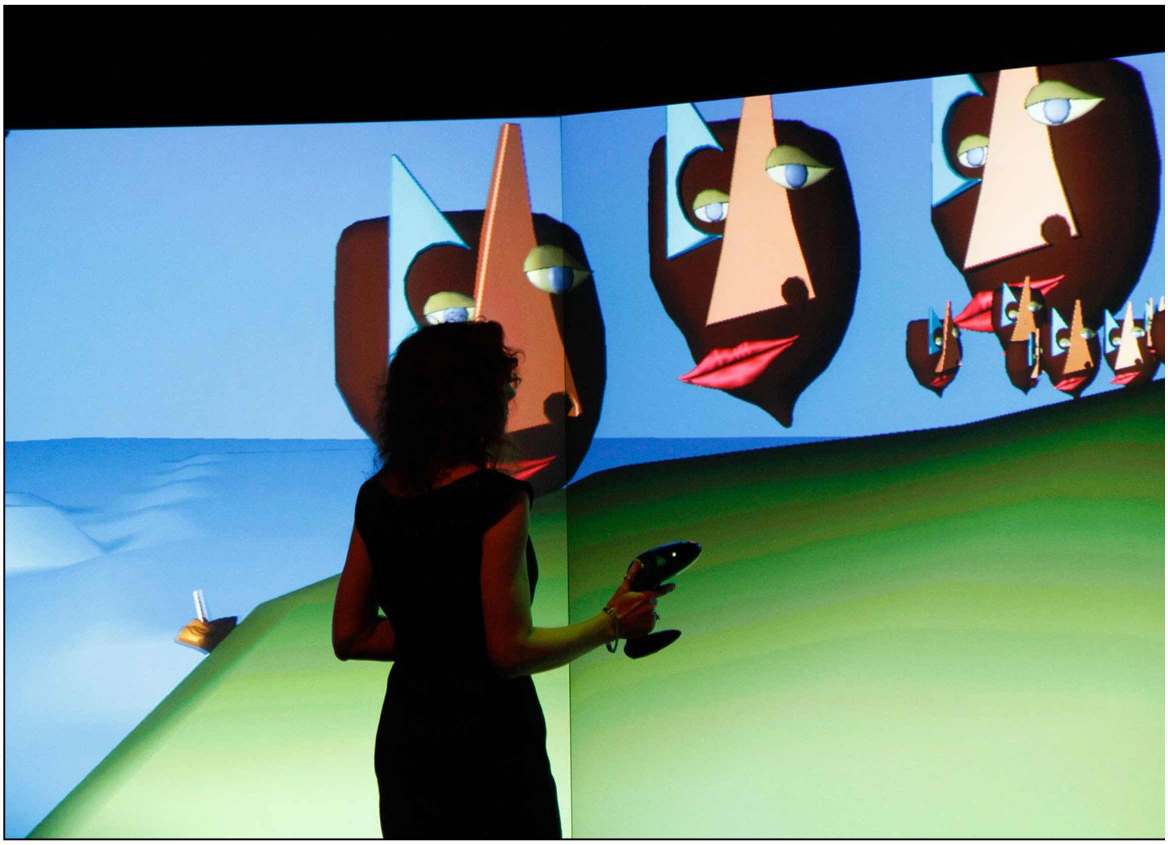


Figure 5.33. “*Figuratively Speaking*" Virtual Environment. This image is of the artist navigating the Indiana University Virtual Reality Theater in Indianapolis, Indiana.

The environment is a wide-open landscape of exploration.

Throughout the scene, small characters or figures are gathered in a community event. The characters move and make sounds when they are approached. It is meant to delight and frighten simultaneously in an effort to create an emotional and subversive confrontation.

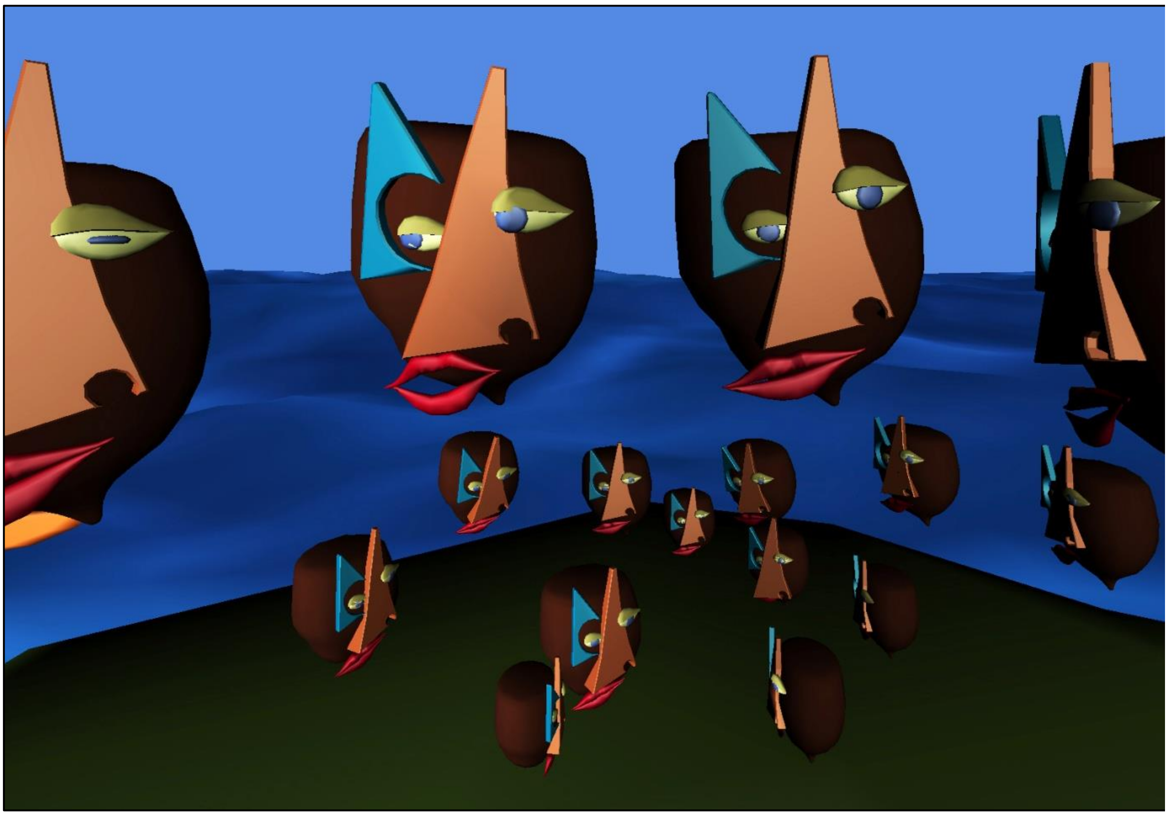


Figure 5.34 "*Figuratively Speaking*" Virtual Environment. The image shows a crowd of heads that move and speak when they are approached. The tilt of the heads and the direction of their focus attract attention.

5.1.4.0 **Operas and Musical performances**

The projection-based virtual environments expanded to the theatrical and performance stage when I began to create interactive projections for operas and musical events. Initially I collaborated with Timothy Nelson, the director of the American Opera Theater. Our first collaboration was called *Fleury: Massacre of the Innnocents*. This led to other collaborations both with Nelson and with the IU Jacobs School of Music. This is a short description of that work. It is significant because the virtual environment expanded to include real world stages on which projections were situated as another actor in the drama.

5.1.4.1 “ ***Fleury: Massacre of the Innocents”* 2007**

Figure 5.35 “*Testament of the Trinity*” M. Dolinsky 2005. Projection for the “*Fleury*” opera production.

The IU Jacobs School of Music's Early Music Institute, the HR Hope School of Fine Arts, and the Advanced Visualization Lab joined forces on a unique production of the French Medieval Latin liturgical drama *Interfectio Puerorum* or *Massacre of the Innocents* based on the 13th century *Fleury* Playbook. See Figure 5.35. Although the manuscript of 10 plays contains no intrinsic relationship to specific religious books or community, they demonstrate how liturgical drama evokes the rise of theatrical practices and allows the church to comment on non-ecclesiastical events. The *Interfectio* is arguably the most innovative play with its dramatic story of infanticide and apocalypse.

The *Massacre of the Innocents* is an episode from the Book of Matthew where the appointed King Herod is visited by the Magi looking for He that is born King of the Jews. Threatened, Herod subsequently orders the slaughter of Jewish children under the age of two. The play is a metaphor for the end of time, using references to the apocalyptic book of Revelations. This includes images of the innocents following the Lamb in a great procession and crying out to the angel to ask why they are forsaken. The angel responds that they should wait until the number of their brothers is complete. The innocents are slaughtered and resurrected.

The abstraction of time is significant. It is essential to play with the audience's temporal experience in order to effectively unfold the drama. The very nature of the work demands the necessity for abstraction in so many elements of the performance. And the very nature of our modern technologically savvy audience will require the technology to exhibit an inherent individuality. This requires temporal shocks and stimulation towards a non-linear experience. The imagery includes animations that fuse liturgical themes with contemporary imagery.

The methods to slow down time, to stop it and bend it will occur in the temporality of the major components: musical and choral performance, the movement of performers and visual imagery projections on the walls of the museum. Visual projections will extend the stages and allow the architectural space to become a source of action and broaden the play with an alternate visual component for the experiential sense of time. Each section of the audience should gain a unique vantage point because other levels of the museum will not be within clear eyesight. See Figure 5.36.

Figure 5.36 “*Fleury*” stage, IU Art museum.

The Fleury plays are imaginative accomplishments as theatrical pieces and demonstrate a clear grasp of stage action and characterization. The aim is to combine the liturgical and musical elements of the "*Interfectio Puerorum*" and juxtapose modern theatrical, architectural and digital techniques in order to infuse contemporary elements in the history of French Medieval Latin liturgical theatrical drama.

5.1.4.2 ***Sponsae Christi: Wives of Christ* 2008**

This musical performance included the world premier performances of the "*Sponsus*" play by Anon., from Paris Bib. Nat. ms. Lat. 1139 (Twelfth Century). This was a translation of early music by Professor Wendy Gillespie, Director of the Early Music Institute, IU Jacobs School of Music. The program that evening also included *Kyrie* (recorders) by Pierre de la Rue (c.1452-1518), "*Quinque prudentes virgins*" by Heinrich Isaac (c.1450-1517) and "*Gloria*" (viols) by Heinrich Isaac and others. See Figure 5.37.

Figure 5.37 "*Sponsae Christi:Wives of Christ*" February 2008. At the IU Art Museum using animated projections.

5.1.4.3 ***Fumeux Fume* 2009**

This production was also in collaboration with the IU Jacobs School of Music Early Music Institute. This production was lighter hearted, including some contemporary music in the same genre. The production occurred at the School of Music Auditorium. In this production, new technology of facial detection was used to capture the audience members and incorporate them into the projection on stage. The video was of a choir and as the audience was detected, the painting animation changed to incorporate the video capture of the audience's faces. The painting animation updated constantly with the newly captured videos. The update occurred in real time during the performance. The video captures resulted in a moving portrait of the audience singing with the choir. As more faces are captured, their videos are integrated into the main video animation. Eventually, the actual faces replace most of the painted faces in the video animation. See Figure 4.38 for the concert hall stage at "*Fumeux Fume*."

Figure 5.38 Musical collaboration, "*Fumeux Fume*" uses facial detection of audience in performance. As more faces of the audience members are captured, the videos are integrated into the main animation.

5.1.4.4 ***Annunciation † Visitation* 2010**

"Annunciation † Visitation" is the continuation of collaboration between artist Margaret Dolinsky and director Timothy Nelson. The first collaboration was presented in January 2007 at the IU Art Museum, entitled "*Fleury: Massacre of the Innocents*." This was the first attempt at thematically combining projected scenography with

new approaches to stage action in ways that not merely incorporated projections, but made them virtual sets with which performers could interact. This work takes that idea to the next level, creating a visual narrative that runs alongside the performers, but also with which they directly engage. From its inception, opera as a genre has always been on the forefront of scenic technologies and advancements. “*Annunciation † Visitation”* is another step on the path to forging a future for opera, questioning not only what opera is, but also what the experience is on a fundamental visual and psychological level for the audience.

“*Annunciation † Visitation”* is an opera performance combining seemingly incongruent musical compositions with experimental staging, and the significant use of new technologies. The project explores how technology can be thematically integrated into the dramatic and musical arts, while at the same time confronting issues relevant to the contemporary social and political discourse. The work depicts two vastly different expressions of female sexuality. It stretches the boundaries of what defines “opera,” breaking new ground as it defies genre classification, seeks to synthesize art and technology in increasingly deeper ways, and serves as an example of how opera can be a force for social commentary, dialogue, and change. The opera included projections that were integrated with such technologies as color tracking of the actors, interactive real time animation, live video feeds, blue-screening and facial detection of the audience. See Figure 5.39.

Figure 5.39. Sopranos Rebecca Duren and Emily Noel perform "*Annunciation † Visitation*" at the Buskirk-Chumley Theater Oct. 2009. Color tracking of the actors controlled the animation display.

5.1.4.5 ***Passion with Tropes* 2011**

Passion with Tropes is the latest collaboration done with the IU Jacobs School of Music, Department of Theater and Drama, Dance and Telecommunications. It was composed by Don Freund and conducted by Carmen-Helena Tellez. The projections became another element or actor on the stage. The images were manipulated in real time by sound activation, facial detection and/ or physical tracking of objects such as the conductor's baton. The meditation on the passion of Jesus is a musical collage of iconic poets and thinkers through the ages. It includes an immersive and interactive participation with audience members who sit on the stage with the performers in the middle of multiple projection screens including all four sides and the ceiling. See Figure 4.40. See accompanying disc for Videos 8-11.

Figure 5.40. “*Passion with Tropes*” opera composed by Don Freund and conducted by Carmen-Helena Tellez. Interactive screens and real time video manipulation was part of the scenery.

5.1.5.0 **Interactive installations**

After spending a number of years producing stage sets, it became important to incorporate elements of the stage technology into interactive art installations so that the pieces could have a life beyond the theatrical stage. The first piece of this kind was Emotable Portraits which included facial detection of the visitors and video capture of their faces, processing that video and compositing it in real time with one of my animations. The following pieces used interactive technologies and their descriptions follow:

5.1.5.1 ***Emotable Portraits***

Emotable Portraits is a video drama that uses a facial detection system to incorporate visitors' faces into a video diptych of The Saint and The Choir. Once the visitor is detected, her face appears in the eyes of the saint and is incorporated into the choir. The Choir displays real time visitors and previous visitors of the exhibition singing in the choir. The system can detect up to four faces simultaneously and can display them alongside eight pre-recorded faces. The more people who stand in front of the Saint, the louder the choir sings. See Figure 5.41.

Figure 5.41. “*Emotable Portraits*” M. Dolinsky June 2009. Installation at the Dean Johnson Gallery, Indianapolis, Indiana.

The imagery is inspired by Eastern Orthodox religious iconography with my own drawings, paintings, 3D modeling and photography. The goal is to create a moment of self-reflection and self-recognition in relationship to the larger whole of society. “*Emotable Portraits”* situates a techno-religious experience. *"Emotable Portraits"* is real-time portraiture invoking a social integration of the self into the art exhibition. Visitors who study the choir imagery become aware of everyone who has stopped at the exhibition and has been detected by the saint. The installation also has the ability to print postcards from real time image captures. Before departing, a visitor can print out a type of prayer postcard with the image of themselves incorporated in the eyes of The Saint or as a member of The Choir.

"Emotable Portraits" comes to full realization when the visitors' images are incorporated into the videos. What is significant is that one feels forever caught in the drama of the video system when one's face becomes embodied into the piece. The work relies on the notion of embodied interaction. *“Emotable Portraits”* communicates with visitors through a responsive system that detects their presence and shifts its morphing images to incorporate a newly arrived person.

The artwork subverts perception, illusion and self-projections to situate a perceptual shift in terms of artistic process. A perceptual shift is a cognitive recognition of having experienced something extra-marginal, on the boundaries of normal awareness, outside of conditioned attenuation. Neuroscience and cognitive science attempt to explain perceptual shifts through biological and perceptual mechanisms. Art is a process whereby they can be understood through visual and sound experience.

The imagery was originally created for operatic performances of liturgical dramas performed with the Indiana University Jacobs School of Music Early Music Institute. The audio is from a performance of *Fleury*'s *Interfectio Puerorum* at the IU Art Museum.

5.1.5.2 ***Poke Holes in My thoughts (swimming on the edge)***

Immersion in water and immersion in the environment are worldly phenomena which, in the digital arts, are a common aesthetic theme. That theme is explored in this immersive arts environment, *Poke holes in my thoughts (swimming at the edge)*. *Poke holes* simulates the edge of a pond where visitors can touch the water to make it ripple or even jump in and scare the fish. The visitors' motions trigger water-drop audio events. The pond is mapped with a range of low to high notes based on vertical and horizontal location of the hands and head adding an interactive musical component. If one crosses the virtual surface of the pond, the appearance of their reflection changes to simulate appearing partially submersed underwater. If they touch that surface with a finger, it ripples. With a hand, the water ripples have a wavy appearance. When an arm is put beyond the virtual surface, the fish swim away very quickly. See Figure 5.43. For videos, see accompanying disc for Video 4.

Figure 5.42. “*Poke Holes in my Thoughts* (*Swimming on the Edge*)” M. Dolinsky. Interactive installation that accommodates up to four people at one time. Photo: William Sherman.

5.1.5.3 ***Walk into my photo! Isn't it a dream?***

Walk into my photo! Isn't it a dream? is interactive art using body detection. It creates a wondrous moment by exploiting imagery that transforms depending on how closely a visitor stands to it. It is meant to invoke memories of the type that we have when we look at old photos or picture postcards. The artwork is an attempt at allowing us to walk through our imagination.

Visitors are invited to look at what appears to be a distant foggy vacation photo. When they physically walk towards the snapshot image projected on the wall, the imagery in the “photo” responds to the visitor’s presence, expanding, and in turn igniting a real time interactive animation. The video simulates being in a whimsical forest with colorful characters, or emotables that appear to pop up amongst the trees. Walking backwards and forwards in front of the small photo projected on the wall, changes the size and shape of the image. As the visitor steps closer to get a good look, the clarity of the animation is revealed. The physical movement of going back and forth to examine the projection is a metaphor for the way that imagery invokes our emotions. The longer we look at an image from our past, the more we are able to recall different instantiations of the memories. In effect, the visitor’s embodiment in the artwork – their walking with the realization of the imagery—causes the imagery to become a part of their emotional and physical body. This generates even new memories. Hence the subtext of the title, *Walk into my photo! Isn't it a dream?*

See Figure 5.43. For videos, see accompanying disc for Video 5.

Figure 5.43 “*Walk into my photo! -Isn’t it a dream?*” M. Dolinsky. Interactive installation that initially appears small and fills with color when you have a closer look.

5.1.5.4 ***It's all about you!***

"It's all about you!" is an interactive animation that suspends visitors within a virtual dilemma; it is a real time role play in the Cartesian mind/body problem. As the visitor steps in front of the video projection, their face is detected and captured in a live video playback. Their portrait is integrated into the projection to complete the animation. Meanwhile, the video is being processed to appear with a painterly quality similar to the video animation. The whimsical and surreal scene portrays a nude androgynous person or character that shows a variety of emotions over what seemingly is their day to night from awake to asleep. The character is surrounded by their own thought bubbles, which range from simple to abstract forms representing memes and their combinatory dynamic. Many thoughts drift aimlessly in the sky while others are anchored to the character. Two major thought bubbles emanate from the character in the animation – one from their head, the other, from their heart. The visitors' video portraits can be captured in either of the two thought bubbles, with up to two people being captured at any one time. Each detected visitor's face appears randomly in the head or heart position. The animation is inspired from a whimsical sketch that has

since been realized as hand brushed oil on canvas that illustrates the mind/body split as a psychic dilemma. See Figure 5.44. For video, see disc for Video 3.

Figure 5.44 "*It's all about you!*" M. Dolinsky 2011. An interactive installation using facial detection.

5.1.6.0 **Strategies and analogies in virtual environment art**

In creating and reflecting on the above interactive artworks I have determined strategies for using analogies and situating perceptual thinking. This was motivated by the previous examination of Hofstadter's philosophy regarding analogies and Arnheim's philosophy regarding visual thinking. The use of particular visual analogies in the artwork provokes a certain type of interaction.

The interaction does not depend on the typical navigation structures of desktop computers, online communities or commercial video games. In order to move through the environment, there are no drop-down menus and no folders to click and open. There is no virtual gun or graphical intermediary to follow around in order to know which direction to pursue.

The visual elements become analogies for psychological moments, much in the same way that the paintings depict people in a particular contemplative moment or predicament. The positioning of objects that act as analogies or abstractions in the work motivates interaction and allows for contemplative moments in virtual environments.

Tables were constructed to examine some of the strategies used for virtual environments. The chart includes the strategy or 3D object, its navigation purpose, what analogy it might stand for and what it establishes for the visitor in terms of navigation. The environments are deconstructed in terms of how the imagery is used as a motivation for establishing interaction strategies.

5.1.6.1 **Analogies in virtual environments - virtual reality**

The circumstances in the virtual environment evoke a particular concept. The action is in the visual strategies, which evoke categories or analogies. The visitor becomes a feature detector and determines the features of the environment and how to pursue them. The mental categories the visitor creates are based on the visual analogies created in the space. For example, in the virtual environment, *Beat Box*, the interaction is based on three audio sequencers. The machines work very similarly but appear a bit different and produce unique results. By learning one machine, the other machines are easily navigated. The visitor adds sounds to a head, which is an interval of the machine. In effect, the visitor gives a voice to the character and changes the appearance of the character. The character is mobile, emotive and malleable which causes a visual update of the environment. By discovering and changing the characters, the visitors interact with the characters, which can offer an update to the emotional landscape.

The CAVE VR environments do not have constrained navigation, so the visitor is free to move about in all directions. In these virtual environments, the objects become the navigational signposts and give the visitors clues on which direction to travel. The complexities of the objects serve as navigational moments. The objects are the waypoints and way stations at which to linger and explore. The objects also become analogies for psychological moments, much in the same way that the paintings depict people in a particular contemplative moment or predicament. The positioning of 3D objects that act as analogies or abstractions allow for these moments in virtual environments.

A list of some of the successful visual elements that I have used is compiled in charts. See Figure 5.45. These charts are grouped in terms of the type of virtual environment. The charts include the element or 3D object, its navigation purpose, what analogy it might stand for, what it establishes for the visitor in terms of navigation and what strategy for generalizations I was using to facilitate an experiential moment. Each chart is followed by an explanatory paragraph explaining the approaches with specific examples. I lay down the foundation of my strategies in earlier environments in order to demonstrate that there is a trajectory of creativity based on the stream of consciousness awareness and the earlier pieces scaffold the strategies of the later pieces.

Virtual environments and Hofstadter's generalizations are abbreviated as follows:

DG: "*Dream Grrrls*"

SD: "*Strait Dope*"

BWP: "*Blue Window Pane*"

BB: "*Beat Box*"

CoD: "*Cabinet of Dreams*"

FS: *Figuratively Speaking*"

IB: Moving internal boundaries back and forth

SW: Swapping components or shifting substructures from one level to another

MG: Merging two substructures into one or breaking one substructure into two

LG: Lengthening or shortening a given component

AG: Adding new components or new levels of structure

RG: Replacing one concept by a closely related one

RV: Trying out the effect of reversals on various conceptual levels

3D object/strategy	Navigation purpose	Analogy	Establishes	Virtual Envir	Hofstadter Generalize
anchor environment - place of return	Starting point, main environment	Home - Place of familiarity You can always go home Resting space Understand your path Determine the next exploration	Control of direction, Self control	DG Oorrt cloud labyrinth BB Confluxus CoD Hallways with rooms	LG AG
windows shattering	Transition to a new environment	Traveling Making decisions Moving from one venue to another	Uncertainty, Movement, Experiencing transition	BWP	MG
Heads	Lead you to a place they sing to you when you arrive	Come face to face with another entity Feel not alone	Camaraderie Safe space Fun space	SD FS	AG RG IB
Guards -objects morphing	Seemingly prevents further navigation, proceed at your own risk	Sentry guard, Warning, signpost	Some hesitation, trepidation, proceed with caution	BWP FS	AG RG IB RV
Faces - masks - stares	Site of transition or revelation	Come face to face with a psychic dilemma	Moment of reflection or psychic connection	SD BWP FS	IB AG
Faces - eyes opening or voice is heard	Move towards a face or mask and the eyes	Coming eye to eye with an emotable in the	Identification with beings that live in the	DG SD BWP BB CoD FS	RG RV AG

	open or the face makes a sound	environment	environment, you are walking in their world		
stairs	Movement in a particular direction	Climbing stairs to another height or psychic level, deeper contemplation	Guides direction	BWP BB	SW MG LG AG

Figure 5.45 This chart outlines artistic elements to facilitate navigation used in Dolinsky's virtual environments. The 3D objects are circumstances or points of interest to help the visitor find their way. The analogies enhance the emotional landscape of the environment.

As I create a virtual environment I am creating aesthetics as behavior. We act and react in a world of constructions whether we are witnessing the real, a dream or the virtual. Our consciousness and our perceptions shift to accommodate our surroundings. As an artist, I feel a responsibility to construct aesthetic moments. In order to convey an idea or a thought as an aesthetic moment I realize that certain connections have to be invoked in the visitor so that a direction can be invoked. I often think of the work as creating a series of subversive confrontations, as if setting up the magic trick, I am constructing, directions, possibilities and circumstances. I can reveal how the drawings are created, I list some of the analogies that they invoke and I can add theoretical ideas to provide ways to assimilate my methods even further. One of the streams of theories that I have chosen is Douglas Hofstadter's work because he subscribes to the notion of the narrative self: that the self is ultimately a hypothetical construct that is constantly weaving a story of connections between all that we encounter. Key to developing our knowledge is the ability to internally reconfigure an idea. (Hofstadter 1995:77) This occurs whenever we are in doubt and we reconfigure our circumstances by making generalizations. These generalizations lead to categories and concepts which establishes the flow of our analogies – the core of our cognition.

In the flow of the virtual environment, we encounter new circumstances and must reconfigure our decisions –especially in novel situations such as an art environment. For these reasons, the elements in my virtual environments act as waypoints or icons to lead the visitor through a personal journey. There is no hierarchy of movement and no proper sequence of direction but rather it is a stream of consciousness direction that I establish. I will discuss some elements that reoccur in my work and how they relate to Hofstadter's list of generalizations.

The first generalization is the idea of moving boundaries back and forth. We can say mathematically that a=1 and whenever we see 'a' we can think of '1'. So in the virtual environments, we might see computer graphics and know that they are not real objects, but we can react to them as real objects. So for that time, we incorporate the virtual as if it were the real world. This is one level of generalization. At another level, for example, an opening in the wall, where there really is no wall, actually becomes a door or passage to another space. Our internal boundaries move back and forth to say that the virtual world is new and then it becomes familiar and integrated to be a part of our world.

In a more specific example, the first list item is an environment as the anchor place, the space that we will return to again and again. This space establishes a home base as the visitor travels between worlds so that they have a place of familiarity and recognizes that they are comfortably directing their sequence. It establishes a control center and a sense of self –control. This allows the visitor to reconfigure the scenes in a lengthening or shortening effect. The visitor can generalize that the home base is a place to start, end or begin a new adventure. See the home environment called "*The Oort Cloud*" which leads to other environments, including "*Dream Grrrls*." Figure 5.46.

Figure 5.46 "*The Oort cloud*" Marcus Thiebaux. VR still. In the oort, a number of stations are visual markers to other worlds. Seen here is the station for "*Dream Grrrls*" with a representation of the world in the distance. By stepping on the adjoining marker one is glided towards the world and when the globe of heads is approached, the scene transitions to "*Dream Grrrls*". Installed at the Ars Electronica Center in 1996.

From the home environment, things will happen… but how? The graphics change and the visitor reacts. For example the second item on the list occurs in "*Blue Window Pane II*." The main room has arched windows that will shatter when approached. This takes the visitor to another environment. It represents surprises on the journey. In understanding what is occurring we use the generalization where we realize that substructures can merge and break apart to become other structures. See Figure 5.47.

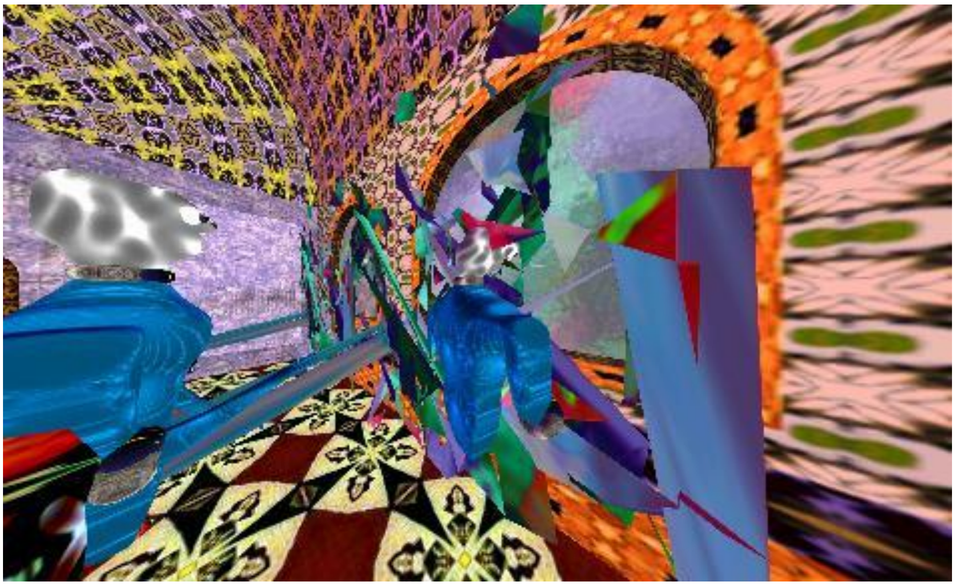


Figure 5.47 “*Blue Window Pane II*” M. Dolinsky. VR Still. When the visitor approaches the windows, they shatter and a spray of colorful computer graphics temporarily and metaphorically “blinds” the visitor with surprise. Then suddenly the scene changes and the visitor is in another environment.

The use of heads or faces or emotables is used throughout my work. They welcome you, lead you to a place, and they sing for you. This is an effort to make the visitor feel not alone. That this is a place of camaraderie and a safe space, a fun space. Even when the faces have a small element of fright, their bright colors and multi-variant patterns provide levity. All the methods of generalizations will apply to the instance of faces depending on the circumstances. For the most part, they move internal boundaries back and forth as they are in the scene and then in “conversation” with the visitor. They also add new components and new levels of structure to the environment because they are often central to the actions that the visitor must complete to move through the environments. They often will replace one concept with another one. For example, a face will become a doorway or a musical instrument or a group of faces will signify a good place to gather. In “*Figuratively Speaking*” some of the emotables are talking at once in a small grouping. As the visitor approaches the heads their voices become more audible. The visitor can generalize that because all the emotables are in one place that is a significant place to be. And indeed, travel to that area reveals new sound perceptions. See Figure 5.48.

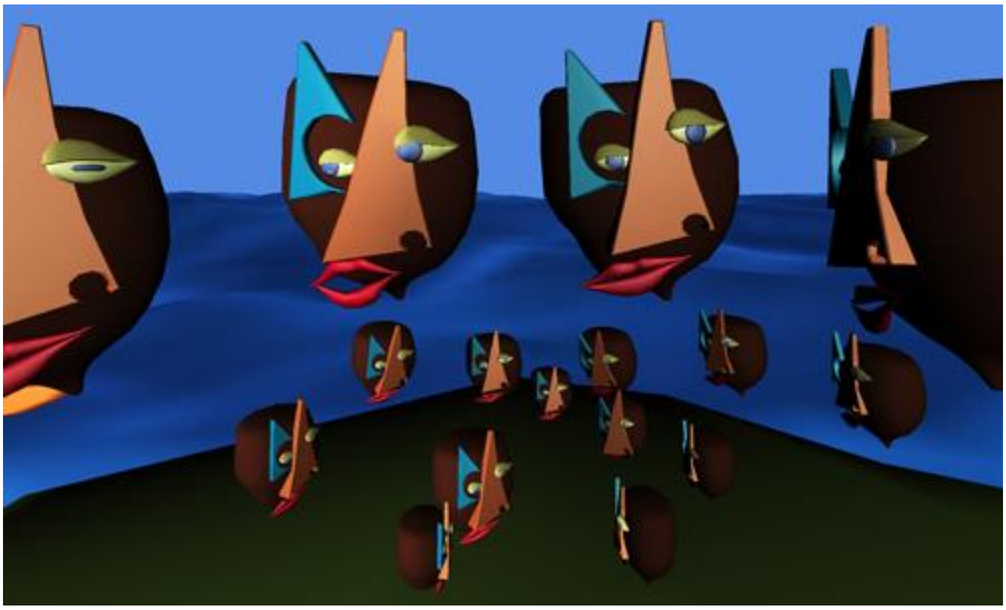


Figure 5.48 "*Figuratively Speaking*" M. Dolinsky. VR Still. The faces are talking at once in a small grouping. As the visitor approaches the heads their voices become more audible. We can generalize that because all the emotables are in one place that is a significant place to be. Indeed, travel to that area reveals new sound perceptions.

I often use what I term "guards" in my environments. The guards act as if they are soldiers guarding an area. Typically it is somewhere that one is not meant to go and represents the innermost psyche. In "*Figuratively* Speaking" the emotable acts as a guard at the bottom of a mountain. It tries to prevent anyone from continuing further. If the visitor moves closer to the path, the guards will gesticulate and wave their arms in protest, often calling out a sound to further their wishes. If the visitor overcomes the guard and continues past, the environment will change in some way to reflect a new consciousness a new stance in that space and a new location. In Figuratively

Speaking, a large sculptural monument animates and becomes reconfigured. It seems to crush someone and the space opens up and provides a clear view of the sky and sea at the top of the mountain. See Figure 5.49. The act of overcoming the guard symbolizes overcoming your own trepidations and the act of seeing the environment change is analogous to seeing your own world in a new way with new connections and seeing a new vista or a clear view is analogous to a fresh start. This may be an instance of trying out the effect of reversals on various conceptual levels when we refer to Hofstadter's generalizations. This process also includes such generalizations as moving internal boundaries back and forth, adding new components or new levels of structure and replacing one concept by a closely related one.

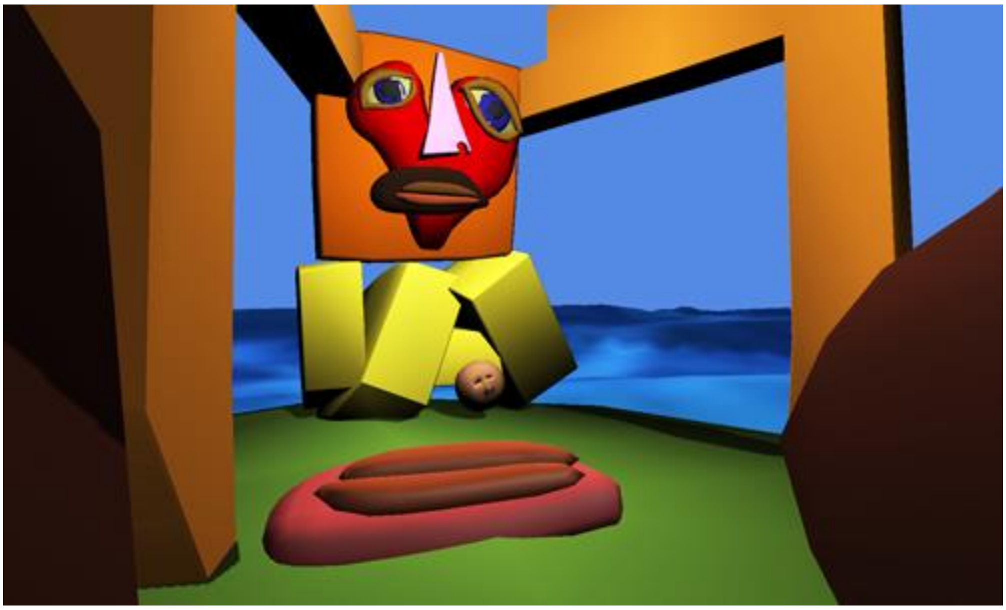


Figure 5.49 “*Figuratively Speaking*” M. Dolinsky. VR Still. The emotable acts as a guard to prevent anyone from continuing further. If the visitor continues, the guards will gesticulate and wave their arms in protest, often calling out a sound to further their expressions. If the visitor overcomes the guard and continues past, the environment will change in some way to reflect a new consciousness a new stance in that space and a new location.

Just as the emotables act as entities, their faces are elements that stand in as masks. They are analogies to sites of transitions or a place for revelations. They represent a time when someone can come “face-to-face” with a dilemma. Unmasking a face is a moment of revealing something that may have not be realized before. It is a moment of reflection or psychic connection. Masks occur as emotables in “*Strait Dope*,” “*Blue Window Pane*” and “*Figuratively Speaking*” and it is a motif found in all of my work and represents a way to generalize from the exterior circumstances to the interior feeling sense. According to the list of generalizations, here I employ moving internal boundaries back and forth. The environment in “*Figuratively Speaking*” is completely created with emotables and the smaller elements that make up the emotables become the larger elements of the environment. The nose of the emotable becomes a tree in a forest of trees. Inside the forest, are two figures hidden in conversation. It is a sanctuary for consultation where a younger emotable is listening to the wise teachings of an experienced emotable. The space is called the "Forest of Knowses." See Figure 5.50.

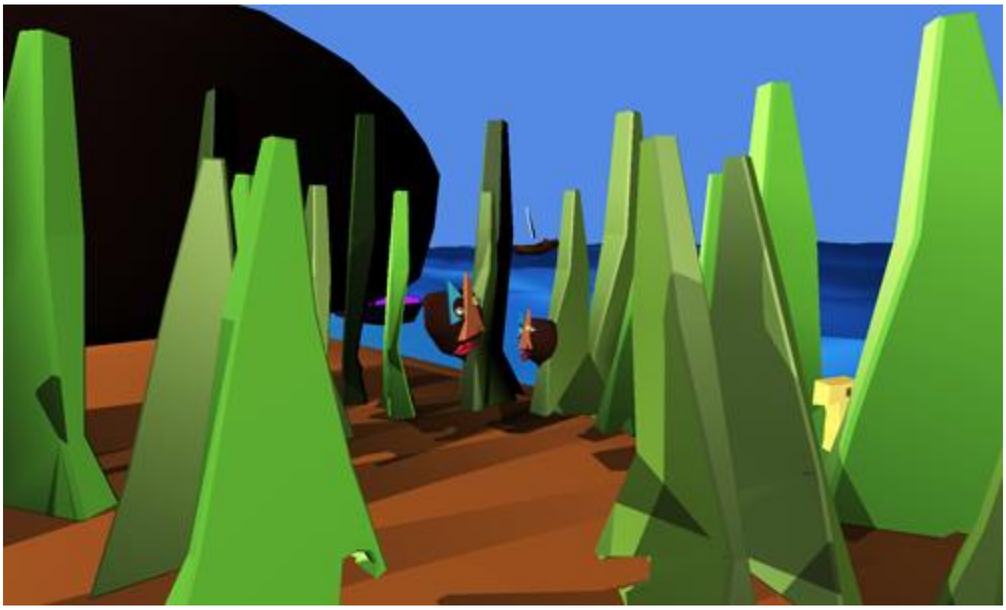


Figure 5.50 "*Figuratively Speaking*" M. Dolinsky. VR Still. "*Figuratively Speaking*" is completely created with emotables and the smaller elements that make up the emotables become the larger elements of the environment. Here one nose of an emotable becomes a tree. Inside the trees are two figures in conversation. The space is called the "*Forest of Knowses*".

The eyes of the emotables play a central role in my work as well. In terms of generalizations, they replace one concept with a closely related one. An emotable with closed eyes will open its eyes once the visitor approaches. The eyes opening represents a voice being heard. It is a more intimate act than face to face, suddenly it is eye to eye. It represents the acknowledgement that we are in another person's space and immersed in their world. We get it because we meet eye to eye. The emotable here has greater significance than many of the other emotables who occupy the landscape. This emotable is especially important and is an entity that requires action and reaction. It often is a transition to another level – both in the environment and in feeling sensing. We intuitively know that this emotable is different. In "Blue Window Pane II" an emotable will be chanting OM until it is approached. Then the eyes open and the audio changes. If the visitor moves in closely to the eyes, the world becomes a spinning tunnel with voices. The end of the tunnel leads to an inner sanctum. For the emotable as mask see Figure 5.51.

Figure 5.51 "*Blue Window Pane II*" M. Dolinsky. Photograph in the CAVE. The emotable appears as a mask that has its eyes closed until it is approached and it stops its repetitive chant of OM. When the visitor comes eye to eye with the emotable, the scene will transition to a rotating tunnel that represents the turnings of the unconscious. The emotable as a mask is generalized as a doorway to another environment as well as doorway to perception.

Stairs occur in all of the environment in the form of stairwells, spiral staircases and ramps. Some of the stairwells are visible but not reachable. Oftentimes the stop of the stairwell allows you to fly or transition to another scene. The stairwell is functional in that it facilitates a movement in a particular direction. Stairwells represent climbing to another height or deeper sense of contemplation. Many of the stairwells are combined with faces and become a type of hidden emotable because they provide stairs as well as stares. In terms of Hofstadter's list of generalizations, the stairs work across a number of generalizations. Moving from one place in the environment to another visitors to shifting substructures from one level to another. When the stairs allow us to fly we can realize that they serve multiple functions so that the general component is shortened to stairs or lengthened to another method of travel, .i.e., flying. When the stairs appear but do not move we see a wall become a substructure and moving about causes the substructure to break into two. When the stairs are giving off stares, we generalize that there are added new components or new levels of structure. The strongest use of stairs appears in the "*Blue Window Pane II*" stair scene where there are stairwells, spiral staircases, the ability to fly and transition scenes at the top of the tallest central staircase. In effect, the stairs stare back and steer back to the main environment. These visual and literary word plays are a method of creating generalizations in order to integrate the self in the scene. See Figure 5.52.

Figure 5.52 "*Blue Window Pane II*" M. Dolinsky. VR Still. Many faces and stairwells make up the scene. The stairs are representative of travel in the environment as well as gaining a height towards a deeper psychic level or deeper contemplation. Here the scene also "stares" back.

Another component of the emotable is the adornments that are integrated into its body. In Beat Box, the audio sequencers are designated by a row of emotables. The visitor can choose sound selections and place the sound at an interval on the sequencer. This sound is attached visually by placing a necklace around the neck. Each color represents a different percussion sound. The generalizations occur that we swap components, the sound and the necklace, the head and the interval and we use the head as another substructure an audio sequencer. As we begin to deconstruct the environment by realizing how the components relate to other components we can integrate the emotables into our own experience. See Figure 5.53.

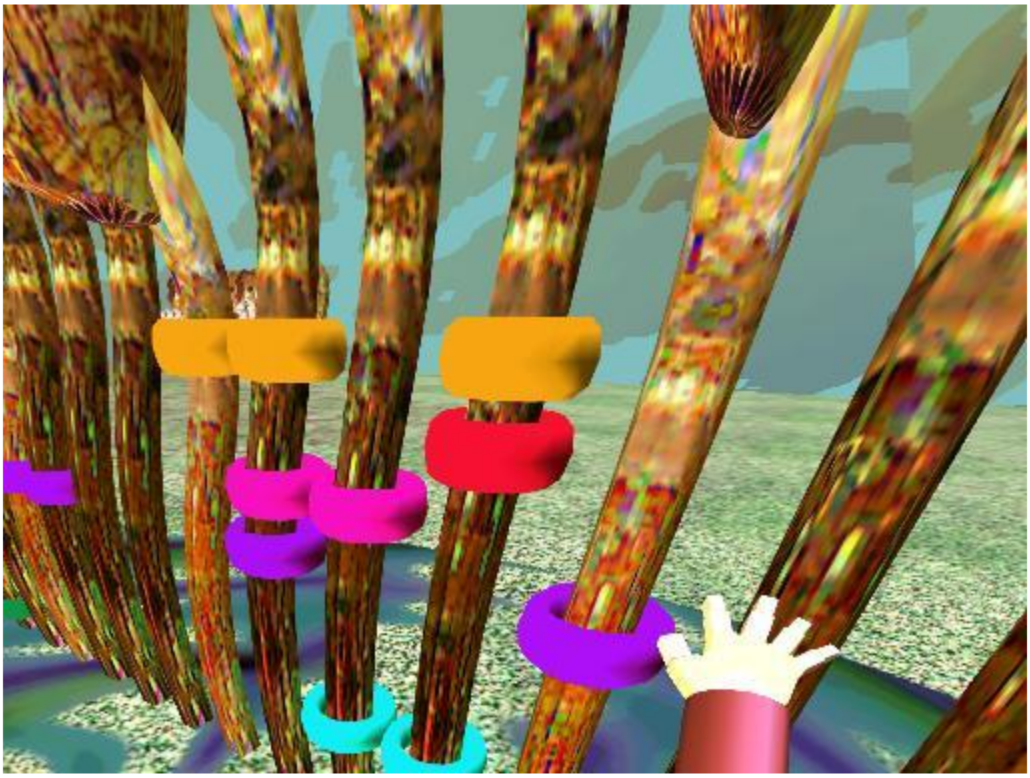


Figure 5.53 “*Beat Box*” M. Dolinsky VR Still. An audio sequencer is made up of a series of emotables with long necks that hold necklaces. Each necklace represents a sound sample that the visitor has placed at an interval on the sequencer.

IB: Moving internal boundaries back and forth
SW: Swapping components or shifting substructures from one level to another
MG: Merging two substructures into one or breaking one substructure into two
LG: Lengthening or shortening a given component
AG: Adding new components or new levels of structure
RG: Replacing one concept by a closely related one
RV: Trying out the effect of reversals on various conceptual levels

3D object/ element	Aesthetic purpose	Analogy	Establishes	Virtual Enviro	Hofstadter Generalize
Sound activated graphics	graphics and shape changes according to the parameters of the new music introduced	Gives voice to an object	Allows objects to have a character or individual quality through them having a voice, or a say within the environment	BWP SD BB FS	LG, AG
light variations darkness - flashlight	See in the dark	Blinded by the hidden messages	Alternative viewing, seeking structure	BWP DG	MG, IB, RV
blinding lights	Cannot see in the light	Flooded with light and blinded by light	Pause, concern, re-establishment of priorities	BWP SD CoD	IB SW MG LG
light variations - color fields	Navigation not based on visual imagery	Sea of color Seeing through the senses	Emotional moment, abstract , seeking	SD DG FS	RG
Height - sense of elevation	clouds stairs mountains	Raising up Rising up Taller than you are	Sense of heights, fear, trepidation, exhilaration	DG BWP BB CoD	RG LG MG
interior/exterior	Interiors, inner sanctums, garage/house	Comfort, cocoon	Safety, pause, sanctuary	All	IB SW AG
surface qualities	grass sea air -sky	Textural modalities	Sense of place and sense of space	All	A, RG
cubism -shifting abstract shapes	Slowing of visitor	Uncertainty Curiosity	Exploration, desire to see from all angles	DG SD FS	RV SW IB

Recurring icon	Wayfinding through object identification example, key is always the way out	Key to finding a way through the environment, a friend	An icon for strength, stability, reliance	BWP FS DG	MG, LG, AG RG

Figure 5.54 This chart outlines artistic elements that guide the navigation in Dolinsky's virtual environments. The 3D objects are circumstances or point so interest to help the visitor find their way. The analogies enhance the emotional landscape of the environment.

Looking further into the elements that appear in my artwork I am using analogy in Hofstadter's sense that analogy is the perception of the communication essence between two things during one's current state of mind (Hofstadter 2006). See Figure 5.54. Sound will seem to emanate directly from the emotables when audio files are linked with their location in space and triggered by the visitor's approach. When the emotable is sound activated, they will change shapes according to the parameters set to the music. For example, the loudness of a sound will increase the scale of the object's appearance. If the sound changes rapidly, the emotable's scale and shape will change giving them an animated appearance that corresponds to the audio levels and frequency. This emotable-audio coupling is an effort to have the emotable appear more as a character with individual qualities that represents their unique voice. This element lends itself to generalizations that integrate the emotables into the world and our world. We can see that the audio lengthens and shortens a given component visually by changing its shape and mass. Also, by coupling the audio it adds a new component-audio- and provides a new level of structure- the unique voice on an animated body. In the environment, “Beat Box” sound activated graphics provides visual cues for the visitor to know which interval on the sequencer is active. When the head enlarges, it is coupled with a unique audio configuration that the visitor has set through their own interactions. The results are that the emotable appears to have a voice and is speaking with their unique sound configuration. See Figure 5.55

Figure 5.55 “*Beat Box*” M. Dolinsky. Sound activated graphics provides visual cues for the visitor to know which interval on the sequencer is active. When the head enlarges it plays a unique sound and appears to have a unique voice.

The general appearance of emotables can change and the general appearance of the environment can change as well. The light variations in an environment can resemble brightness or darkness. In “Dream Grrrls” the navigation wand acts as a flashlight so that visitors can see inside a dark room that represents a nightmare. This establishes a shifting in the mood and an alternative method for finding the way to navigate around and out of the environment. By moving into the darkness and the images on the walls that appear to be causing the darkness one in effect confronts their fears and is released back to a world of safety. The generalizations include moving internal boundaries back and forth by going from a light to a dark environment and using the wand as a flashlight. This also s method for breaking one substructure into two as a wand and light and environmentally as well where we now have a VR world with a new challenge of a dimly lit VR world and trying out the effect of reversals on various conceptual levels. We situate our ideas of being in light and dark within the virtual environment as the light source becomes pointing our hand with the navigation wand. See Figure 5.56.

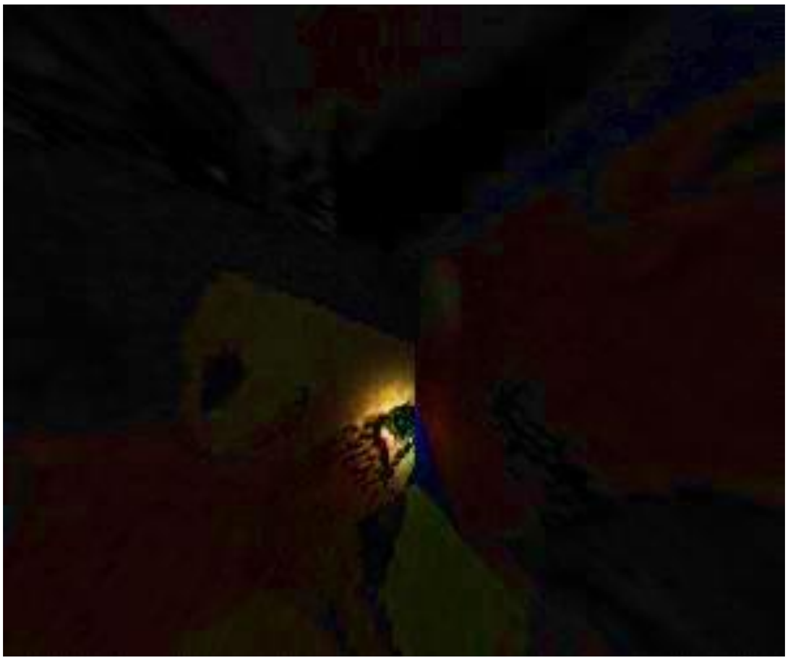


Figure 5.56 “*Dream Grrrls*” M. Dolinsky, Grit Sehmisch 1996. The environment becomes very dark and the navigation wand becomes a flash light. This is analogous to discovering new ways of traveling in the dark and ideas of self-discovery.

In juxtaposition to bright and dark are scenes that emphasize a single color as a respite or calming devise. The navigation is not based on specific visual imagery but rather the expanse of a color. The generalization here is that we are replacing one concept by a closely related one. The sense of space occupied by objects is replaced by a sense of space without objects. This type of scene will occur after a significant event or particular achievement in the scene. For example, when the visitor moves past the guards in “*Figuratively Speaking*” and the sculpture animates to a very different and surprising configuration the world becomes placid. There is a large sea of blue and there are no more demands made of the visitor – they have climbed the mountain both literally and figuratively. The sea scape is a play on see scape. The visitor is now in the land of sees – and sees where navigational accomplishments have led: to the zenith of the mountain with the calm seas to behold. The visitor climbs a mountain to the "*Land of Sees*" where the blue water and sky offers an expanse of color where we can generalize that the world can be filled with objects or not filled with objects but contains us all the same. We have the ability to see it in many ways depending on the vantage point. See Figure 5.57.

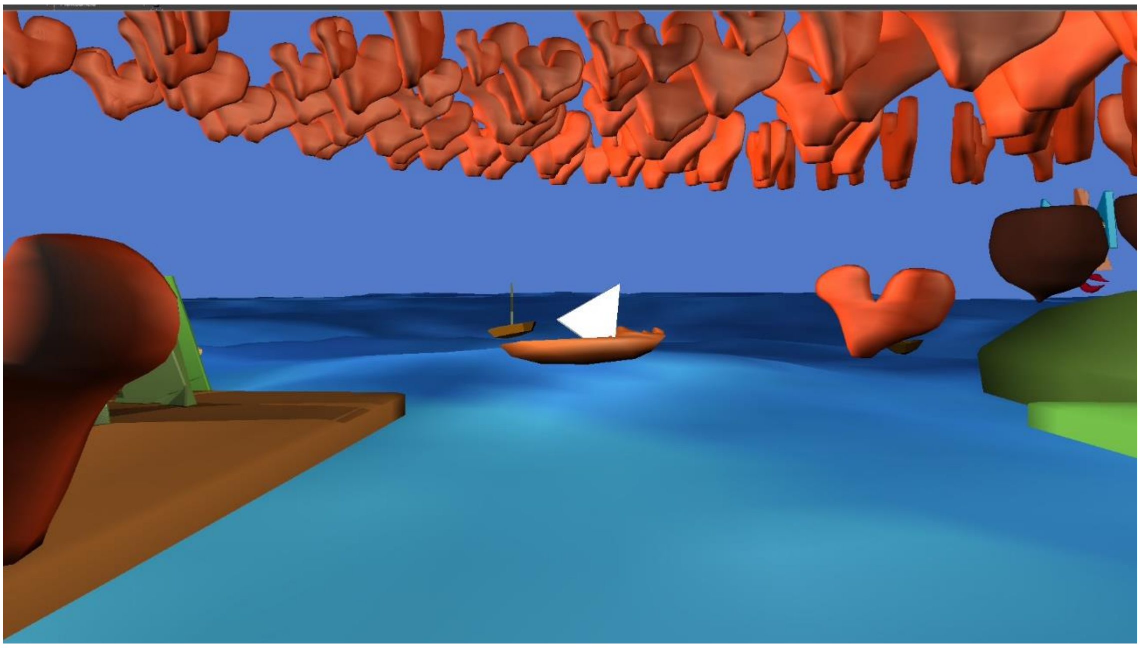


Figure 5.57 “*Figuratively Speaking*” M. Dolinsky. The visitor climbs a mountain to the “Land of Sees” where the blue water and sky offers an expanse of color where we can generalize that the world can be filled with objects or not filled with objects but contains us all the same. We have the ability to see it in many ways depending on our state of consciousness and what we connect with.

A similar trope occurs in the “*See-Saw World”* of “*Dream Grrrls*.” Here the emotable is attached to your peripheral vision and asks you to play. When the visitor follows the emotable, they join together in a game of see-saw in the clouds. Although there is no actual see-saw, the spheres of emotables act as a see-saw to carry the visitor and the emotable in a sea of clouds high in the air. We can generalize from the playground see-saw to the virtual spheres as a see-saw. See Figure 5.58.

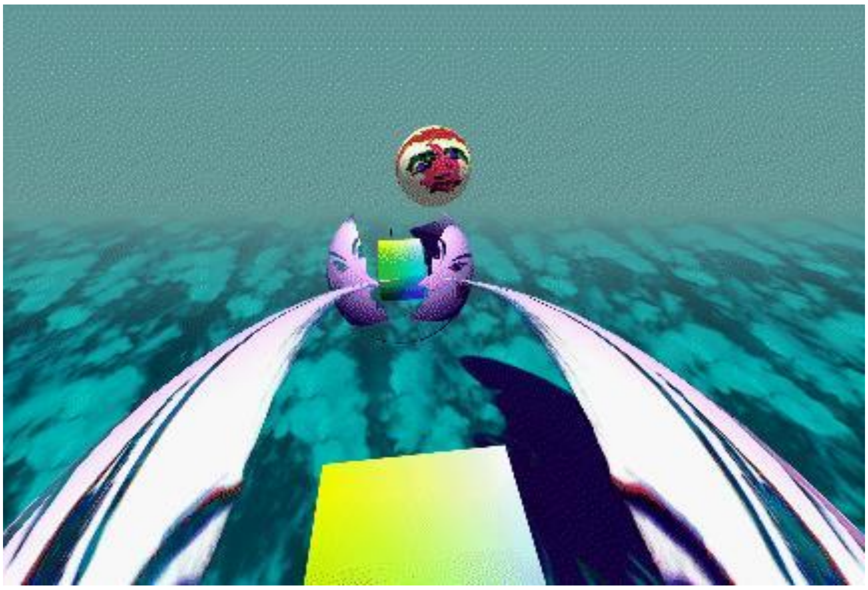


Figure 5.58 “*Dream Grrrls*” M. Dolinsky, Grit Sehmisch 1996. In the “See-Saw World,” the spheres of emotables act as a see-saw to carry the visitor and the emotable in a sea of clouds high in the air.

Along with the color expanse in these scenes and with other scenes, height is a trope that I use in the environments to offer the visitor a new perspective or a new way to look at a situation. The effect is greater in the CAVE environment where the walls offer a way to look out towards the expanse in front of the visitor and the floor offers a way to look down and into the expanse below us. Generalizations that I am trying to create include replacing one concept by a closely related one in that height in the real world can be similar to height in a virtual world. Also lengthening or shortening a given component where the viewpoint changes as we rise up to gain a feeling of tall or as we climb down to gain a feeling of grounded-ness. By merging these two experiences of height – grounded and above ground level - we are merging two substructures into one experience. This strategy occurs in the “*See-Saw World”* of “*Dream Grrrls*,” the “*Stair scene”* of “*Blue Window Pane II”* and in the “*Land of the Sees”* in “*Figuratively Speaking*.” In the “*See-Saw World*,” the spheres of emotables act as a see-saw to carry the visitor and the emotable in a sea of clouds high in the air. In the “*Stair scene”* a sense of height is gained by climbing the central spiral staircase and jumping off the stairs. The height is a generalization of how height is experienced in the real world and metaphor for a new lease on life and gaining a new perspective. In the “*Land of the Sees”* a mountain is climbed and a sculpture reconfigures itself to reveal an expansive viewpoint. The concept of travel and height is generalized to be able to travel up into the mountains in the virtual world. See Figures 5.58, 5.59 and 5.60.

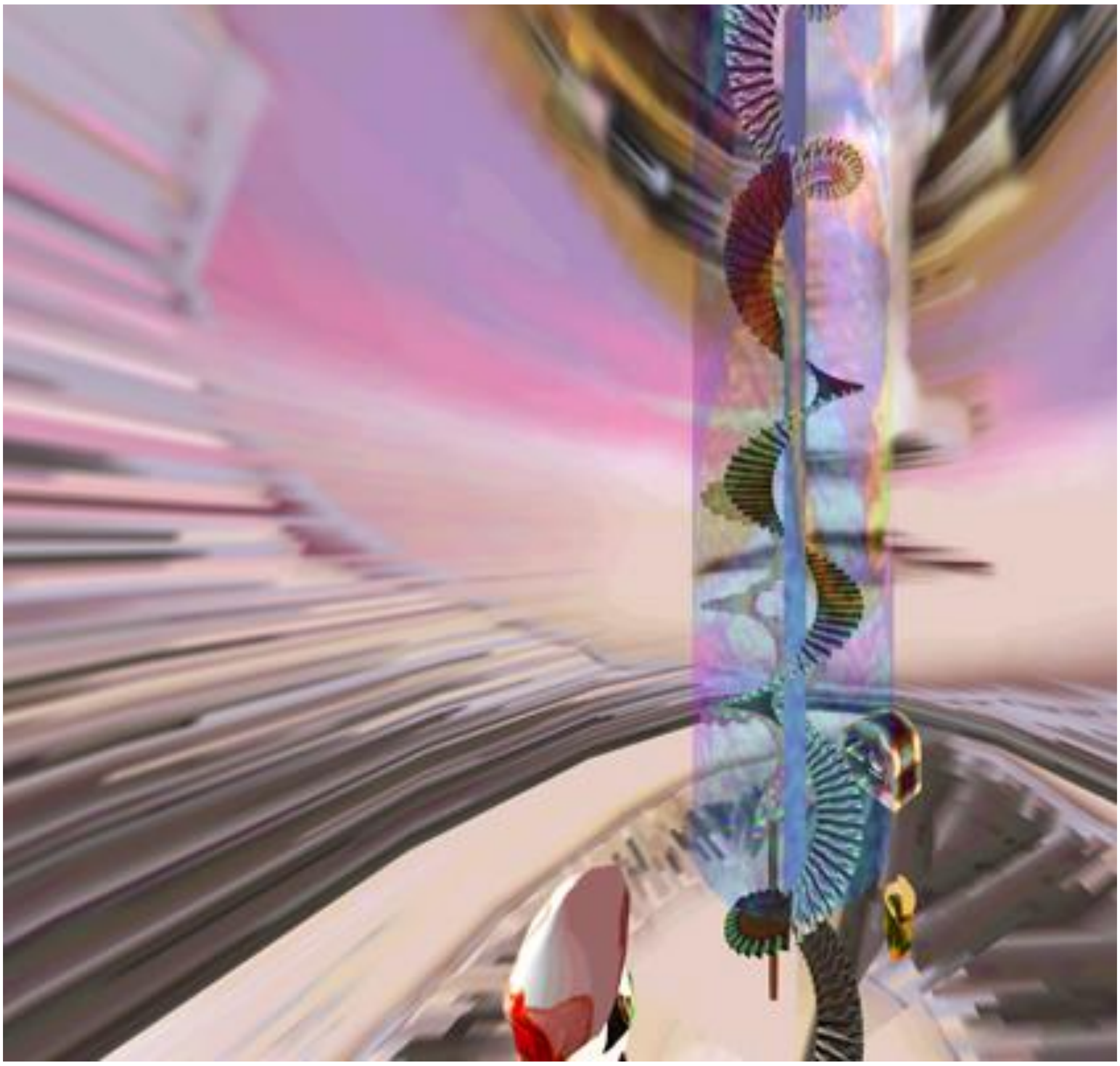


Figure 5.59 “*Blue Window Pane II*” M. Dolinsky. In the “*Stair Scene*” a sense of height is gained by climbing the central spiral staircase and jumping off the stairs. The height is a generalization of how height is experienced in the real world and is a metaphor for a new lease on life and gaining a new perspective.

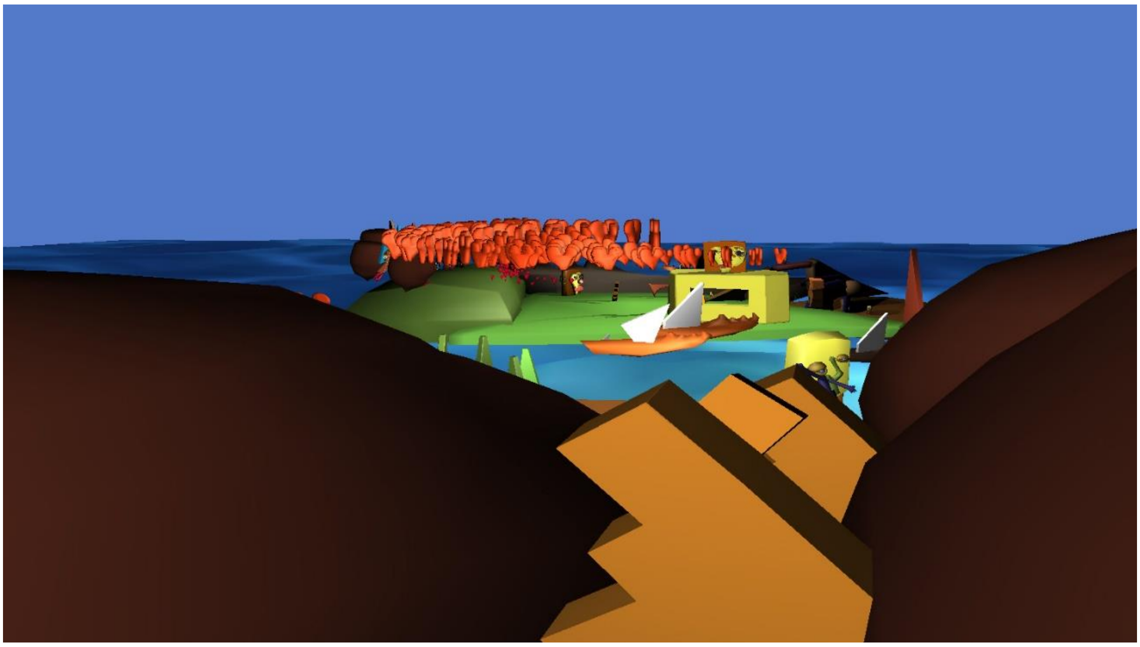


Figure 5.60 “*Figuratively Speaking*” M. Dolinsky In the “*Land of the Sees*” a mountain is climbed and a sculpture reconfigures itself to reveal an expansive viewpoint. The concept of travel and height is generalized to be able to travel up into the mountains in the virtual world.

The environments are created to be explored on several levels of interiors and exteriors that primarily constitute the generalization of moving internal boundaries back and forth. Many of the environments have landscapes with wide open spaces while others are interior rooms or hallways. Moving between scenes within an art environment affords separate spaces for exploration while particular locations in those scenes become spaces within the space. The smaller spaces that the environments hold are meant to signify inner sanctums that contain protected objects that are not easily understood. These inner spaces can also appear as houses or garages that provide a cocoon or resting place that offers pause, safety or sanctuary to contemplate something unfamiliar. This adds new levels or components to the overall structure. The navigation between multiple scenes shifts the direction from one scene to another and creates new levels of engagement. An example of an interior space within a landscape occurs in "*Figuratively Speaking*." On the beach is an open structure with an emotable bending over. When the visitor enters the space, it triggers the emotable to animate as if in greeting and they straighten themselves and look up. The open room has windows with cut out shapes – a rectangular and a circular hole – that frame the outside environment and give another window to the world. The windows are meant to act as framing devices similar to when an artist joins the tips of the pointer fingers and the tips of their thumbs to frame a scene to discover in which direction to paint. Real world moments become circumstances that inform my creative decisions for the environments. By generalizing from one aesthetic experience to another, I create situations for the visitor to explore. See Figure 5.61.

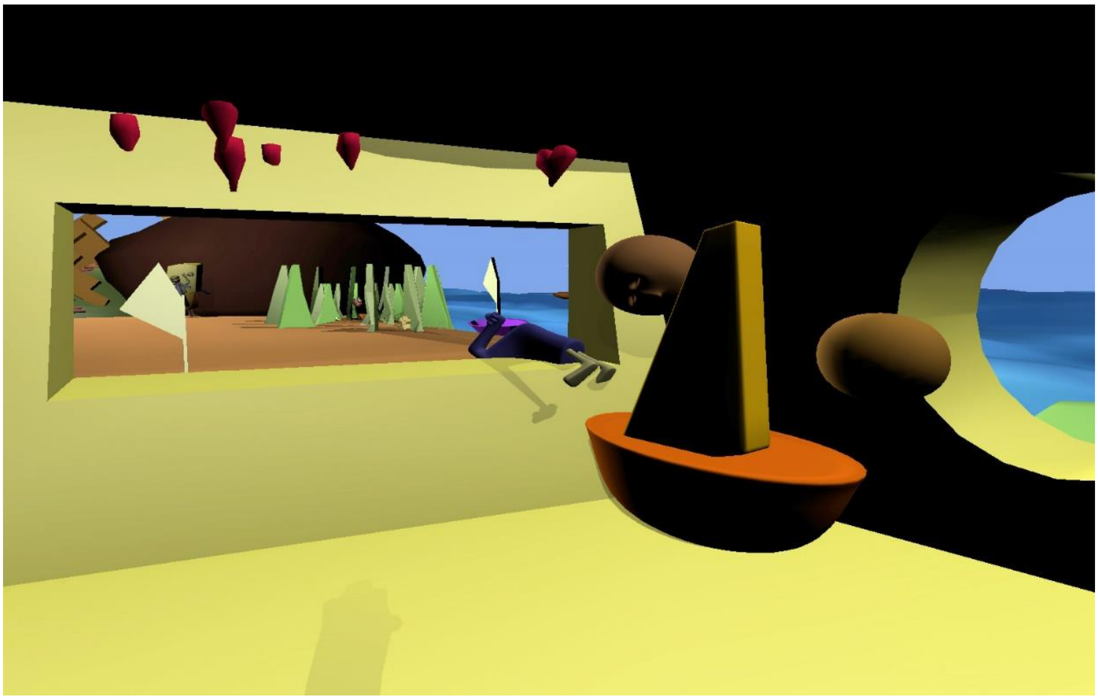


Figure 5.61 “*Figuratively Speaking*” M. Dolinsky. VR still. Interior and exterior spaces allows boundaries to shift and substructures to break apart or merge. Here the windows frame the outside world.

The surface qualities of the objects called the texture maps are imagery that comes from my paintings or is digitally painted for the express purpose of an environment. “*Figuratively Speaking*” is created in a bright primary color pallet using simple geometric shapes. Each of the features is color blocked to delineate their form, similar to the approach that cubist Archipenko delineated his sculptural materials by giving them bold colors. There are no textures maps at all. The simplicity adds a playfulness to the scene and to the characters in the scene. The feeling is to have a sense of play as if the scene were made up from a toy box. I am creating a whimsical and non-threatening sense of exploration that is punctuated with fanciful animations including sailboats sailing in the sea and slow moving red hearts that cloud the skies. See Figures 5.60 and 5.61.

The other environments are decidedly texture rich with each surface having some type of treatment. The predominately texture laden environment is "*Blue Window Pane II.*" The main room or inner sanctum resembles a mosque like setting and represents the place of familiarity and the place where the visitor ventures out from. It represents a home or beginning point. The purpose of the multi-textured room is to indicate that this is not the real world, this is somewhere new and different and the challenge is to explore it and discover if there is some sense to be made of it. The imagery is adding new components or new levels of structure to the walls and floor and its presentation resembles the real world but looks nothing like the real world. It is replacing one concept by a closely related one. See Figure 5.62.

Figure 5.62 "*Blue Window Pane II*" M. Dolinsky. VR Still. The inner sanctum of the environment is texture laden in order to indicate somewhere novel yet the structure is reminiscent of real world walls and windows in order to set up a challenge to explore.

Another texture laden environment is "Strait Dope" which relies on seemingly hallucinogenic imagery while one is perfectly sober. It is filled with faces and animated vignettes that confront the visitor. In one scene two emotables protect a third. When closely approached the third emotable's face animates and changes as if it is revealing it thoughts. The face animates and changes as if it is playing a movie of its thoughts. This intimate approach and subsequent exchange simulates how we relate to another person when we get close and see eye to eye with their thoughts. My effort is to reveal how a stream of consciousness exploration occurs in the VR environment much as it does in the real world. We are making generalizations about our confrontations and combining what we know with what we see to make sense of the world. See Figure 5.63.

Figure 5.63 “*Strait Dope*” M. Dolinsky. VR Still. The texture rich environment is an imaginary hallucinatory scene that occurs when we are sober. Confrontation with the emotables provide a level of conversation in the form of animated exchanges. Although the scene is not familiar, it has a landscape and characters that we can explore in a manner similar to the real world.

"*Strait Dope,*" “*Figuratively Speaking*” and “*Blue Window Pane II*” have features that are reminiscent of cubism in that they explore a level of reality that artistically adheres to expressing not only an environment but also a feeling sensing aspect of the environment. Some of the strategies that I use to create a cubist sensibility is to create novel shapes with colorful and unusual treatments. These are designed with a stream of consciousness type of intuition that allows me to create freely and with a sense of flow. I use this trope in order to shift shapes into further abstraction so that the visitor must slow down and experience perhaps uncertainty and foster a sense of curiosity so that the desire is to see the object from all sides. Ultimately, like the cubists, I hope the visitor would contemplate the environment and its emotables both as a material entity and as an element to be confronted and to eventually accept and perhaps incorporate into their experiential knowledge base. The effort is to make a novel experience that is curious and renders the visitor uncertain in order to create a desire to see things from all angles. This is the illustration of how generalizations occur: we confront something new, relate it to something we already know and then integrate the ideas into our idea-system, whether it is a mode of acceptance or rejection or neutrality is not the real concern, it is the act of building and integrating the environment through generalizations. The approach to remind people that things are unfamiliar is also part of Shklovsky's idea of defamiliarization, or making strange where art makes a familiar circumstance seem strange so that it can be met with a fresh perception. To do this, I present the material in unexpected ways. (Shklovsky 1965:12) An example of cubist influences and the element of defamiliarization is "*Strait Dope*." In the colorful environment are emotables that speak in strange demands such as "Are you watching me?!" and "Help me up! Help me up!" They flail about and open up to pop out balloons or throw balls straight at the visitor. These unexpected events are ways to keep you guessing about what might happen next. Although the scene is novel the events are familiar when they are generalized to previous circumstances. The emotables are moving internal boundaries back and forth when they are an entity to be dealt with. In reality, there is nothing there but the VR environment sets up an emotable to contend with. The emotables are swapping components and shifting from one level when they move from being quiet to becoming animated. The emotables are trying out the effect of reversals on various conceptual levels when they demand attention and a reaction to them which interrupts our expectation that we are relatively passive as they are to be entertaining us. See Figure 5.63 and Figure 5.64.

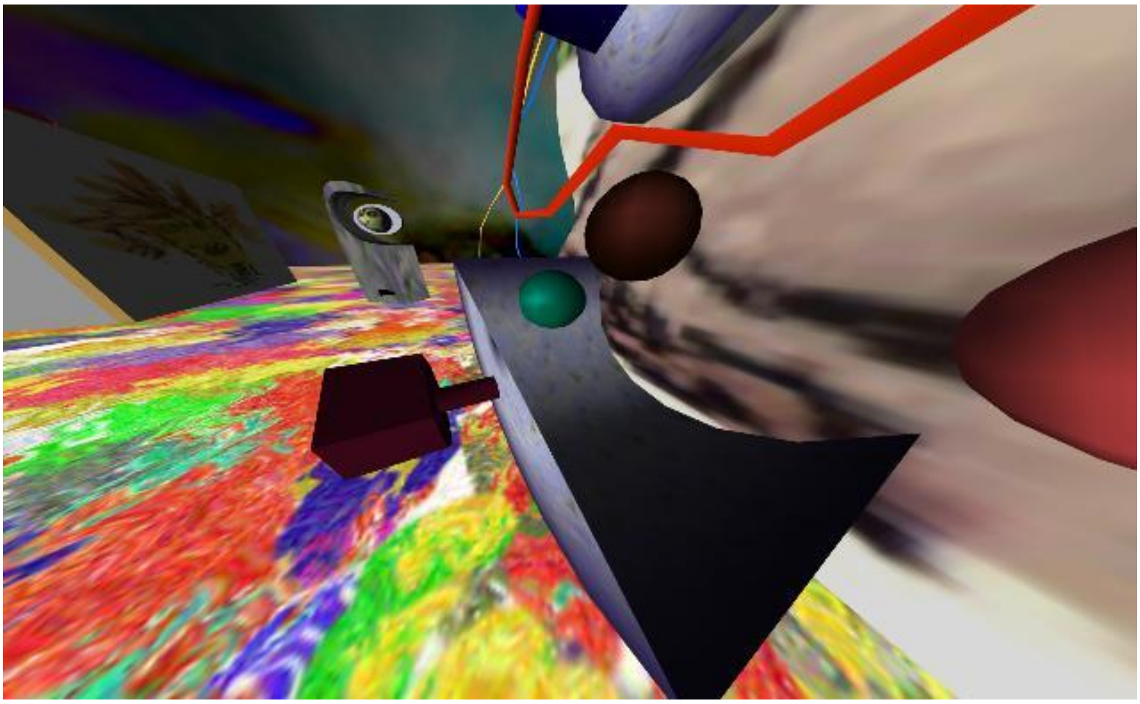


Figure 5.64 “*Strait Dope*” M. Dolinsky. The emotables are swapping components and shifting from one level to another when they move

from being quiet to becoming animated and demand things of the visitor who is originally there to be entertained.

The opposite trope of cubist and shifting abstract shapes is the stable and continually recurring element which is a site of familiarity, reliability and loyalty. This is used in a number of ways in all of the environments including "*Dream Grrrls,*" "*Blue Window Pane II*" and "*Figuratively Speaking*" by establishing recurring scenes, recurring objects and recurring parts of objects. In many of my environments there is a scene that reoccurs as the home or main room. In "*Dream Grrrls,*" the main room is a labyrinth that is filled with emotables that are portals to other dream worlds. When one of the five emotables is entered, the scene changes. In all of those scenes, the visitor has to navigate towards the horizon as if looking for something else out there. Depending on the secondary dream scene, the navigation moves either quickly or slowly and one always returns to the labyrinth. The process is a generalization of how we wake up from dreams – back where you started. So the labyrinth symbolizes the waking, in control and not knowing where the dream portals lead state. After each dream there is a security once the pattern is established and it is meant to be easier to know how to navigate the dream worlds. This dynamic is replacing one concept by a closely related one in that waking up from the dream is similar to finding oneself moving between visual worlds and in VR, the visitor finds themselves leaving a secondary dream world to return to the main world. Another generalization at work is merging two substructures into one and breaking down one substructure into two. This occurs when the labyrinth and the dream worlds become an entire world until the visitor is physically in one of the worlds, then it becomes a singular space. It is at the moment of transition between worlds that the visitor might realize that the structures are breaking into two worlds. This in effect, gives the generalization of lengthening and shortening the components. They can be seen as continuous or as separate entities because the worlds are distinctive in their situations and do not relate to the other worlds except conceptually. The entire VR environment is a metaphor for the passage of consciousness that seems to be a continuous stream of storytelling, thought and visual progressions. We are in effect hallucinating all the time, collecting new points of view and assimilating present circumstances with past knowledge. To see the main room or recurring space of return for

“*Dream Grrrls*” see Figure 5.65 and for the main room of “*Blue Window Pane II*” see Figure 5.62.

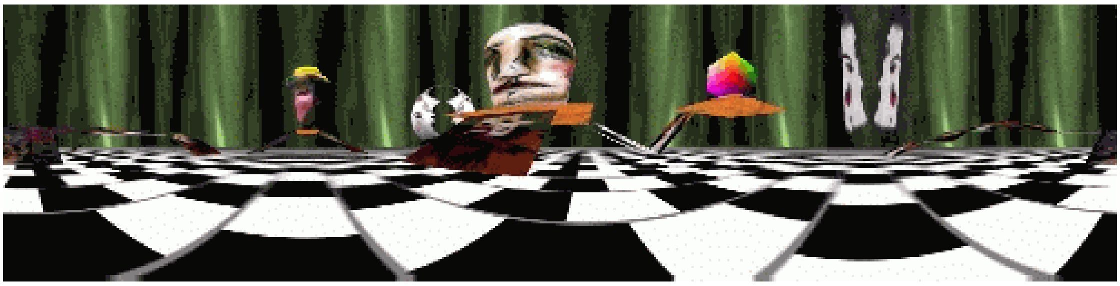


Figure 5.65 “*Dream Grrrls*” M. Dolinsky, Grit Sehmisch. VR Still. The labyrinth is the main room with emotables that are portals to other dream worlds. The Labyrinth is the place of return from the dreams and when the visuals transition to this scene, it is a metaphor for waking up from the dream.

In terms of scenes reoccurring in the VR art, there are also objects that appear routinely to symbolize particular events. This occurs in a few of the environments and particularly in “*Blue Window Pane II*” where a golden skeleton key is found in each room. The key gives the visitor a clue to the way in or out of an environment. Sometimes it is next to a door, on a shelf or being held by an emotable. If the visitor the finds the key or follows the key it will lead to a new world. In one room it stands next to the door of the inner sanctum. In the main room it is on a shelf and the key will expand and float and lead the visitor into the inner sanctum. In the Living Room, one of the emotables carries the key with him and where he stops is the portal to the main room. The key is the object to identify to understand that it shows the way through to another environment and symbolizes passages, strength, stability and self-reliance. In terms of generalizations it adds new levels of structure because the environment can be navigated without realizing its function. At times, the visitor would be told to look for the key but typically they would discover the key for themselves. See Figure 5.66.

Figure 5.66 "*Blue Window Pane II*" M. Dolinsky 1999. A gold skeleton key is found in each room and the key points the way in or out of an environment.

Another instance of a recurring object is in "*Figuratively Speaking*" where the landscape is made from components of the emotables faces. So for example the part of the head that holds the eyes, nose and mouth will be stripped of its adornments and lay blankly as the landscape environment. It is scaled to appear as a separate entity, the land. This is a metaphor for how the individual shapes their environment and becomes a part of the scene. Being inside a world has reciprocal effects on the body, mind and the surroundings, each defines the other. The relationships between the emotables and their space is an intimate one because the land is intrinsic to who they are. It defines where they eat and play and who they know, including themselves. There are parts of the land that act as bridges, doorways, blockages and sailing machines. It is reflective of how we change depending on where we are and who we are with. Our landscape changes and our mental outlook changes accordingly. See Figure 5.67.

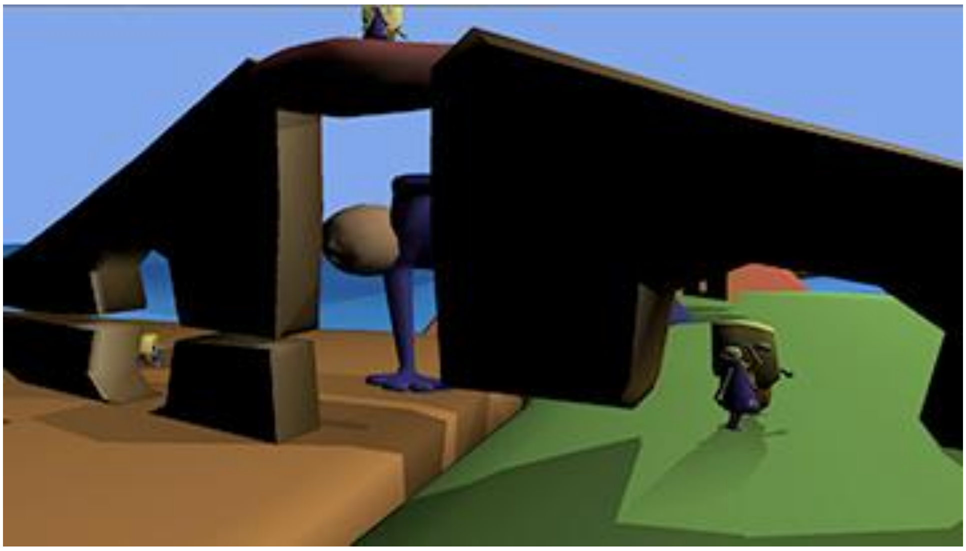


Figure 5.67 "*Figuratively Speaking*" M. Dolinsky 2012. VR Still. The landscape is made from components of the emotables faces to symbolize that the land is intrinsic to who they are.

IB: Moving internal boundaries back and forth
SW: Swapping components or shifting substructures from one level to another
MG: Merging two substructures into one or breaking one substructure into two
LG: Lengthening or shortening a given component
AG: Adding new components or new levels of structure
RG: Replacing one concept by a closely related one
RV: Trying out the effect of reversals on various conceptual levels

3D object/ element	Aesthetic purpose	Analogy	Establishes	Virtual Enviro	Hofstadter Generalize
Nonlinear pathways	No hierarchy of pathways, the choice is up to the visitor	Stream of consciousness	Freedom of movement, safety of choices, no right or wrong way to travel	DG BWP FS BB	LG, RG
windows shattering, new scene	transition strategies	World shatters around you and you learn something new	Changes the environment and takes the visitor to a new scene	BWP	SW, MG
eyes open, new scene	transition strategies	Wake up to a new day, open yourself up to a new idea	Changes the environment and takes the visitor to a new scene	BWP	SW, MG

doorway opens to new scene	transition strategies	Open yourself up to a new experience, travel somewhere you have not experienced previously	Changes the environment and takes the visitor to a new scene	BWP DG SD FS	IB, SW, MG
top of stairs, new scene	transition strategies	Reach the height, hit the zenith	Changes the environment and takes the visitor to a new scene	BWP BB	IB, SW, LG
move away from the center of the scene, towards horizon, heading west… out of town	transition strategies	Move away from what you know and escape out to the outer bounds of the space, leaving	Changes the environment and takes the visitor to a new scene	DG BWP SD	IB, SW, MG, LG
Navigation buttons on a virtual object	buttons on objects are mapped to buttons on input device	The buttons on the wand acts as a channel changer	Changes the videos being viewed in the projection screen	BWP	SW, MG

Figure 5.68 This chart artistic elements that guide the navigation in Dolinsky's virtual environments. The 3D objects are circumstances or points of interest to help the visitor find their way. The analogies enhance the emotional landscape of the environment.

All of the environments are built with non-hierarchical pathways so as to promote a non-linear, stream of consciousness movement through the spaces. There is no specific goal towards a winning strategy, rather exploration and contemplative reflection are the goals. This strategy allows the visitor freedom of movement, safety in making navigational choices and the ability to realize that the choices on which way to travel are theirs for the most part. Figure 6.68. So, for example, the "*Cabinet of Dreams*" has eleven different environments that can be explored in many combinations of sequence. This strategy provides generalizations for knowledge making. In terms of allowing the lengthening or shortening of a given component, the scenes can be visited over longer or shorter periods of time and they can be seen as a continuous narrative or a discontinuous series of vignettes. Each scene is replacing one concept by a closely related one when the scene switches. The movement is similar to a book of short stories with selections being read in any order. To see the table of contents, one would visit the main room that has all the possible selections. The reason for this strategy is that it complements the making of the art in a stream of consciousness fashion. It is important that it unfolds in a fluid way without prescribed paths in order to emphasize our ability to change our minds depending on what we encounter and think at the time. This type of movement is a metaphor for me that reality is dependent on our thought processes and decisions and the way that we create generalization effect circumstances at the time. The artwork unfolds for the visitor without prescribed paths because the work is created in order to enhance a self-directed flow. See Figure 5.69 and Figure 5.70.

Figure 5.69 “*Cabinet of Dreams*” M. Dolinsky 2005. The main room has the possible selections for the non-linear movement by way of the cabinets that act as portals to take the visitor to other worlds.

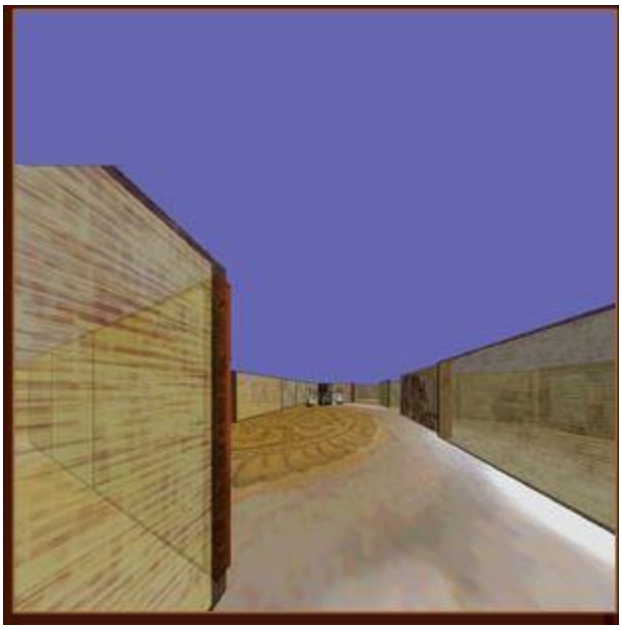


Figure 5.70 “*Cabinet of Dreams*” M. Dolinsky 2005. The main room has all the possible selections for non-linear, non-hierarchical travel. The work unfolds for the visitor without prescribed paths because the work is created in order to enhance a self-directed flow.

Nonlinear pathways and cabinets that act as portals are only some of the strategies for moving between environments. Others include hidden doorways, shattering windows, being at the top of stairs or a mountaintop and meeting an emotable with their eyes opening wide. All of these strategies, including simply moving towards a horizon, are an attempt to help the visitor recognize where they are at and to follow what they see and recognize that the moment can change and present a new set of challenges. We meet those challenges by using generalizations to scaffold our knowledge in order to determine our next move. Predominately in effect are Hofstadter's generalizations regarding swapping components and merging substructures to create another level is meant to occur as the visitor swaps out one scene for another in order to further their own narrative.

IB: Moving internal boundaries back and forth
SW: Swapping components or shifting substructures from one level to another
MG: Merging two substructures into one or breaking one substructure into two
LG: Lengthening or shortening a given component
AG: Adding new components or new levels of structure
RG: Replacing one concept by a closely related one
RV: Trying out the effect of reversals on various conceptual levels

3D object/ element	Aesthetic purpose	Analogy	Establishes	Virtual Envir	Hofstadter Generalize
Navigation buttons on an actual object	The joystick buttons appear as the eyes of the character because the navigation device is embedded in a soft sculpture	See through the eyes of a character, the character is navigating the environment	A physical link to the environment by holding one of the characters in your hand	FS	SW, LG, AG
Musical instruments	places a new object in the scene when a sound is attached to a head	Adding a sound to a character by placing a sound at an interval - giving a voice to the head	Musical scene is established and t makes the characters more animate with their own unique sound, establishes a dialogue between the	BB BWP SD	IB, SW, MG, LG, RG

			visitor and the virtual characters		
Drawer/ door opening Windmill/pinwheel in the garden near a door	geared to respond to movement of encounter with foreseeable opportunities	Smoke emanating = fire = life= person feeding the flames of energy	Particles and energy	SD BWP DG FS	AG, RG

Figure 5.71 This chart outlines artistic elements that incorporate animations to guide the visitor in Dolinsky's virtual environments. The 3D objects are circumstances or points of interest to help the visitor find their way. The analogies enhance the emotional landscape of the environment.

The next chart contains artistic elements that incorporate animations to guide the visitor. These include animations on objects that serve a specific function for other events to occur. The first example is the three buttons on a projection screen in "*Blue Window Pane*" that correspond to the three buttons on the navigation wand. The buttons in the virtual environment are animated faces and when a button is pushed on the navigation wand the corresponding button on the projection screen lights up. This changes the frequency being transmitted to the screen and changes the display. The navigation wand becomes a generalization to correspond to a television controller. It is subtle but a clever interaction if it is discovered. See Figure 5.72.

Figure 5.72 “*Blue Window Pane*” M. Dolinsky 1999. VR Still. The Living Room has a projection screen with buttons that correspond to the navigation wand.

In the same space, an emotable has a mouth that becomes a drawer when it is approached. The drawer opens and shoots particles in the air – small spheres- that appear to come from nowhere. When it was being created, I was thinking that it is similar to finding your underwear drawer exploding or discovering some hidden information that is unexpected. Moreover it points to the emotable – that people are not what they seem, anything can come out of their mouths and hit you in an unanticipated way. Figure 5.73.

Figure 5.73 "*Blue Window Pane*" M. Dolinsky 1999. Animations are embedded in the emotables where mouth become drawers that throw things into the air.

The animations are punctuated with sound that is used as a device to emphasize the moment. Other times the sound is integral to the environment, such as the musical instruments in "*Beat Box*." The visitor selects a sound which places a new object in the scene and attaches a sound to an emotable. In effect, allowing the emotable to have a say. The emotables appear more animate with their own unique sound, and this is done in order to establish a dialogue between the visitor and the virtual characters. This occurs because we can make generalizations by replacing one concept with a closely related one. For example, once we learn that the sound selections adhere to intervals we can liken that to placing musical notes to create a song. This allows the visitor to add new components and new levels of structure and to lengthen or shorten a given component.

5.1.6.2 **Analogies in virtual environments - interactive installations**

Next I will discuss the interactive installations that I have created in 2011. The circumstances in the interactive installations, including their titles, are meant to evoke a particular concepts regarding perceptual thinking, cognition and analogies. The action is in the visual strategies, which invoke analogies in order to encourage the visitor to interact and contemplate the work. The visitor becomes a feature detector and determines the features of the artwork and how to place themselves within the art. The visual analogies generate mental categories in order to facilitate the visitor to create the space.

The following environments are deconstructed using a similar charting system: *Emotable Portraits, Poke Holes in My thoughts* *(swimming on the edge), "Look at my photo! Isn't it a dream?"* and "*It's all about you!"* The charts include some information about the visual imagery, the navigation purpose, the analogies, and the results established for the visitor viewing the work.

I have included pointers to Hoftstadter's list of generalizations and will discuss the work in terms of aesthetic strategies and how they are incorporated into the work.

IB: Moving internal boundaries back and forth
SW: Swapping components or shifting substructures from one level to another
MG: Merging two substructures into one or breaking one substructure into two
LG: Lengthening or shortening a given component
AG: Adding new components or new levels of structure
RG: Replacing one concept by a closely related one
RV: Trying out the effect of reversals on various conceptual levels

Emotable Portraits				
3D object/ element	Aesthetic purpose	Analogy	Establishes	Hoftstadter Generalize
Saint Image	Solemnity	Religious icon	Moment of self reflection and wonder	IB
Choir image	Group think	We are all in this together	Togetherness, unity	IB
Faces video updates	Real time interaction	No matter where you are at, there you are, Realm of	Portraiture within the artwork	AG, RG

		divinity		
Instruments/singing	Animation of people in choir	Birds of a feather flock together Flock of churchgoers	Liveliness of choir Allows recognition of choir as moving people, engagement	AG
Appearing in eyes of the Saint	Real time interaction	Recognized by the saint	Connection with the power of the Saint image and your own	RV, AG, RG
Emotables	Attention to another level of thinking	Angel and the devil on your shoulder, The right/left side of the brain Your conscience speaking to you	A meta level of reflection Directs you to your conscience Spiritual concepts Higher authority	IB, SW, LG

Figure 5.74 This chart outlines artistic elements and their analogies in "*Emotable Portraits".*

"*Emotable Portraits*" is an interactive video drama that uses a facial detection system to incorporate visitors' faces into a video diptych of "*The Saint*" and "*The Choir*." See Figure 5.74. Each screen incorporates captured live video into its existing video. The visitor's video portrait appears as the eyes of "*The Saint*" and as member of "*The Choir*." Visitors watch the screens and eventually realize that they are being captured live. One visitor asked me how I had gotten a photo of her until she realized the photo had her wearing a white hat and it was then that she realized the video was live which perplexed her even further. Initially, she did not realize that a camera was part of the installation and subsequently she could not determine where the camera was located. This attitude helps to focus the attention on the imagery rather than the technical details but people remain curious which points to a lasting impression from the work.

The imagery is based on Russian icons and medieval paintings that dramatize religion. The image in "*The Saint*" denotes solemnity and represents a moment of reflection and wonder. The generalizations at play are moving internal boundaries back and forth. We might ask questions about saints, saint hood or question ourselves as saints. It is a solitary moment. "*The Choir*" incorporates lots of people's videos and is a place to join together to sing. It symbolizes group think, that we are all in this together and we sing in unity. It also generalizes internal boundaries moving back and forth as we visually join the choir with an individualized video portrait and realize that we are part of a larger togetherness. Some people go to the extreme to be sure that they appear to be singing in their videos. Others are grateful to be in the eyes of "*The Saint*." The generalizations that I point to are created with the video faces and their updates along with the emphasis on real-time interaction. In terms of appearing in the eyes of "*The Saint*" I infer that no matter where you are, there you are and "*Emotable Portraits*" places you in the realm of divinity. In terms of "*The Choir*" where you are placed within a group singing alongside you, there is a pointer to churchgoers, that birds of a feather flock together and that the liveliness of choir attracts a sense of recognition and engagement with choir as moving people. We are trying out the effect of reversal on various conceptual levels concerning religion, videography, portraiture and self-reflection. The artwork is an illustration of the stream of consciousness moment because "*The Saint*" has two faint figures-emotables- one on each shoulder appearing to whisper in a respective ear. These two emotables represent the angel and devil on your shoulder, the left and right side of your brain and that your conscience is allows speaking to you. See Figure 5.75 and 5.76.

Figure 5.75 “*Emotable Portraits*” M. Dolinsky. This interactive video drama uses facial detection to incorporate visitors' faces into a video diptych, here “*The Saint*”.

Figure 5.76 “*Emotable Portraits*” M. Dolinsky. This interactive video drama uses facial detection to incorporate visitors' faces into a video diptych here of “*The Choir*.”

IB: Moving internal boundaries back and forth
SW: Swapping components or shifting substructures from one level to another
MG: Merging two substructures into one or breaking one substructure into two
LG: Lengthening or shortening a given component
AG: Adding new components or new levels of structure
RG: Replacing one concept by a closely related one
RV: Trying out the effect of reversals on various conceptual levels

Poke holes in my thoughts (Swimming on the edge)				
3D object/ element	Aesthetic purpose	Analogy	Establishes	Hofstadter Generalize
Fish with faces	See the fish swim faster when the third membrane is penetrated	"Memory is a net; one finds it full of fish when he takes it from the brook; but a dozen miles of water have run thorough it without sticking." - Oliver Wendell Homes The Autocrat of the Breakfast Table (Holmes 1899: 278)	Whimsical moment	SW, AG, RG
Multiple membranes	Reach of arm Finger - water ripples Hand - water waves Arm - fish swim faster	No matter where you are, you are always in the director's chair. How do you measure your reach?	Multiple layers of identities	LG, AG
Sound grid	Audio component Sound activated	Are sounds blown by a blower into shapes -	Grid like structure of high and low notes	AG, SW

	graphics	Wallace Stevens, Parochial Theme		
Swimming fishes	Using water and swimming to create interactions with waves	Swimming over a vast sea of interests	Go with the flow of life	RG
Reflection	See your own image in the artwork	Mirror metaphor Watch yourself Mirror of your actions	You can see your controls and its results	IB

Figure 5.77 This chart outlines artistic elements and their analogies in "*Poke holes in my thoughts "Swimming on the edge*".

"*Poke holes in my thoughts (Swimming on the edge)*" is an interactive projection installation whose title is implies stream of consciousness by asking visitors to poke holes in thoughts and swim on the edge of what could be considered life or conscious thought. See Figure 5.77.The visitor stands near a virtual pool of water filled with plants and fish and sees their own reflection. The concept of a true pond can be replaced with a virtual one and through this generalization and the appropriate instructions, one can learn that the interaction of poking at the water will cause ripples to develop. The interaction depends on putting a finger, hand or arm towards the screen in order to agitate the water. Depending on the reach, the water has more ripples and with the entire arm forward the fish swim away very quickly. This is analogous to the concept of agitating the waters and stirring the pot. One particular quote pertains to the work: "Memory is a net; one finds it full of fish when he takes it from the brook; but a dozen miles of water have run thorough it without sticking." (Holmes 1899:278) The ripples are a symbol of water rippling and the rippling of our thoughts in a stream of consciousness. The artwork has three parallel planes of invisible sensors that depend on the visitor's reach to display one of three reactions at that point in the water. The deeper the reach the more significant the reaction will be. This symbolizes the many ways that someone is able to reach out into the world and the range of that influence. By generalizing concepts from a real pond to the virtual, we are swapping components to use similar interactions and by considering the stream of consciousness, we are shifting levels between substructures. The more involved our movements, the farther our reach and the greater the influence is on the work. The fish will swim away fast when your arm is submerged in the water. The fish are swimming in a sea of thoughts and we have to go with the flow of life.

By way of the tracking system, the image of the visitor is incorporated in the scene to appear as a reflection on the water. The water in a sense, acts as a mirror, mirroring the life of the person through a live video feed and figuratively mirroring the person by referring to thoughts as a process of reflection. The graphics are also sound activated by a virtual grid that contains high to low notes. As the visitor pokes holes across the surface of the water, the artwork becomes a musical instrument and sounds out the emotions of the visitor’s movements. This is a metaphor for a sounding board and getting a reaction. This adds new components by adding sound to where one would hear sound if they were agitating water. By making generalizations between a real world pond and the virtual world pond, concepts are built to realize the piece and immerse the visitor in an interactive art experience.

IB: Moving internal boundaries back and forth
SW: Swapping components or shifting substructures from one level to another
MG: Merging two substructures into one or breaking one substructure into two
LG: Lengthening or shortening a given component
AG: Adding new components or new levels of structure
RG: Replacing one concept by a closely related one
RV: Trying out the effect of reversals on various conceptual levels

Look at my photo! Isn't it a dream?				
3D object/strategy	Navigation purpose	Analogy	Establishes	Hofstadter Generalize

Small image of light	Draws your attention	Good things in small packages	Light is focused as an object on the wall	RG
Fog, animated mist	foggy animation, undecipherable	Peering through the thick fog	Attention Wonder what that is	SW
Colorful forest	Approach wall to reveal the forest	"…twigs cracking and feel hooves planted down in the depths of that leaf-encumbered forest, the soul. -Virginia Woolf, Mrs. Dalloway	The reward for approaching the foggy light postcard	SW LG
Animation	Movement on wall	Catches your eye	Attention towards the object,	LG AG
Postcard animation	Draws your attention	Travel memories	Wondering what the image reveals	IB
Expansion of image	Interaction is to walk towards it	See it clearly as you approach it Digest it Bring it to the fore	Encourages people to walk towards the artwork as it expands and backwards as it shrinks	AG RG RV

Figure 5.78 This chart outlines artistic elements and their analogies in "*Look at my photo! Isn't it a dream?*".

"*Look at my photo! Isn't it a dream?*" is also a video tracked system that reacts to the visitor's presence. See Figure 5.78. A small rectangle of light appears as if a small photo were resting on a large green wall. As we approach the wall, the small photo enlarges to become a forest of trees. We are using the generalization of walking towards a forest to trigger the animation and as we get closer to the trees, they become larger, mimicking the action of trees in real life yet they look nothing like trees. We also use the generalization of trying reversals because when the visitor walks backwards, the forest becomes smaller and returns to appear as a photograph. The forest is a metaphor for the soul because trees are able to hold the attention in a way that other circumstances cannot. The vibrant colors of the forest imagery and the emotables hidden within the trees are a metaphor for the energy of the soul and our interactions with life. The light at the beginning of the piece is a metaphor for life energy. It expands as we immerse ourselves in it. The stream of consciousness is a major topic in my work and I believe the piece is effective without the visitor needing to get too deep philosophically because the imagery is fun and the activity is engaging in that it is a major part of realizing the piece.

IB: Moving internal boundaries back and forth
SW: Swapping components or shifting substructures from one level to another
MG: Merging two substructures into one or breaking one substructure into two
LG: Lengthening or shortening a given component
AG: Adding new components or new levels of structure
RG: Replacing one concept by a closely related one
RV: Trying out the effect of reversals on various conceptual levels

It’s all about you!				
3D object/strategy	Navigation purpose	Analogy	Establishes	Hofstadter
Thought bubbles	Capture and display more than one person at once	Left brain right brain Similar to reading a fortune Finding an answer to yes/no	A place for the visitor to be integrated into the video thought process	SW
Video face capture	Integration of visitor's portrait in the piece	See your own reflection in the other's, other as mirror "There are no wrinkles in the heart, and you will see my face only in the reflection of your attachment, eh, Victor, my beloved” - Juliette Drouet, Letter to Victor Hugo, November 19, 1841 (Drouet 1914:292)	Self-reflection	AG
Day to night, seasons	Passage of time	Seasons change and so do I	Passage of time Stream of consciousness	AG
Thought icons	New formations of ideas	Always another thought popping up , the realm of possibility	Malleability of thought patterns Stream of consciousness	RG
Skin icons	Bring attention to the main character	Flowing across surfaces, water cascading , flowing thoughts	Little drawings are flowing across the skin of the main emotable in the animation. It establishes	RG

			personal thought process unencumbered by the outside forces, represents unconscious thoughts	
Small emotables	Bring attention to the thought bubbles	contemplation	The importance of the video face capture to the process of thoughts and integrating people into thoughts	AG, MG

Figure 5.79 This chart outlines artistic elements and their analogies in "*It's all about you!*".

"*It's all about you!*" incorporates a tracking system that detects faces and records live video. See Figure 5.79. The imagery depicts a woman who has small black and white icons cascading down her face and neck. Her skin is covered with the symbols of some unconscious alphabet. The symbols on the skin can be generalized as tattoos or symbols flowing from her mind, as if her thoughts or her personality or something from deep within is oozing through her pores and revealing a side of herself that she would rather keep hidden. By integrating multiple portraits in the artwork, it is a kind of self-reflection, the visitor's portrait is within the portrait of the thinking woman/man. The generalization is to lengthen the component of the concept of self and imagine that as we influence one another (the visitor influences the way the art appears) we are a part of one another. Both in image, video and standing in front of the art is meant to point at the way we integrate one another in our lives. The thoughts that come to pass daily are illustrated in thought bubbles which can be generalized as the new formations of ideas because thoughts are always popping up and expanding the realm of possibilities. There are small emotables that point out the thought bubbles and emphasize their importance. Here, the illustrations are actively trying to merge two thought structures into one as the visitor scans the art and attempts to unify its symbols. The face is kept slightly androgynous in order to maintain a level of ambiguity as it reflects both the masculine and feminine aspects of the self.

The aspect of time is incorporated into the sky as it changes from day to night indicating the passage of time and the central figures eyes close when the background is dark. This offers a new component in that time, including days and seasons, is integral to the process of the stream of consciousness that is being illustrated. The different images within the work stream towards one another, offering new symbols, icons and time elements as the visitor is incorporated in the head and heart of the person.

5.2.0.0 **Audience reception and evaluation of my artwork**

The following comments were solicited by the author of this thesis to individuals, including curators, virtual reality artists and professional colleagues who attended or viewed my artwork. The request was sent in a short email with the simple statement: could you please send 2-3 short comments, perhaps a sentence about my artwork with your name and title/affiliation.

"Margaret Dolinsky is one of those rare artists that merges the past and the future. She is a painter and sculptor who refers to great artists like Modigliani and Picasso in her traditional work and then translates them with bravery and fervor into virtual spaces, biotech, and fabrication. She is a true cybrid – the technological artist who understands technology for its expressive value beyond its novelty.

"For decades, Margaret Dolinsky has been at the leading edge of art and technology while grounding herself in the practice of painting and sculpture in the vein of the First Wave Avant Garde. She surfs with culture as it advances, exploring new forms and technologies with a painter's touch."

Patrick Lichty
Artist, Writer, Curator
University of Wisconsin–Milwaukee

“Margaret's work draws the gaze onto worlds of strong connections of color and strokes in space. Her virtual environments are keen to a stream of consciousness as they parallel the changing point of view towards her imagery, imagery that you can move through, while retaining her masterful craft to understand what is essential to form.”

Julieta Aguilera
Systems Designer
Chicago Planetarium

“As a scientist, I often find it difficult to approach art. Margaret's interactive, and often whimsical, art installations unerringly draw me in. I very much appreciate that she manages to communicate with her audience via her art seemingly effortlessly.”

Sandra Kuebler, Associate Professor
Department of Linguistics, Indiana University

"Upon first seeing Dolinsky’s work it took a moment to navigate the perceptual shifts that the pieces provoked. The work was infused with novel and captivatingly creative visions. I saw a refreshing whimsy with an astonishing complexity in even the most simple of her pieces."

Roger P. Hangarter

Class of 1968 Chancellor's Professor
Department of Biology, Indiana University

"Margaret Dolinsky is a distinguished artist who has been continuously producing and exhibiting virtual reality (VR) artwork since the mid-1990s. Moreover, she is among the handful of artists who conduct research that is consistent with that of academic communities. In my position as one (1) of five (5) Directors of GRAND-NCE, a Canada-wide research network of technological experts from computer scientists to interactive artists, I can say with confidence that her ability to produce significant artwork of the highest caliber and to conduct research is a rarity.

"The impact of Dolinsky's work extends from international exhibitions to her sustained presence in Computer Science venues, and recognition in that community. In the SPIE conference, for example, Dolinsky has maintained a leadership position for over a decade.

"During this time, she has created a space for the handful of other VR artists who conduct research to discuss and publish their work in this rigorously peer-reviewed conference. The strength of her artwork and quality of her research together enable her to maintain this important leadership position.

"Dolinsky's research in VR art focuses on perception. Her CAVE environments are unique in their ability to shift the perceptions of its participants. It accomplishes this in a number of ways, from spatial anomalies to creative uses of light, colour, sound, and interactive techniques. Her work, in the context of Computer Science conferences, provides important exemplars of Non-Photorealism (NPR).

"Dolinsky's VR artwork has consistently been recognized in international, national and regional art fora as well.

"It is perhaps here that her work has important and longstanding impact in artistic communities that range from interactive art to Music and the performative arts. It is no surprise, therefore, that she holds a tenured faculty position in one of the highest ranked American art departments at Indiana University.

“It is important finally to emphasize Dolinsky's long-standing exhibition record, as this will doubtless mean that the impact of her work will be well represented in the historical record of interactive artwork. To my knowledge, Dolinsky easily has produced and exhibited the greatest number and diversity of VR artwork. Numbers of artworks is not, of course, necessarily meaningful in itself, although it must be recognized that producing VR artwork is itself a comparatively intensive process.

“The artwork becomes meaningful only when it is exhibited in peer-reviewed and curated venues; when it is recognized and reviewed in art communities; when it is cited by other prominent artists, art historians or critics; and when it becomes part of important historical records. Dolinsky's work has this significance, and has gained additional significance by sustained recognition in scientific conferences and publications over the past two decades.

“Finally, immersive VR was a popular technological form that captured the public's imagination in the 1990's, before the World Wide Web, social media, or the diversity of subsequent technological forms that have been adopted by artists and the public more generally. The hyperbole that attended VR is well known, as is its subsequent position as a technological form that has been eclipsed by many other forms, such as video games and 3D movies that were expected to become outgrowths of VR. In the last few years, however, VR has enjoyed a resurgence in interest, exemplified most recently by the availability and accessibility of VR hardware such as Oculus Rift. Dolinsky's commitment to VR artwork has thrived throughout this time, long after other artists had abandoned VR because of its technical difficulty, expense and perceived loss of popularity and innovation. That Dolinsky has sustained her VR art practice despite the vagaries of VR, and that her work has garnered recognition over time in itself is significant, and speaks volumes of its importance. Her sustained record positions her in this time of renewed interest in VR to make even more significant contributions to interactive artwork, and doubtless will ensure the historical significance of her artwork and research.”

Professor Diane Gromala
Canada Research Chair
Simon Fraser University, Canada

"Since the 1990's, Margaret Dolinsky's virtual reality artworks have pioneered the use of the technology to create dreamlike interactive environments, rich in symbolism and mystery. Figuratively Speaking continues this body of work, drawing the viewer in to explore a world that is bright colored, inviting, and meditative, but with the sense of something rumbling just beneath the surface. While mainstream computer graphics pushes either towards photorealism or hard-edged technological abstraction, Dolinsky's work links high-tech simulation with the modernist tradition in figurative painting. The experience of these virtual environments is not a literal simulation of reality, but rather an investigation of psychic dimensions of form and color."

--Ben Chang, Director, Games and Simulation Arts and Sciences, Rensselaer Polytechnic Institute

"*Annunciation and Visitation*"

"A rich, integral layer of visual expression that unites disparate elements of music and theater from wildly distant eras of history."

-Bernard Gordillo, Musician and archivist, Indianapolis, IN

"I'm all about you"

"In this work, Margaret explores the relationships existing fine art forms establish with an audience in new ways by placing works into projected interactive environments where viewers become participants with the artifacts rather than mere observers. Her work retains the attention to detail and whimsy of fine art and manages to accomplish this within the bounds of what the available technology can reasonably deliver."

Ian McDowall
Principal Engineer, Intuitive Surgical
CEO, Fakespace Labs

"*Emotable Portraits* with the saint and the choir"

"Saint: a tempo-less, prayer-less moment of contemplation as the icon transforms itself while the viewer remains unchanged, yet inexplicably moved. Choir: an organic integration of the viewer into a choir that silently, yet perpetually, intones within the mind of the artist."

-Bernard Gordillo, Musician and archivist, Indianapolis, IN

"*Figuratively speaking*"- vr art

"The experience of navigating in the space is like an adventure in a wonderland. We can discover and interact with the figures that are living in this environment from a first person perspective."

Catherine Chi, IU MFA Graduate, Indiana University

"*Passion with Tropes*"

"The artist's iconic images interplay with the larger musical composition. One gets the feeling that their presence is also form of commentary, albeit silent, on the developing action."
-Bernard Gordillo, Musician and archivist, Indianapolis, IN

"*I'm all about you*"– interactive installation

"The piece successfully subverts the traditional habit of viewing art. The viewer's face is viewed as part of the art, allowing us to read the image as a self-reflection."

- Catherine Chi, IU MFA Graduate, Indiana University

“*Poke holes in my thoughts (swimming at the edge)”* – interactive installation

“While interacting with the piece, It feels like my body turned into raindrops falling from the sky and into the pond under the moonlight, and created a unique music box rhythm.”

Catherine Chi, IU MFA Graduate, Indiana University

"There is something about Margaret's work that makes me feel like a child, seeing a new world for the first time. It is gripping: some of it feels threatening, some makes me feel wistful, and all of it is compelling."

Kelly Berkson, Assistant Professor
Department of Linguistics, Indiana University

“Both disturbing and somehow familiar, with a complexity of composition and subject matter that draws me in and refuses to let me pull away.”

Nat Southern, gallery visitor

“*BEAT BOX*”

“Margaret's work 'BEAT BOX' creates an interactive musical environment which engages the visitor with a visual stereoscopic virtual environment and interactive hand controllers which enable the visitor to interact. Musical interludes are interactively created and 'played' by a number of virtual busts which sing back to the visitor. “

Ian McDowall
Principal Engineer, Intuitive Surgical
CEO, Fakespace Labs

“Margaret Dolinsky’s art stimulates a part of my brain that I didn’t know exists.”

Ian Woollen, Author and novelist, Bloomington Indiana

5.3.0.0 **Exhibition dates (selected)**

2013 Supercomputing 13. Denver CO. Nov 17-22. The Living Canvas digital canvas and IQ Tables. Research Conference - Academic Audience.

IEEE Cluster 2013. Indianapolis, IN. Sept 23-27. The Living Canvas digital canvas. Research Conference - Academic Audience.

Grunwald Gallery of Art, Aug 30- Oct 11. The Living Canvas digital canvas and IQ Tables. Open Exhibition -cross-section of general public.

Bushwick AR Intervention, Thin Air Gallery, Bushwick, NY. May 31-June 2. Augmented Reality. Open Exhibition -cross-section of general public.

2012 Supercomputing 2012 Salt Lake City,UT. Poke holes into your Thoughts interactive installation. Research Conference - Academic Audience.

Smithsonian Folklore Festival Emotable Portraits installation, Washington DC. Open Exhibition -cross-section of general public.

Ecclesiastical Art Exhibit, Emotable Portraits installation Indianapolis Convention Center Open Exhibition -cross-section of general public.

Adler Planetarium "Moon Lust" Chicago, IL Open Exhibition -cross-section of general public.

Bushwick Studios, New York Augmented Reality Exhibition June Open Exhibition -cross-section of general public.

Manifest AR Shanghai Augmented Reality Exhibition. June Open Exhibition -cross-section of general public.

Manifest AR Bloomington Augmented Reality Exhibition. May Open Exhibition -cross-section of general public.

Out of the Box, San Francisco, CA. Augmented Reality Exhibition. Jan 23-25. Strait Dope. Open Exhibition -cross-section of general public.

IU SoFA Faculty Exhibition, Grunwald Gallery, Indiana University, Jan 13-28. Figuratively Speaking. Open Exhibition -cross-section of general public.

2011 Cyberinfrastructure Building (CIB) Dedication October 12, 2011 Research Conference - Academic Audience

Inter:Facing, Grunwald Gallery, Indiana University, Sept 9-28. Solo exhibition of interactive animations. Open Exhibition -cross-section of general public.

Passion with Tropes, Opera with IU Jacobs School of Music, Dept of Theater&Drama, Halls Theater, May. Open Exhibition -cross-section of general public.

Telematic Collective Concert & VR Exhibit. IUPUI Informatics & Communications Tech Complex. Apr 21. Open Exhibition -cross-section of general public.

Big Robot, University of Illinois at Urbana-Champaign. Separation in concert. Apr 14. Open Exhibition -cross-section of general public.

Zerospace Conference on Distance & Interaction in Music. Univ Wisconsin-Milwaukee. Feb 18. Fig Speaking. Research Conference - Academic Audience.

PVE: Performance Video Event, University of the Streets, NYC. Separation animation. Feb 12 Open Exhibition -cross-section of general public.

30 Second Spot, School of Visual Arts, NYC. Separation animation. Feb 9. Open Exhibition -cross-section of general public.

2010 IEEE Cloud Computing. Indianapolis, IN. Dec 1-3. Emotable Portraits, animations. Separation-concert premier. Research Conference - Academic Audience.

Intermedia Festival Marion County Public Library Central Branch, Indianapolis. Apr 23-27.Emotable Portraits. . Open Exhibition -cross-section of general public.

Intermedia Festival IUPUI VR Theater, Indianapolis. April Six Friends VR. . Open Exhibition -cross-section of general public.

IEEE VR 2010 March 20-26, 2010 in Waltham, Massachusetts, USA Six Friends VR. Research Conference - Academic Audience.

Simon Fraser School of Interactive Arts and Technologies March. Emotable Portraits. University - Academic Audience

Bloomington Faculty from IU's Hope School of Fine Arts. IU Art Museum. Emotable Portraits Jan 22-Mar 7. Open Exhibition - cross-section of general public.

Art in Virtual Reality. IS&T SPIE Electronic Imaging: Science & Technology. San Jose, CA. Jan. 18-21. Six Friends. Research Conference - Academic Audience.

2009 Beihang University, Beijing, China. Nov. Emotable Portraits. University Exhibition –academic audience.

Indiana University Kokomo Art Gallery. Kokomo, IN. Jan. Hello World large screen installation. Open Exhibition -cross-section of general public.

Annuncaition+Visitation: operatic projections of her sexual insight. Buskirk Chumley Theater Oct 9-10. Projections. In collaboration with American Opera Theater and IU Jacobs School of Music. Open Exhibition -cross-section of general public.

Celestial Reflections. Indiana University Kokomo Oct 1-Nov12. Solo. Emotable Portraits and interactive projections. Open Exhibition -cross-section of general public.

International Association for the Study of Dreams Art Exhibition. Chicago IL. Jun 25-30. 2D Prints. Research Conference - Academic Audience.

Dreamtime. Dean Johnson Gallery. Indianapolis, IN. May1-Jun18. Emotable Portraits, Painting, Videos. Open Exhibition -cross-section of general public.

Concentus. In collaboration with the Early Music Institute at IU Jacobs School of Music Recital Hall. Mar 29. Emotable Portraits interactive installation and projections. Open Exhibition -cross-section of general public.

AXIOM Center for New and Experimental Media. MG Fest09, Motion Graphics Festival. Boston MA. Mar 7-14. Emotables Portraits animation. Open Exhibition -cross-section of general public.

MASHITUDE. MG Fest09, Motion Graphics Festival. Chicago IL. Jan 24. Emotables P. animation. Open Exhibition -cross-section of general public.

VR Works! IS&T SPIE's Electronic Imaging: Science & Technology. San Jose, CA. Jan. 18-21. VR Portraits.

2008 Supercomputing 2008. Austin, TX. Nov. Emotable Portraits interactive installation. Research Conference - Academic Audience.

Towards a Science of Consciousness. Tucson, AZ. Apr. Hello World screen installation. Research Conference - Academic Audience.

Sponsae Christi.. In collaboration with the Early Music Institute, IU Jacobs School of Music, IU Dept of Theater and Drama. Indiana University Art Museum. Bloomington. Feb 24. Drama. Open Exhibition -cross-section of general public.

MG Fest08, Motion Graphics Festival, Society for the Arts. Chicago IL. Jan 15-21. Hello World screen installation. www.mgFest.com Open Exhibition -cross-section of general public.

Indiana University Kokomo Art Gallery. Kokomo, IN. Jan. Hello World large screen installation. Open Exhibition -cross-section of general public.

2007 Glitches, Bits, & Switches. Alogon Gallery. Chicago, IL Dec 1-31. Hello World large screen installation. Open Exhibition - cross-section of general public.

INtransit V.2: Fast Women. 119 Gallery. Lowell, MA. Oct 13. Video collaboration with Bebe Beard. Open Exhibition - cross-section of general public.

DART Gallery. IV07 Information Visualization. Zurich, Switzerland. Hello World (Illuminated Script), July 3-6. DART gallery online and poster. Open Exhibition -cross-section of general public.

ACM SIGCHI Creativity & Cognition Conference. Washington, DC. June 14-15. Interfectio Puerorum : Digital Projections and the12th Century Fleurys. Demonstrations. Research Conference - Academic Audience.

Fleury: Massacre of the Innocents. Trinity Congregational Church, Bloomington. Mar 31. Drama in collaboration with the Early Music Institute, IU Jacobs School of Music. Open Exhibition -cross-section of general public.

The Bloomington Biennial 2007: Faculty Artists from IU's Hope School of Fine Arts. Indiana University Art Museum. Hello World (Illuminated Script) Jan 27-Mar 11. Open Exhibition - cross-section of general public.

Cinewomen NY presents Animation, Avant-Garde, and Experimental Films. Two Boots Pioneer Theater. Experimental: interactive movies for CAVEs. NY, NY. Jan 23. Open Exhibition -cross-section of general public.

Fleury: Massacre of the Innocents. In collaboration with the Early Music Institute, IU Jacobs School of Music. Indiana University Art Museum. Bloomington. Jan 13. Drama. Open Exhibition -cross-section of general public.

2006 IU Research Works. SuperComputing 06. Tampa FL. Nov 13-16. Cabinet of Dreams Poster. Research Conference - Academic Audience.

Cabinet of Dreams. Indianapolis Museum of Art. Asian Galleries. Nov 06-. Permanent Collection. Open Exhibition - cross-section of general public.

Buffalo Infringement Festival VR Subfest. Haywalls Arts Center. Buffalo, NY. Beat Box. Aug 4-6. Open Exhibition -cross-section of general public.

Society of Imaging Sciences and Technology International Society of Optical Engineering. IS&T SPIE's 17th Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality. Cabinet of Dreams VR exhibition, San Jose, CA. Jan 20. Research Conference - Academic Audience.

2005 ResearchWorks. SuperComputing 05, Seattle Washington. Nov 12-18. Cabinet of Dreams. John-e-box. Research Conference - Academic Audience.

IGRID, International GRID, San Diego CA. Sep 26-29. Cabinet of Dreams. CAVE-to-CAVE. Research Conference - Academic Audience.

I-Light, IN Univ. Purdue Univ., Indianapolis. Sep 21- 25. Cabinet of Dreams. CAVE-to-CAVE to IUB. Research Conference - Academic Audience.

Ingenuity Festival. Cleveland Museum of Art, OH Sep 1-4. Cabinet of Dreams. CAVE wall. Open Exhibition -cross-section of general public.

X Room. Indianapolis Museum of Art. May 5-Nov 2006. Cabinet of Dreams- Permanent Collection. Open Exhibition -cross-section of general public.

American Association of Museums Conference. May 3. Cabinet of Dreams. Research Conference - Academic Audience.

Bloomington Biennial 2005: Faculty Artists from IU's Hope School of Fine Arts. Indiana University Art Museum, IU Bloomington. Mar 25-Apr 30. Journey 405. Plasma Display. Open Exhibition -cross-section of general public.

VR Works Panel and Demonstration. Society of Imaging Sciences and Technology International Society of Optical

Engineering IS&T/SPIE's 16th Annual International Symposium: Electronic Imaging: Science & Technology. The Engineering Reality of Virtual Reality Conference Exhibition. San Jose, CA. Jan 17-21. Beat Box. CAVE-to-CAVE to Univ. of Illinois Chicago, SUNY Buffalo, IU. Research Conference - Academic Audience.

2004 Red Gate Gallery, Dongbianmen Watchtower, Chongwenmen, Beijing, China. Nov 24-27. Vintage ImmersaGrams. Open Exhibition -cross-section of general public.

CAVE to CAVE Network Art Exhibition. SVR 2004 Seventh Symposium on Virtual Reality. In Sao Paulo, Brazil. Oct 21. Collaboration between Brazil, SUNY Buffalo, EVL-UIC Chicago, Royal Institute of Technology [Kungliga Tekniska högskolan], Stockholm Sweden and IU. Research Conference - Academic Audience.

The Lounge. School of Fine Arts Gallery, IU Bloomington. Oct 8. Activations No. 2. John-e-box. Open Exhibition -cross-section of general public.

Networks and Collaboration. SUNY Buffalo Conference Apr 24-25. CAVE-to-CAVE. Beat Box. Open Exhibition -cross-section of general public.

IEEE Virtual Reality Annual International Symposium. VRAIS '04. Chicago, IL. Mar 29. Network CAVEs from IU to Chicago and Sweden. Beat Box. Research Conference - Academic Audience.

DART Exhibition. SoFA Gallery, IU Bloomington. Feb 9-21. Activations. John-e-box. Open Exhibition -cross-section of general public.

VR Works. Society of Imaging Sciences and Technology International Society of Optical Engineering IS&T/SPIE's 15th Annual International Symposium: Electronic Imaging: Science and Technology. The Engineering Reality of Virtual Reality Conference. In San Jose, CA. Jan 18-22. Beat Box. Networked at Univ of Illinois at Chicago, SUNY Buffalo and IU. Research Conference - Academic Audience.

2003 The Lounge. School of Fine Arts Gallery, Indiana University, Bloomington. Oct 10. John-e-box. Open Exhibition -cross-section of general public.

Immedia. University of Michigan Media Union. Ann Arbor, Jan 31- Feb 8. Beat Box CAVE. Open Exhibition -cross-section of general public.

Bloomington Biennial 2003: Faculty Artists from Indiana University Hope School of Fine Arts. Indiana University Art Museum, Bloomington. Jan 25-Mar 9. Beat Box. John-e-box. Open Exhibition -cross-section of general public.

2002 I-Light. IUPUI, Indianapolis. Dec 4. Indiana test-bed CAVE Exhibit over the Indiana Fiber Optic Net. Research Conference - Academic Audience.

International Grid applications-driven high bandwidth testbed. IGrid 2002, Amsterdam, Holland. Sep 24-26. Beat Box–CAVE environment was networked simultaneously between CAVEs in Indiana, Univ of Illinois at Chicago, NCSA Champaign IL, SUNY Buffalo and Amsterdam. Research Conference - Academic Audience.

digitalwind. Museum of Contemporary Art Chicago Version 2.0. Apr 18. Dream Grrrls and Beat Box. Open Exhibition -cross-section of general public.

The WHO? Show. Murphy Art Center, Indianapolis, IN. Mar 16-22. Vintage ImmersaGrams: signed interleaved CAVE Epson prints and Kodalith films mounted on Plexiglas, framed in a metal light box. Open Exhibition -cross-section of general public.

Immedia Digital Arts. University of Michigan Media Union, Ann Arbor. Beat Box. Feb 8-17. CAVE. Open Exhibition -cross-section of general public.

Margaret Dolinsky. Space version 2.1 [Online Gallery] Curator: Ryan Gibson. Open Exhibition -cross-section of general public

2001 Research@Indiana. SC01, SuperComputing, Denver, CO, Beat Box Networked CAVE. Nov 10-16. Research Conference - Academic Audience.

Digital Frontier–The Buffalo Summit. University of Buffalo. Nov 2-3. Beat Box–ImmersaDesk. Open Exhibition -cross-section of general public.

Digital Innovations in Printmaking. Drexel University Arts Gallery, Philadelphia, PA. Oct 31- Dec 7. Open Exhibition -cross-section of general public.

New Media Aesthetic. Alternate Currents. Chicago IL. Oct 27. Beat Box CAVE-to-CAVE. Open Exhibition -cross-section of general public.

Alive on the GRID. Ars Electronica Festival 2001 Linz, Austria. Sep. Beat Box collaboration with UIC Chicago, SUNY Buffalo, Umea, Sweden, C3 Budapest, Amsterdam and IU. Permanent Collection. Research Conference - Academic Audience.

Blue Window Pane II. NTT InterCommunication Center. Tokyo, Japan. June 24. CAVE Exhibit. Open Exhibition -cross-section of general public.

CAVE-to-CAVE Artspeak: Visual Metaphors for Collaborative Navigation. and LVis - A Smart Virtual Reality Interface to Digital Libraries. Collapsing Time & Space: A High Performance Network Application Program Symposium, IUPUI Indianapolis. Apr 6. Poster. Research Conference - Academic Audience.

Bloomington Biennial 2001: Faculty Artists from IU’s Hope SoFA. IN Univ. Art Museum. Mar-Apr. Open Exhibition -cross-section of general public.

2000 Wired Women: On the Verge of a Digital Renaissance. The Gallery at the Three Arts Club, Chicago, IL. Dec 8 - Jan 22. ImmersaGrams exhibition. Open Exhibition -cross-section of general public.

Research@Indiana. SC2K SuperComputing 2000. Dallas TX. Nov 6-10. Blue Window Pane II–Networked CAVE to

ImmersaDesk Exhibition. LVis–ImmersaDesk exhibition, & Virtual Poster. Research Conference - Academic Audience.

Alberto Casiraghi. IU School of Fine Arts Gallery, Bloomington. Sep 15 - Oct 6. "Sanctum" book collaboration with Casiraghi. Open Exhibition -cross-section of general public.

International Grid Research Infrastructure Exhibition. INET Global Research Summit. IGrid 2000, Yokohama, Japan. July 16-21. Blue Window Pane II–CAVE-to-CAVE. Research Conference - Academic Audience.

ImmersaGrams Virtual Reality Snapshots. (art)^{n} Laboratory, Chicago, IL. May 8-13. Open Exhibition -cross-section of general public.

1999 After Hours, Walker Art Center, Minneapolis, Nov. Artist in Residence. Dream Grrrls ImmersaDesk. Open Exhibition - cross-section of general public.

CAVE Exhibition. Ars Electronica Center Festival 1999. Linz, Austria. Sep. Blue Window Pane–Permanent Collection. Open Exhibition -cross-section of general public.

SigKids. SIGGRAPH '99. ACM Special Interest Group on Graphics, Los Angeles CA. July. Blue Window Pane, Panorama Screen Stereo Display. Research Conference - Academic Audience.

Second Nature: A Show of New Media for the New Millennium Ukrainian Institute of Modern Art, Chicago IL. May 9-June 27. ImmersaDesk and ImmersaGrams Exhibition. Color catalogue. Open Exhibition -cross-section of general public.

Immedia 99. University of Michigan Media Union, Ann Arbor. Dream Grrrls–CAVE. Jan 27-Feb 6. Open Exhibition -cross-section of general public.

Margaret Dolinsky–Electronic Fields. Illinois Art Gallery, Chicago. Feb 26-Apr 9. Curator: Jane Stevens. Sponsored by the Sony Gallery of Consumer Electronics. Individual Exhibition. Open Exhibition -cross-section of general public.

Digital Tools and Output Media: Deleting the Discord between Art and Technology. Dorothy Uber Bryan Gallery, Bowling

Green State University, OH. Dream Grrrls. Dec 5- Feb 5. Open Exhibition -cross-section of general public.

6th NY Digital Salon. Center de Cultura Contemporania de Barcelona, Spain. Mar 22-Apr18. [Traveling] Open Exhibition -cross-section of general public.

6th Annual NY Digital Salon. Triennale di Milano, Italy. Feb 15 – Mar 15, 1999. [Traveling exhibition.] Open Exhibition - cross-section of general public.

6th Annual New York Digital Salon. Circulo de Bellas Artes, Madrid. Jan 8 - Feb 7. [Traveling exhibition.] Open Exhibition -cross-section of general public.

5.4.0.0 **Exhibition venue descriptions**

AppliedVis 2005

AppliedVis 2005 is a new regional conference on Applied Visualization. The Applied Visualization Lab is a public/private/non-profit collaboration established to cultivate the momentum of environmental, digital media, information technology, and entrepreneurial resources in Western North Carolina. Our mission is to create compelling and intuitive interactive visual interfaces from complex data and concepts to increase understanding by civic leaders, entrepreneurs, educators, students and the general public. http://www.appliedvis.org/ Invited. Research Conference - Academic Audience.

Consciousness Reframed.

Consciousness Reframed: art & consciousness is an international research conference that was first convened in 1997, and is now in its 8th incarnation. It is a forum for transdisciplinary inquiry into art, technology and consciousness, drawing upon the expertise and insights of artists, architects, performers, musicians, writers, scientists, and scholars, usually from at least 20 countries. Recent past conferences were convened in Beijing and Perth Western

Australia. Last year the conference, with sixty-six presentations, was organized under the rubric of Altered States, a theme that will be continued this year. Papers are also invited which will explore the theme of Immateriality. As last year, the conference will be held on the main campus of the University of Plymouth, England. The conference will include researchers associated with the Planetary Collegium, which has its CAiiA- hub at Plymouth, and nodes in Peking University, Beijing, the Nuova Accademia di Belle Arte, Milan, and the Hochschule für Gestaltung und Kunst, Zurich. The Collegium benefits from the advice of the distinguished members of its New Knowledge Advisory Board: James K. Gimzewski, Roger Malina, Thomas S. Ray, Marilyn Schlitz. www.planetary-collegium.net/conferences/detail/200607   Invited. Research Conference - Academic Audience.

Biennale of Electronic Arts. Perth, Australia. BEAP CAiiA-STAR Symposium.
The Biennale of Electronic Arts, Perth actively embraces the opening of new technological frontiers. BEAP is an international event which includes a conference, symposiums, forum and exhibition presenting the theoretical, cultural and philosophical basis of Electronic Arts practice. The inaugural thematic focus for BEAP is LOCUS, the place where we believe consciousness exists. The idea of place is being renegotiated through the developing biological relationships, effecting consciousness. These effects are further confronted through the external input of computer generated and augmented virtual realities. We find ourselves as the centre of this point of convergence, our senses become the portals, our skin becomes the screen between these immersive realties. This portal, this relocated screen, should now be at the forefront of minds, when the skin no longer defines the boundaries of our sense of self. Invited. Research Conference - Academic Audience.

Boston Cyberarts Festival
The Boston Cyberarts Festival is the first and largest collaboration of artists working in new technologies in all media in North America, encompassing visual arts, dance, music, electronic literature, web art, and public art. The 2007 Festival took place at more than 50 museums, galleries, theatres, universities, and public spaces in and

around the Boston area. Invited. Open Exhibition - cross-section of general public.

C@T: The Connecticut College Center for Arts and Technology. The Biennial Symposium on Arts and Technology, New London, Connecticut.
The Biennial Arts and Technology Symposium at Connecticut College is a major international conference devoted to presenting the edge and exploring the increasing links in the interdisciplinary world of arts, sciences, media, and technology.
The Center presents research papers and presentations in the specific area “Transparent Technologies” and in the general areas of Interactivity, Virtual Reality, Cognition, Information Technologies, Applications in Video and Film, Music (composition, performance, theory, interactivity, etc.), Experimental Theater, Experimental Dance,
Compositional Process, Innovative Use of Technology in Education, Computer Simulations of Physical Phenomena, Scientific Visualization and Social and Ethical Issues in Arts and Technology, and other pertinent topics relating to arts and technology.
The symposium will consist of paper sessions, panel discussions, art exhibitions, interactive environments, music concerts, animations, mixed media works, video screenings, dance, experimental theater and scientific visualization. In an effort to demystify the artistic process and create a forum for dialogue, we encourage all presenters and artists to attend the symposium and speak about their work. http://cat.conncoll.edu/2003.html Juried. Research Conference - Academic Audience.

Centre Interuniversitaire des Arts Médiatiques Montréal.
The Planetary Collegium Summit is about agenda building for the art of this century, sharing dreams, identifying emergent practice, and articulating new theory. The Collegium is an international community of artists and scholars working at the highest levels of practice and research that will seek through these public interactions to provide the roadmap to a planetary culture. Invited. Research Conference - Academic Audience.

Centers for Creative Technologies University of Southern California, LA, CA. Oct 26-27.
Presence Workshop, Invited. Research Conference - Academic Audience.

Ciber@rt Bilbao 2004 Festival, Spain.
Ciber@rt is a biennial event that began in Valencia, Spain in 1996 and relocated to Bilbao in 2004. It is a space for debate and art exhibition/reflection. It will focus on the challenges posed by cyberculture and the new artistic practices that use digital technologies and emerging technologies for their development. These technologies and the discussions, which they generate, have a wide-reaching social repercussion.
http://www.ciberartfestival.net/congreso_en.htm Invited. Research Conference - Academic Audience.

The Engineering Reality of Virtual Reality.
Society of Imaging Sciences and Technology International Society of Optical Engineering IS&T/SPIE Annual International Symposium: Electronic Imaging: Science and Technology. Virtual and augmented reality systems are evolving. In addition to research, the trend toward real applications continues and practitioners find that technologies and disciplines must be tailored and integrated for specific visualization and interactive applications. This conference serves as a forum where advances and practical advice toward this end is presented and discussed, and where research results can be presented. In addition to the general topic area, the 2006 conference is encouraging the submission of work in the following areas Industrial Applications, Compelling Experiences, Stubborn Problems, Demonstrations, Late Breaking Progress.
http://electronicimaging.org/call/06/conferences/index.cfm?fuseaction=EI102 Invited. Research Conference - Academic Audience.

High Performance Network Application Program. HPNAP Symposium, IUPUI, Indianapolis.
High performance digital networks and distributed software systems are transforming the way we work, communicate, learn, retrieve and store information, and conduct research. The purpose of the Program is to promote development, implementation, and testing of

innovative applications in research and teaching that use advanced local, national and international networks available to the IU community, as well as emerging high performance domestic network connection technologies such as cable modems, xDSL, satellite and wireless.
The Program aims to significantly accelerate the development of next generation network-based applications and development tools at IU through a joint effort of faculty, graduate students and staff and University Information Technology Services (UITS). The Program will provide funds, access to advanced networks and support resources through peer reviewed proposals. Applications developed through the Program can be expected to provide considerable competitive advantage to the University. http://www.indiana.edu/~uits/hpnap/
Invited/Artist Made Book. Research Conference - Academic Audience.

iGrid. International Grid Forum. Yokohama, Japan/Amsterdam, Holland/ San Diego, CA.

iGrid, the community-driven biennial International Grid event, is a coordinated effort to accelerate the use of multi-10Gb international and national networks, to advance scientific research, and to educate decision makers, academicians and industry researchers on the benefits of these hybrid networks. This year, iGrid showcases more than four-dozen real-time application demonstrations from 20 countries, as well as a symposium with 25 lectures, panels and master classes on the applications, middleware, and underlying cyberinfrastructure.
At its core, this cyberinfrastructure has new architectural approaches to next-generation internet design and development using optical networking. A single optical fiber can carry multiple wavelengths of light, or lambdas, enabling multiple networks to run in parallel. New middleware technologies enable applications to dynamically manage these lambda resources just as they do any grid resource, creating LambdaGrids of interconnected, distributed, high-performance computers, data storage devices, and instrumentation.
On the last day of iGrid 2005, the Global Lambda Integrated Facility (GLIF) has its annual meeting. GLIF is the international virtual organization creating a world-scale LambdaGrid laboratory, driven by the demands of application scientists, engineered by leading network

engineers, and enabled by grid middleware developers. iGrid showcases the latest advances in scientific collaboration and discovery enabled by GLIF partners, by providing a forum for these far-flung teams to test interoperability on a global scale. www.igrid2005.org/ Juried. Research Conference - Academic Audience.

IAMAS Symposium Institute of Advanced Media Arts and Sciences
IAMAS consists of two schools: the Institute of Advanced Media Arts and Sciences and the International Academy of Media Arts and Sciences. The Institute is solely a graduate school (for obtaining a Masters Degree) and has one faculty and one course, namely Media Creations. There are 20 students in each year of the course. The Academy is a vocational college accepting 30 students each year who must have at least graduated from high school. The Academy was founded in 1996 and the Institute was opened in 2001. Both schools were established by Gifu Prefecture as part of a strategy to promote advanced information technology and the culture that develops from this. The schools' activities are closely linked with Softopia Japan, the hub of the Prefecture's information industry. Invited. Research Conference - Academic Audience.

Institutions of the Visual, Arts and Humanities Conference, Champaign Urbana, Il.
The Illinois Program for Research in the Humanities at the University of Illinois at Urbana-Champaign was established in 1997 to promote interdisciplinary study in the humanities, arts, and social sciences. The IPRH grants fellowships to UIUC faculty and graduate students, who work in yearlong symposia on thematic topics such as “Cities,” “The South,” “Violence,” “Difference,” “Belief,” and the theme for 2006-07, “Beauty.” The program coordinates and hosts an annual conference, typically during the spring, coordinated with the annual theme and featuring presentations by the IPRH Fellows and an invited keynote speaker. http://www.iprh.uiuc.edu/default.htm
Juried. Research Conference - Academic Audience.

International Visual Literacy Association (IVLA) Conference.

IVLA is an eclectic organization of professionals working toward a fuller understanding of the way we derive meaning from what we see and the way we interact with our visual environment.
Members represent a wide range of disciplines including: the arts, sciences, communication theory, semiotics, graphic design, photography, videography, media studies, architecture, business, education, educational technology, instructional design, health, psychology, linguistics, philosophy, cultural anthropology, brain research, and computer applications.
Cross-fertilization of ideas coupled with human interests and values have made IVLA a vital, multidisciplinary forum for over thirty years. Dynamic interaction between practitioners and theorists from diverse cultures and disciplines are its greatest strength.
http://www.ivla.org/org_what_ivla.htm Juried. Research Conference - Academic Audience.

ISEA International Symposium on Electronic Art.
Founded in the Netherlands in 1990, the Inter-Society for the Electronic Arts (ISEA) is an international nonprofit organization fostering interdisciplinary academic discourse and exchange among culturally diverse organizations and individuals working with art, science and emerging technologies.
ISEA publishes a newsletter; hosts an online archive and exchange environment and oversees the International Symposium on Electronic Art, a regular gathering of the international art, science and technology community. http://www.isea-web.org/eng/index.html Juried. Research Conference - Academic Audience.

New Music & Art Festival
The annual New Music & Art Festival at BGSU has traditionally brought international musicians and artists to Bowling Green for a celebration of current art and music. The work of over two dozen composers and artists will be presented at the 23rd Annual New Music & Art Festival on Oct. 17-19, 2002. The festival includes concerts, film screenings, lectures, exhibitions, workshops and other exciting opportunities. Organized by the directors of the MidAmerican Center for Contemporary Music and the Fine Arts Center Galleries, Burton Beerman and Jacqueline Nathan, the Festival

supports the creation of new work and engages both the University and city communities in the process of art appreciation and awareness. The majority of events are accessible, free and open to the public.
http://www.bgsu.edu/colleges/music/MACCM/festival/nmaf23/about.html_ Invited. Research Conference - Academic Audience.

New Forms Festival Old and New Forms: A Post-Traditional Technography of Word Media Arts.
The New Forms Festival, held at the acclaimed Vancouver Art Gallery, is an annual cross-disciplinary festival exploring installation, performance, music, film, and electronic arts.
http://www.newformsfestival.com/nff06/ Juried. Research Conference - Academic Audience.

NEXT—New Extensions in Technology, Karlstad, Sweden.
NEXT 2.0 will bring together for a second time in Karlstad an international field of practitioners and scholars engaged in the work of making these technologies meaningful for contemporary culture. An academic conference and an artistic exhibition, NEXT 2.0 will represent a unique forum for celebrating and critiquing the techniques, forms, and aesthetics of digital media.
http://www.media.kau.se/next2/callforpapers.html Juried. Research Conference - Academic Audience.

Nomadic Transitions: Thinking in Art. University of Art and Design, Zurich, Switzerland.
Part One of Nomadic Transitions: The speakers will address the controversies surrounding the discourses of Art, Art Theory, Perception, Media theory and Media Technology. Nomadic transitions also questions new concepts of creativity and co-authorship, as well as the future of theoretical education in relation to contemporary art and media practice. In this light participants will talk about the value of art research in future scenarios, interactive nomadic communities and the meaning of post-graduate education in the related fields of art, design and media research.
Part Two: Brainstorming Sessions with Invited Guests and public attendance. Using provocative statements, leading theorists and artists will present and moderate focused discourses surrounding the

concepts of Art, education and post graduate research, Art and Applied Science and Art and design in relation to language and politics.
In parallel sessions we will attempt to monitor the importance of dialogue as a sub-basis for research in trans- disciplinary areas. Is research and experimentation encouraged by recorded and moderated discussions within focused themes with specially invited guests? http://www.nomadic-transitions.ch Invited. Research Conference - Academic Audience.

REFRESH! Histories of Media Art, Science and Technology
Recognizing the increasing significance of media art for our culture, this Conference (Evenings of September 28, 29, 30, October 1) on the Histories of Media Art will discuss for the first time the history of media art within the interdisciplinary and intercultural contexts of the histories of art. Leonardo/ISAST, Banff New Media Institute the Database for Virtual Art and UNESCO DigiArts are collaborating to produce the first international art history conference covering art and new media, art and technology, art-science interaction, and the history of media as pertinent to contemporary art.
http://www.banffcentre.ca/bnmi/events/refresh/ Juried. Research Conference - Academic Audience.

Sensorial Net: Art, Science and Technology, Fortaleza, Brazil
Sensorial Net was a symposium held at the Centro Dragao do Mar de Arte e Cultura November 29-30, 2003. Invited. Research Conference - Academic Audience.

SIGGRAPH Conference.
SIGGRAPH (short for Special Interest Group for Computer GRAPHics) is the name of the annual conference on computer graphics (CG) convened by the ACM SIGGRAPH organization. The first SIGGRAPH conference was in 1974. The conference is attended by tens of thousands of computer professionals, and has most recently been held in Boston. Past SIGGRAPH conferences have been held in Dallas, Seattle, Los Angeles, New Orleans, San Diego and elsewhere across the United States. en.wikipedia.org/wiki/SIGGRAPH The annual SIGGRAPH conference and its year-round initiatives provide unique crossroads for a diverse community of researchers, developers,

creators, educators, and practitioners. Our continuing mission is to be the premier annual conference on leading-edge theory and practice of computer graphics and interactive techniques, inspiring progress through education, excellence, and interaction. www.siggraph.org/conferences/confmission.html Invited. Research Conference - Academic Audience.

Society for Literature, Science, and the Arts (SLSA) Conference
The Society for Literature, Science, and the Arts (SLSA) welcomes colleagues in the sciences, engineering, technology, computer science, medicine, the social sciences, the humanities, the arts, and independent scholars and artists. SLSA members share an interest in problems of science and representation, and in the cultural and social dimensions of science, technology, and medicine. SLSA publishes the professional journal Configurations through Johns Hopkins University Press. http://www.litsci.org/ Juried. Research Conference - Academic Audience.

Toward a Science of Consciousness. University of Arizona.
A series of biennial interdisciplinary conferences on consciousness held in Tucson in even-numbered years since 1994. The "Tucson conferences" have helped to catalyze the recent development of scientific research on all aspects of the problem of consciousness. The Tucson conferences stress interdisciplinary exploration, bringing together perspectives from philosophy, neuroscience, psychology, cognitive science, computer science, physics, biology, anthropology, contemplative traditions, the arts, medicine, and other areas. A continuing focus of the conference is the integration of the first-person and third-person perspectives on the phenomena of the mind. http://www.consciousness.arizona.edu/tucson2006.htm Juried. Research Conference - Academic Audience.

Transmodalities: mind, art, new media. Sabanci University, Turkey.
Transmodalities: mind, art, new media is a conference that presents ideas, proposals, and projects by artists and scholars of the Planetary Collegium in association with faculty of the Sabanci University. Increasingly artists work across cultural modes, media and genres, invoking both science and mythology, technology and tradition. The

postmodernist turn has become the transmodal transit, as we hyperlink and network our way through the emergent realities that new models of the world and our own subjectivity are creating. New media art is at once pragmatic and philosophical; it generates interactivity and transformation both socially and aesthetically, while reflecting on the changing nature of perception, connectivity and consciousness. Its outputs are deeply layered, with associations, meanings, feelings, histories, unities and discords richly woven into new telematic, digital or post-biological environments, providing us with new experiences and creative visions. Invited. Research Conference - Academic Audience.

VSMM Virtual Systems and Multi Media (VSMM)
Virtual reality technologies and their applications provide a new medium for the advancement of human expression, interpretation and preservation of the human spirit and essence of humanity. The International Society on Virtual Systems and MultiMedia, seeks to address these concerns and issues and provides a foundation for integrating together the human, technological and strategic aspects of VR under the umbrella of international exchange, cooperation and development.
Virtual and Multimedia information processing technology is currently attracting the attention of many people because its considerable progress is expected to change human society extensively in the near future. We cannot be ignorant of the progress of this technology; instead we have to investigate its future possibilities and as well as the effects it brings to society.
To discuss these issues from an artistic, technical and commercial perspective is the objective of the VSMM Society. This society covers a very wide range of topics of interest, including not only pure technological issues but also mathematical, medical, agricultural, educational, psychological, artistic, social, and other issues related to virtual systems and multimedia information processing.
http://www.vsmm.org/profile.cfm?CFID=895387&CFTOKEN=aaf90b8c26e89494-572AAC4A-CA29-C8A8-345DBD80A8901482 Juried. Research Conference - Academic Audience.

5.5.0.0 **Summary**

This chapter discusses my artwork and examines the types of phenomena that promote analogies and visual thinking. It begins with drawings that are generated in a process that Csikzentmihalyi terms “flow experiences” (Csikzentmihalyi 1999, 1996) and Carl Jung terms “active imagination” (Jung 1936:102). These activities in which we lose ourselves to a creative challenge can help define how we experience our lives. When we engage with activities or establish objects with significance into our lives, it creates meaning for our lives.

As philosopher John Dewey asserted, all experience has the potential for an aesthetic experience - in unity and in depth, which is characterized by the integration of perceptive, affective, and cognitive processes, the very same processes that intelligent functioning depends upon (Dewey 1934).

The image making practice begins with a stream of consciousness process or mindset in order to situate a flow of drawings that become paintings and eventually virtual environments.

The artistic practice concerns perception of the emotional landscape, the use of emotables, plasticity and the fusion of art with technologies so the hardware, software and the portability of equipment help to define the experience.

The environments are dependent on the visitor's ability to navigate through the scenes. The environment has no drop down menus or avatars to control so the objects within the environment become the sign posts for navigation. The aesthetics depend on Arnheim's visual properties of balance, shape, form, growth, space, light, color, movement, dynamics and expression in order to exploit visual perception and create an emotional landscape.

This is enhanced by the audio, which acquires meaning by its reference to other sensory data in the scene. Our vision offers information about objects and events in the interior and exterior worlds in the environment and vision is the primary medium of thought because these environments are based on digital paintings created from sketches that are generated from hypnopompic imagery.

There is an attraction to light, glimmering, shimmering, moving characters or emotables that fill the landscape and instigate the navigation. We distinguish motion from immobility so motion attracts attention. In my work, motion happens through loud colors, whimsical objects and unfamiliar landscapes. The environment is loud and calls for exploration. It is an emotional landscape.

The major points of my artwork include:

- A perceptual shift is a cognitive recognition of having experienced something extra-marginal, on the boundaries of normal awareness, outside of conditioned attenuation.
- Emotables are graphical characters intrinsic to the emotional landscape with a variety of characteristics including emotion, motility, ability, motion, and malleability.
- Emotables are distinct from avatars because they do not represent the real time movements of an active person.
- Emotions and psyche are a hidden element to many of the analogies embedded in the artwork.
- Multimodal sensory stimulation is key to immersion and aesthetic experience in interactive art.

- An event or an interaction can situate consciousness and provoke frames of mind.
- Real time action and reaction is occurring in a constant loop between the visitor and the environment so that one is constantly igniting the other.
- Portraiture and elements of portraiture are prime components of the environments.

Chapter Six: Apogee

6.0.0.0 Apogee

6.1.0.0 Summary of the research

6.2.0.0 Discussion of the results

6.3.0.0 Suggestions for further research

6.4.0.0 Concluding remarks

6.0.0.0 **Apogee**

This chapter is a culmination of the discussion thus far about art and virtual environments, technology and the interactive arts, and immersion and consciousness. This chapter includes a summary of the research, discussion of the results, suggestions for further research and concluding remarks.

6.1.0.0 **Summary of the research**

"A quick and spontaneous drawing created through the process of active imagination—a method that generates imagery from the unconscious— is transformed into a virtual world of communication, immersion and interaction and is realized as an interactive computer-generated experience." –M. Dolinsky, 2014

This thesis investigates virtual environments as an artform. It begins by examining art as a process and immersion as a trajectory in that process. A historical drive for mark making is a biological imperative according to Dissayanake who uses the term "making special" to describe our inherent need to create items of significance (Dissayanake 1980:404). Along with these physical mark making activities, early man explored cave dwellings as places of ritual and decoration which may have facilitated social and cultural practices to form communities and alliance networks. The thesis investigated the interplay between action and reaction, where in the early eighteenth century these concepts became active pursuits in terms of goals to pursue and values to assert (Starobinski 2003:305). Concurrently, art forms developed that emphasized an awareness of psychological immersion such as paintings in the style of Cubism, Surrealism and Formalism as well as panoramas, labyrinths and gardens that created environments that exploited multi-sensory modalities. These modes of expression are desirable because their visual input and at times auditory stimulation ignite our mental processes to create metaphors and build new concepts that either solidify or alter our frame of consciousness and current belief system. These moments of cognitive awareness I term perceptual shifts. A perceptual shift is a cognitive recognition of having experienced something extra-marginal, on the boundaries of normal awareness and outside of conditioned attenuation. These recognitions help us realize our environment, whether real or virtual.

Artists simulate spaces of the imagination by employing screen based projection systems and surround sound to provide a 3D, stereo, real time computer graphics performance. Fleischmann (2001) and

Strauss use a head mounted display (HMD) with a graphical representation of the visitor's hand within the virtual environment, which is indicative of the fact that we exist in many worlds simultaneously: real world, virtual world, corporeal being, and philosophical thought machine. This recognition of the multiplicity of worlds and their corresponding psychic states is something that is fundamental in virtual worlds.

Many artists are discussed in the thesis including artists such as Daria Tsoupikova, Tim Portlock and Wille Mäkelä whose background in painting informs their VR aesthetic. Tsoupikova illustrates Russian folktales and Portlock creates surreal cities while Mäkelä draws in real space in real time using computer graphics.

Much of my own work began with non-linear story telling around certain themes of dreams and psychic dilemmas and became more specific and interaction-intensive. Created in the 1990s, "*Dream Grrrls*," "*Strait Dope*" and "*Blue Window Pane*" are non-linear stream of consciousness narratives. In the new millennium "*Beat Box*" and "*Cabinet of Dreams*" were created to be very goal oriented but also maintain the stream of consciousness narrative. For example, "*Beat*

Box" allows visitors to configure audio sequencers, which is labor intensive. The navigation wand buttons are pressed and held next to a graphical character in order to toggle through the sound selections and essentially choose a voice to assign to a particular interval on the audio sequencer. The musical instruments are set within an environment of grassy flowers and hills that are ideal for wandering in the resultant music.

Another artwork that requires some labor of the visitor is "*Cabinet of Dreams*" which is inspired by and houses a collection of ancient Chinese sculpture from the Indianapolis Museum of Art. Its main environment is a labyrinthine architectural structure that hides portals to surreal environments that are the opposite: nonsensical and free roaming.

In an effort to further expand the scope of the virtual environments they were incorporated into several operas and musical performances. Theatrical stages incorporated the virtual environments as interactive projections during the performance which is accompanied by live music and vocals. This trajectory expands the sense of what a virtual environment is by combining the intimate space of the VR theater with the place of the dramatical stage into an intimate space with a shared collective experience using the technological sound design and light projections as another actor in the drama.

One example of the virtual world augmenting real world drama occurred in the opera “*Annunciation and Visitation*” where the facial detection system of “*Emotable Portraits*” captured live audience members, processed video of them to output a painterly display of them situated in a religious choir on stage. Here the ‘emotable’ represents a type of emotive portraiture distinctive in virtual space. The portrait is a unique entity that is separated from the real world person and exists in an evolving collective of the landscape.

The psychological instantiations of perception, psychic dilemma and choice making guide my construction of the artworks towards the goal of creating a subversive confrontation and a compelling experience. The thesis investigated physical and virtual experience in rhythm with our perceptions and the resultant connections and associations that can be established.

Various approaches to virtual environment art were considered including those by Jeffrey Shaw, Char Davies and Brenda Laurel. There is no given visual prescription for a VR navigation methodology or for creating in an immersive virtual environment so the drive was to create my own using my drawings and paintings. An example of how confrontation is a perceptual dimension of the experience occurs in “Figuratively Speaking” where at the bottom of a mountain has a narrow path leading towards the top. There two gendarmes attempt to prevent anyone from going further. They wave their arms, shout out words and block the way. If the visitor continues past them, the landscape has walls that open up and the mountain becomes accessible and the climb to the top reveals a large temple that is constructed and erected as the visitor approaches (Dolinsky 2011). In effect, by overcoming the guards a new pathway begins and the summit is reached and a temple is built in upon your arrival.

In the process of creating characters such as the gendarmes I began to identify and term them emotables. Emotables are the characters that inhabit a unique particular aspect of the virtual world. They are emoting, moving and are malleable. Their purpose is to situate the environment and to create a level of emotion or shift in perception for the visitor. Moreover, by existing intrinsically in the environment they are also a feature of the environment. For example, in "*Figuratively Speaking*" the emotables' noses become the forest of Knowses and a place where the emotables confer and gain advisement. In "Blue Window Pane," a seemingly religious icon hangs on the wall and when it is approached, it swells open to become a doorway of sliding portraits that guide the visitor into a hidden inner sanctum. It is a secret doorway to a room that represents the psyche.

The emotable is distinguished and separate from the avatar. Avatars are representations of remote visitors through which real people can converse with one another in a collaborative or networked world, for instance, when the CAVE is connected to other CAVEs.

Occasionally, my work has contained avatars for the networked exhibitions. "*Blue Window Pane*" was initially conceived as a stand-alone artwork and later it was networked so that several remote locations could visit the world simultaneously. As a result, an avatar was required and constructed to appear as a muscular body-builder without legs. It resembles the emotables in bodily dimensions but is decidedly more humanoid. The absence of legs allowed the avatar to glide through the environment. This gave it an unearthly feel and a ghostly type of movement. The avatar was stylistically designed to be distinctive from the environment so that it functions purposefully without affecting the emotional landscape of the scene.

The networked VR pieces I created include "*Blue Window Pane II*" "*Beat Box*" and "*Cabinet of Dreams*" (Dolinsky 2000, 2001, 2005). They offer interaction in a shared virtual environment where the remote visitors from various cities engage with others who are in a CAVE or CAVE-like display. Each display is connected over the network so that the CAVE you are in is updated according to the motions happening in other CAVEs. Visitors are able to speak with others who are local or remote while manipulating virtual objects. A shared networked environment is an illustration of a shared collective consciousness in action.

Consciousness inevitably shifts when someone reaches out and tries to touch the graphical objects hovering in space or when they try to jump in and out of objects. For example, in the vessel world in "*Dream Grrrls*" the visitor can move inside a larger than life sized head and be totally surrounded by it. Or inside an open room with large windows in "*Figuratively Speaking*" you can peer around the corner or look through the window to see are a cloud of hearts flying through the air. You can reach out and try to catch them as they go by or if you fly with them, it can feel like the hearts are coming out of your own body.

6.2.0.0 **Discussion of the results**

"The limits and multiplicities of our frames of vision determine the boundaries and multiplicities of our world." The Virtual Window, Anne Friedberg

It is a daunting endeavor to attempt to deconstruct one's own images and articulate their origin, development and direction. For me, art making is a visual process and the undertaking is devoid of verbiage until much later after I have come to live with the images, as they continue to reveal things long after their arrival. The reveal begins in the visual with the relationships of the objects in the scene, how they are positioned and weighted by color, shape and form and how that form becomes hidden and then visible and then hidden again. The looking at objects in a virtual world is similar to the looking at objects in an actual world in that we assimilate one plane of meaning and transfer to another by our construction of metaphors in order to integrate the outside world with our inner consciousness (Friedberg 2006:11).

I am interested in the process of understanding images from the unconscious and the shift they can create in our perceptions. I have developed stylistic and technical strategies that are the result of an introspective analysis during the course of my art making process. The process relies on developing connections to the self by becoming aware of making judgments, building a knowledge base and developing an awareness of visual, auditory, mental, physical and verbal dynamics.

Combining art with technologies offers a multifaceted opportunity for investigating art, communication and perception. As an artist, one of my objectives for virtual environments is to position the visitor to coalesce with the apparatus. The aim is to overcome the wonder of the technology and situate attention, and therefore, consciousness within the sensorial moment. Artistic design is critical to promoting aesthetic, visual and sensory stimulation that establishes environments and develops the human-to-machine synergies for socialization and experiential exploration. A virtual environment's creation must consider aesthetics in order to strengthen technological tools and innovation.

Lewis-Williams's book *Mind in the Cave* as well as the writings of Dissayanake and Turner established a historical trajectory for using images for shifts in perception. Lewis dismisses the cave images as information theory because their capacity to store or convey information was limited in that we do not know their actual purposes (Lewis-Williams 2002:67). However, pictures mean something and at the same time carry information which is often beyond mere words. Images have the power to move people and to be read in very different ways. As a result, images trigger memories that are integrated both verbally and experientially. By employing a process of active imagination, images are triggered by unconscious memories and integrated into an experiential art form.

This research concludes that by generating images from an active imagination and integrating them into a 3D emotional landscape, the graphical environment will bridge the visitor to an affective realm, where analogies will trigger the action-reaction process towards immersion and an aesthetic experience.

In effect, there are important parallels between the functions of the fire-animated art in the Paleolithic natural caves and the interactive art in the current technological CAVEs. The images maintain spiritual power in both realms. The seemingly shamanic experience of the Paleolithic people in the caves echoes that of the modern day enthusiast in computer-generated CAVEs. In both cases the environment allows visitors to suspend their disbelief and succumb to the immersion of the artwork. In regards to my own artistic process, I can only surmise that both sets of images, Paleolithic and contemporary, emanate from a state of active imagination or an unconscious mind. Moreover, both instances of experiencing imagery can have a direct impact on social relations. In the Paleolithic era, the cave paintings were a byproduct of spiritual beliefs and helped maintain a society. In the contemporary framework, the CAVE virtual environments are bringing visitors together to share in a ritualized art phenomenon.

The formation of virtual environments begins in its construction process, both analog and digital and continues as an interactive experiential process. The dynamic progression of the aesthetic for the artist occurs in a very different way for the visitor. Art begins as an inspiration and continues as intervention, dissemination and being-there. Throughout the processes, art situates consciousness. An active imagination technique for creating illustrations positions the artist as agent provocateur of consciousness. The artist must situate the visitor in an action-reaction loop with the artwork, the computer and the cultural and biological circumstances. The syncretism between biological self and technological world is deeply rooted in consciousness. Aesthetic theories offer insights towards the discovery of principles establishing distinct aspects of arts and consciousness (Ascott 1966-7, Shanken 2003). My methodology is one way of spawning virtual environments that leads to the creation of visual analogies that are personal and have the potential to be shared with others. The creation of these images includes:

1. A quiet space
2. A calm mind devoid of specific goals

3. Drawing implements
4. A willingness to simply let the drawing utensils explore the drawing surface and accepting the outcomes. It's best to have no preconceived notions.
5. Transfer the images to another medium for further development and embellishment using other materials
6. If using colors, choose the color that asks to be next
7. Keep all utensils and drawing surfaces as neat and tidy as possible
8. Keep all materials in a dedicated location so that they are ready at a moment's notice
9. Develop a daily routine to tap into the drawing power of the unconscious.

My method of drawing relies on a social awareness and an intimate moment of resituating the personal in the experiential, time-based mode of the virtual environment. Specifically, I argue for an experiential process for creating interactive aesthetic experience in order to tap into one's own personal aesthetics. Jung has outlined an unconscious creation mode with the potentiality for the artist to reveal their “inner nature” by giving over to “uttering things which he would never have entrusted to his tongue” (Jung 1966:72-73). “The true symbol … should be understood as an expression of an intuitive idea that cannot yet be formulated in any other or better way.” (Jung 1978:70). A recognition of this intuition is within the artistic process and can lead us to understanding how to develop active illustration from the active imagination, a type of unconsciousness describes as a ”sequence of fantasies produced by deliberate concentration” (Jung 1936:102). In particular, I recommend immersive virtual environments as sites (sights) for consciousness awareness and using the active imagination to create aesthetic experience where the enactment of processing visual forms and making artistic decisions moves on a continuum from inception to conception, where conception is a constant occurrence commencing from the initial art making and continuing through to the visitor realizing the art through the navigational process. In interactive arts, the flow of visual analogies guides the visitor and impacts perception. The environment has the ability to isolate and delineate how visual analogies are unraveled during a constructed ongoing reality. As the progression of establishing metaphors is fundamentally mental and consists of broad categories in which we coalesce our present circumstances with our previous circumstances, a scaffolding of metaphors builds an experience that moves between knowledge systems and belief systems in order to establish and expand our world to an accepted form of reality. What we know and what we think we know depends on our frame of mind and how our body is reacting to the environment. The roots of this discourse may have begun with Plato and such writings as the *Allegory of the Cave* in which men chained to a rock are limited in their field of view and are confined to knowing only shadows as their reality in order to understand their surroundings (Cornford 1965:228). The idea of virtual as described by Anne Friedberg:

> "serves to distinguish between any representation or appearance (whether optically, technologically, or artisanally produced) that appears 'functionally or effectively but not formally' of the same materiality as that which it represents. Virtual images have a materiality and a reality but of a different kind, a second-order materiality, liminally immaterial. The terms 'original' and 'copy' will not apply here, because the virtuality of the image does not imply direct mimesis, but a transfer— more like metaphor— from one plane of meaning and appearance to another" (Friedberg 2006:11).

Douglas Hofstadter, philosopher and cognitive scientist, and his colleagues argue for an approach to analogy as a high-level perception because they believe that perceptual processes cannot be separated from other cognitive processes even in principle (Chalmers et al. 1992:185).

By considering how cognitive science examines the notion of 'analogy' and 'concept,' my art making helps me to investigate how visual imagery influences concept building and how using analogies plays a role in the digital interactivity of consciousness. As analogy is "the perception of communication or essence between two things" (Hofstadter 2006). Therefore if analogy is a mental property that is dependent on one's current frame of mind and active imagination is used to generate visual analogies, it is possible that circumstances will evoke a particular concept that will create a new form of communication.

The descriptive narratives and analogies that are evoked by my visual imagery brings to mind Noel Carroll's cinematic term *mimed metaphor* whereby disparate objects are identified with something that it is not. (Carroll 1991:30-33) He provides the example where

Charlie Chaplin in “*The Gold Rush*” (1925) indulgences in a boot as if it were a meal and treats the sole as a filet, the nails as bones and the laces as spaghetti. The objects have incongruous interpretations and the object can be seen literally or figuratively. However Carroll writes that this is not the same as the duck-rabbit phenomenon because we see the nail as a bone at the same time we see the nail as a nail:

> “The humor in the situation rides on the possibility of its simultaneous play of interpretation, which interpretations are nevertheless delightfully opposed, allowing and even encouraging alternative-literal versus metaphorical-views” (Carroll 1991:32).

All of my works of art, from paintings to virtual environments to dramatic musical performances and interactive installations include an element of subversive confrontation in terms of the imagery. The work is evolved from my stream of consciousness and presents a confrontation that involves psychic flow portrayed with hidden emotional dilemmas. As the visitor walks through the shattering windows to the expanding emotables that act as doorways or as the visitor approaches a head and its eyes open up to reveal a new emotable or an entry to a new emotive landscape. The alternate landscapes are filled with the stares of computer graphical characters, or emotables, and the circumstances that they create.

These characters or emotables are different from avatars. Avatars are an invocation of our self, a representation of our self within the environment. The characters in my environments are meant to stand on their own and invite the visitor into their world. In the past I have called them avatars but through doing this research I am referring to them as emotables. Emotables are characters that are computer graphic characters but not avatars.

These faces and characters as emotables, confront visitors in the virtual environment to engage them in an interactive, stream of consciousness dialogue. The emotables are designed to represent those intimate moments of self-reflection and confrontation that occur daily within ourselves and with others. They reflect moments of wonderment, hurt, curiosity and humour and are waypoints for practical or purposeful endeavours. The characters create conditions that allow visitors to contemplate their emotional state, enabling them to trust and understand their personal space, in which decisions are made and the nature of world is determined. The emotables point the way through the environment and create the environment at the same time.

The emotable is simultaneously emotion, motion, motility, ability and motive. The emotable represents point, line, plane within the Cartesian coordinate system, and offers a place in the psychological world. The emotable is a point or place in space. An entity attracts the visitor towards it. The emotable also has an orientation as the head or character is turned in a specific direction, which offers a line of sight. An emotable also serves as a plane because the plane serves to define the limits or boundaries of a volume. The emotable as plane becomes the ground, the wall, or the forest in the landscape. Its boundary houses the environment and captures the emotional space by delineating interiors and exteriors with color, shape, motion and sound. These are Arnheim's fundamental visual elements.

Planes in architecture define three-dimensional volumes of mass and space. The properties of each plane—size, shape, color, texture —as well as their spatial relationship to one another ultimately determine the visual attributes of the form they define and the qualities of the space they enclose. They also have supplemental properties - size, surface color, pattern textures, visual weight, and stability.

The emotable is the foundation of the landscape in the latest virtual environment, "*Figuratively Speaking*." The elements of the emotables are the elements of all of the architectural construction. The noses, lips and eyes become the environmental conditions of the landscape. The features and elements of the emotable characters become the ground plane that situates the emotables. The emotable, its structure, emotion and mobility influence the forms and their functions. The elements of the emotables are the building materials that comprise the landscape. It creates an emotional landscape where each element of the environment merges with the other as an element of subversive confrontation and a move towards a psychological state. The emotables emerge as the ground plane, rest firmly on it, elevate above it and sail through the sees. The ground planes are the faces of the emotables. They establish a podium for building form and for navigation. The faces are elevated to become a sacred or significant place; to create both an interior and an exterior space. The spaces lead to a religious temple, creating an elevation that can be easily traversed to a platform carved of emotable elements to reveal a new entity that is recognized by a manifestation, a meeting of the minds.

The emotable is a compelling way to integrate the visitor into the work because it is the structural system of the environment and of the navigation. It is the emotional bearing-wall. It represents a parallel series of analogies that evoke self, other and a collective consciousness. These emotables can be related to only by inserting oneself into their space and becoming a part of their activities. This occurs in the virtual environments, the interactive installations and in the process of viewing the paintings and the dramas. For me, it also occurs in the making of the drawings when I discover the emotables and what they have to say. It occurs, too, after the artworks are complete when they continue to convey new information as they continue to interact over time.

The emotables create visual properties in their relationships to one another. They situate the environment, inhabit it with one another, and invite the visitor to interact or live in their space. The shapes, colors and configurations create an interlocking series of events and places to explore. Some of the emotables inhabit interior rooms and define the degree to which the visitor is welcome to relate to them or to see them relate to one another.

As a design element, the form, color, texture, and material of the spaces define the emotional landscape. The artwork denotes a psychic, emotional or subversive confrontation for the visitor to contemplate if they recognize it. Otherwise, the designs become the signposts for wayfinding.

The walls create privacy within interior spaces that establish intimacy and limit movement. Openings in the walls become part of the spatial experience. By revealing hidden doorways and shattering windows, we transition to other spaces where we can reestablish continuity with neighboring emotables. Movement between interior to exterior spaces allow the passage of time and reveal a new space. Continuity is maintained using the emotables as a ritual or unifying device with a distinct color texture, shape form and audio sound. As they increase in size, these openings begin to erode the natural sense of enclosure walls provide.

All of the virtual environments have different elevations of the space. The ceiling or sky becomes the primary sheltering element that unifies the emotional landscape. It may be a single color or a repository for frescoes and other artistic expressions or simply become a passive or receding surface. It can be raised or lowered to alter the scale of a space or to define spatial zones within a room. Its material, color and texture can be altered to control the emotional quality within a space by adding light and sound.

Sound enhances the intimacy of the space and the acoustical quality sets the psychological or emotional landscape. The voices of the emotables as soft whispers establish an intimacy in the environment. Loud spaces express loud sounds. The audio design is critical to helping the visitors weave themselves into the space; it carries them viscerally through the emotional landscape. Sound can enhance the form and the silhouette of the elements as well as establish the setting of the space.

The sounds can express themselves in a single voice, a shattering event and it can extend outward to form overhangs or continue downward to relate itself more closely to the ground plane. The most compelling experience aurally is through sound activated graphics. By establishing a reaction from the emotables and the environment when they are approached, a sound signals the existence of both the visitor and the elements within the space. The sound, its generative reaction and the changes in the emotional landscape unites all of the elements within that time frame. Here the plasticity of the environment or the installation becomes immersive and the visitor can lose their sense of disbelief in order to gain a sense of "being there."

The supplemental properties - size, surface color, pattern textures, visual weight, stability become animated entities and characteristics of the emotables. They are dynamic - alive entities and smart object beyond the representational avatar that denotes the direction of navigation. The avatar removes the visitor from the situation by placing them in a third person viewing modality. In my virtual environments, visitors establish a first person perspective without an interlocutor. The visitors must determine their own path.

The head and hand triggers are used differently in the environments. For example, *Beat Box* is very manipulation and audio intensive while the peripheral vision is exploited by attaching something to the head in *Dream Grrrls*. In this virtual environment of dreaming that is a reflection of childhood, the entrance to the world appears as a vast sky filled with clouds. A small whimsical emotable head is attached to the visitor's peripheral vision. If you turn your head, the emotable moves away and follows the head turn. The emotable head is nearby, attached but not seen. It can be heard. A voice is begging you to "come out and play" and directing with "can we go over there." When you comply, the emotable becomes visible, detaches from the peripheral vision and cries with excitement "let's go over there!" By following the directions, you transition the environment to walk among the clouds to play a game of seesaw in the sky.

Often time, emotables or other objects are used as a recurring icon. The visitor can establish their wayfinding by identifying an object that occurs repeatedly by appearing within different spaces. The icon symbolized strength, stability and reliance. It is an analogy in terms of being the key to finding a way through the environment. It is also analogous for a helpful and reliable friend. For example, in *Cabinet of Dreams*, each environment has at least one cabinet in it. That cabinet becomes the transportation or the portal between the environments. In a more elaborate example, in "*Blue Window Pane*," there is a golden skeleton key. The key is placed on a shelf inside what looks to be a religious icon. The key is golden, moving in a pulsating fashion, inviting the visitor to touch it. Peering at the key closely will only cause the object to seem to hit you in the head. However, if you reach out as if to pick it up, the key moves inside the icon and the icon begins to swell. The icon swells up and becomes large enough to walk through. It becomes a passageway to an inner sanctum. In a related space, the key is held by an emotable who runs away when you enter the room. If you approach that emotable, the environment changes and the visitor transitions to another scene.

There are times when the emotable is a head that represents a psychic dilemma and the opportunity to enter an alternate space. In "*Blue Window Pane*," through a hidden doorway protected by guards is an interior intimate and small space. It represents an inner sanctum. In the middle of a room is a large head floating inside a diaphanous globular and elliptical fog. Inside with the head the space is very small and one must struggle to stay contained within the ovoid. When the visitor reaches out towards the head, it is as if going inside a psychic dilemma. As you try to reach out and touch it, your head is so close to it that the sculptural object is pressing up against you and the sounds of cackling are heard, as if you have gotten so close to your psyche that it is painful. It forces you to leave because you cannot be so close to yourself for very long. You must exit your mind and deal with what is happening in the world outside of yourself.

The significance of the first person perspective is that the tracking devices afford an experience so that the view is updating according to the tracked visitor's movements. The display responds to body positions and the speed of navigation through the scene. The speed is controlled using a pressure sensitive joystick. This is a significant difference from virtual environments that are web based or video game based where a gun or car is being controlled. This is also distinctive from environments such as the Sims or Second Life where a visitor is being denoted in the environment through the use of an avatar. The use of an avatar or some type of intermediary such as a gun or menu system can be integral to the design of some art environments. Here the first person experience is necessary to situate the self within the emotional landscape.

In the interactive installations, the visual structures are analogies for concepts and help to encourage the visitor to participate in the realization of the artwork. The interactive installations are: "*Emotable Portraits*," "*Poke Holes in My thoughts (swimming on the edge)," Look at my photo! Isn't it a dream?*" and "*It's all about you!"* The following is a deconstruction of their concepts individually.

"Emotable Portraits" uses two video screens that situate the visitor in front of what appears to be a liturgical drama. One video is reminiscent of a Russian Orthodox icon and the other of an Italian medieval painting of a choir. Both of the video animations change when someone is standing in front of the artwork. The change is that video is captured of the visitor's face and processed to appear painterly and then incorporated into the animations. One animation is of a Saint whose eyes change to become the video capture of a face when someone stands in front of the artwork. The Saint animation is inspired by the work of Andre Rublev. The top corners of the icon have little figures looking down, reminiscent of angels. They represent your consciousness speaking to you, the devil on one shoulder and the angel on another. In "*The Choir*," the singing faces of the painting change to the faces of the people who visit the artwork. "*The Choir"* is animated and the video capture of the faces is

animated. “*The Choir”* displays live faces and also pulls from a video archive of faces. “*The Choir”* is a living structure of who is in front of the piece and who visited the piece in the past. By looking at your own reflection and seeing it in the eyes of a higher authority, a sense of solemnity is established. Then looking at the animation of “*The Choir”* provides a sense of togetherness and community.

“Poke Holes in My thoughts (swimming on the edge)” is a piece about how our thoughts can be poked and provoke ripples in our world. The visitor stands in front of a projection of a pond of swimming fish. The visitor sees their own reflection under the water with the fish. If a finger is extended, the projection produces ripples, with a further extension of the hand, waves appear, and with the furthest extension of the arm, the fish swim faster and appear to swim away. The piece has three layers or membranes that must be poked in order to get different reactions. The piece is a metaphor for conceptual thinking but is one that conveys the whimsy of being near a pond in the moonlight. The interactions included a sound grid of high and low notes and soft and loud sounds from left to right. The piece tracked up to four people at once. Visitors were cautious, exuberant and

danced and ran across the front of the pond. There was no one way to interact with the work.

"Look at my photo! Isn't it a dream?" is an interactive installation that initially can be overlooked. On the wall is a postcard-sized image of light. The image is an animation of sepia toned fog. It is meant to represent the nostalgia of old vacation postcards. When the animation is approached, it enlarges with the visitor's proximity. As it enlarges, it becomes clearer and displays an animation of a colorful forest. The interaction is addictive as people walk back and forth to manipulate the image and reveal the forest. One woman insisted that I take her video as she danced in front of the piece. It was very amazing to see how people walked, danced and acted out gestures with the work.

"It's all about you!" is a facial detection animation. It depicts an ambiguously gendered person with small icons cascading down their skin. Thoughts are floating I bubbles around them. Two thought bubbles similar to a cartoon comic strip emanate from each side of the face. The thought bubbles represent the right and left side of the brain or good and evil. The visitor's face is captured in video,

processed to appear more painterly and then incorporated into one of the thought bubbles. The visitor will end up in either space. It is random. I liken it to a fortune teller because if you ask it a question, the animation will make your face appear on the proper side of the situation. The artwork is an illustration of decision-making and how others are incorporated into our thought processes.

The emotables are a metaphorical symbol of circumstances. They are meant to guide the visitor through the environment the way that one learns their mother tongue - through experience and absorption. The process is a symbol of what Juhani Pallasmaa calls the most essential manner of learning: “the unconscious embodied” because the emotables guide the visitor through a personal experiential learning. (Pallasmaa 2014:8:33) The imagery in my artwork is metaphorical and I create with the intention to drive experience.

> “Poetic imagery is capable of overcoming contradictions of logic, through its polyvalent, synthetic and unconscious imagery.” (Pallasmaa 2014: 30:25)

It is here that the core of the research stands. Standing inside the virtual environment, being immersed, we perceive characters, spaces, and landscapes that are able to instigate emotion. A fluid sense of awareness can frame our mind and allow us to question our circumstances and consider what is an illusion as in Plato's cave (Cornford 1965:227-235) or in the cliff illusion experiment (Gibson, Walk 1960:67-71). We learn through experience, combining our memory and empathy, projecting ourselves and integrating into the circumstances. Yet in virtual worlds, the presentation is unreal - there is no actual character, space or landscape—it is not a real object and we do not touch a group of fixed pixels but VR does create imagery that has a persistent identity and its own types of behaviors. The analogy (perception, essence) that the virtual objects offer and how the entire system manifests experience positions visual imagery and sound and actions to influence cognition, and in effect, immerse ourselves inside another person's active imagination. My artwork is unique in that a personal drawing method is in use to create these experienced environments and the imagery draws from an inner sanctum that provokes fresh scenes with corresponding analogies. The two modes of creation that Jung describes as "a conscious product shaped and designed" with intention and "an event originating in an unconscious nature" (Jung 1966:75) are both valuable for creating virtual environments.

The navigational strategies are created to motivate the visitor on a journey in a personal search for their own path in the environment. The objects are meant to scaffold conceptualization by the visitor's circumstances and configuration of choices. These options structure dilemmas that point to a place for the visitor to position herself in reality. The idea of mapping visual analogies to conceptual domains and corresponding neural networks in the brain becomes a political act, one of subversive confrontation.

The characters that I create in the works are not representatives of people in the way that avatars are. We have an avatar when a graphical object represents us in a virtual environment. For example, we can be represented by an avatar that purchases real estate on an island in Second Life and construct our home and configure its décor and subsequently move about our configuration imagining ourselves through our chosen avatar. This type of avatar is not what my graphical characters are about. They do not represent a person in the real world nor are their movements reflective of a real person's whims. The use of the word avatar for my characters is not sufficient. My characters live in a virtual world where the computer graphics machine directs their actions according to my imagination. They exist in VR because they propelled themselves from my active imagination into my drawings to my VR art. They are their own peculiar entities that function as what I am terming an 'emotable.' Emotables are digital characters that emote with ability, motion, motive, and voice. ¬Their construction and placement enhances aesthetics and helps guide visitors through an environment. Emotable is the opposite of an avatar that represents a real world person. The emotable can have facial expressions, with an animated face and a unique voice, but it does not represent any person in particular. It acts as its own entity and may act as a mirror to a receptive visitor.

The role of human emotions, the subtlety of human intuition and the complexity of human consciousness play an integral role in realizing the artwork and establishing the imagery as a situated space. The viewpoint or vantage point for the artwork is chosen by the visitor. The navigation is not constrained to a single path and there is no hierarchy of direction and few limits on the freedom of movement.

There are no avatars, guns, menus, cars or other interlocutors to follow. This is a deliberate construct to help the visitor provide meaning to the experience. The visitor is held in a space of seeing and in an act of active creative engagement. The visitor realizes the artwork through their thinking and feeling. As a result, there is no one definitive meaning that results from the engagement (Burnett 2005:13). The visitor must meet the artwork by facing the challenge of a new situation: they have to orient themselves and they have to find a structure that will lead the mind to the artwork (Arnheim 1982:71). This meeting point between the visitor and the virtual environment occurs when the visitor constructs a system using their own analogies to establish a connection. The result is that the visitor integrates their personal experience with a meaning filled virtual environment experience.

It is imperative for the artist to consider life as a critical component in the realization of the art. The artist in effect must guide the visitor who has to be encouraged to weave him or herself into the narrative. It is necessary to create worlds with the realization that there is for the visitor a real time performance and the visitor's attitude and posture become integral to the art. Taking an image and creating a dimensional environment that one can walk through is counter-hegemony. It is the shock to a system to create a shift in perspective.

Immersion is produced when artwork and image apparatus converge, or when the message and the medium form an almost inseparable unit. Then, in a moment of calculated totalization, the artwork, for a limited time, permits unconscious perception to become conscious illusion. Propelling the unconscious onto a medium that transcribes its thoughts to the conscious world helps to establish a relationship with our unconscious world.

Environments that integrate an understanding of perception and consciousness develop human-to-human synergies. VR is a definitive technology that promotes sensory stimulation and establishes socialization and communication.

Perceptual shifts occur in projection based interactive arts through visitor confrontation environmental objects that signal the way for navigation. Moreover, perceptual shifts in VR are able to augment paradigm shifts by including multi-model perception. In developing VR environments, the visitor situates within a framework that exploits perception in order to create an experience. I disagree with theorists who posit that new media is a mediation with a screen that acts like a window or mirror (Burnett 1995:7). Experience goes beyond a struggle between the proximity and the distance from the screen. While completing the dissertation, I have realized that the screen acts like a membrane that encompasses your field of view, similar to the real world field of view. We can never really understand reality because we can never realize it for what it actually is. We can only know it through a filter of our perceptions. The process of creating so many virtual environments has allowed me to realize that we are constantly creating constructs and probing levels of reality. Virtual environments as I know them collapse the boundaries between spectator and image – it puts you in the image. Virtual environments permit the images and sounds to become paramount--as if in a dream. If we are able to find the connections, we make the experiences personal and establish dialogues with the images. So whether the images are real or virtual, we process them in a similar fashion using metaphors. That dynamic occurs whether awake or dreaming, walking in reality or virtuality and the imagery and sound invokes our mental processes that allow us to assimilate our location, so perhaps at some level, we are hallucinating all of the time and my art creates pointers to the constant stream of consciousness that is one of our levels of reality.

6.3.0.0 **Suggestions for further research**

The analysis of art practice that I have conducted within the dissertation has been focused on interactive art and virtual environments technologies and the history of immersion. The analysis using analogies and visual thinking could be extended to investigate others' work in virtual environment art. Specifically, an examination of multi-modal metaphors and how they defined, constructed and operate as visual concepts would be of merit because currently the emphasis is on the linguistic use of metaphor with some investigations occurring into visual image metaphors (Eggertsson, Forceville 2009; Rohdin 2009).

A database of how multi-modal metaphors are being used in interactive arts would be particularly beneficial to develop a language for visual strategies. Also it would be constructive to create a database online that was specific to virtual environments that use

CAVE, HMD and related technologies in order to form a common language to describe the environments and strategies used therein. This would expand on the discussion of archiving the work and produce better documentation for others to use in their research. Currently there is difficulty knowing which institutions are using these devices and when artists are specifically directing the development. Such an online database would enable a richer discussion of the future of virtual environments by establishing both their legacy and future directions.

Currently Oliver Grau's Database of Virtual Art serves as an archive for my virtual environments and art installations and needs to be expanded to include digital paintings (Database of Virtual Art 2011).

It was particularly important for the development of the research to create theatrical performative spaces and musical events. Further research should consider how to create performances that include augmented reality to create an immersive anthropomorphic space.

Further research needs to include first person anecdotal accounts of work. This is difficult to obtain. The appropriate questions would need to be constructed—this would be a research design problem in and of itself. Moreover, one would need participants who are both well-versed in art and who are able to effectively articulate their personal aesthetic experiences. This would provide useful information about the levels of immersion and aesthetics. Otherwise, the results might be a satisfaction rating. The more interesting data would be to understand how visitors perceived the experience on a conceptual level.

Further research should include a comparison of navigational strategies for exploring virtual environments and their pitfalls across domain disciplines. For example, the research could establish the effectiveness or ineffectiveness of navigational strategies such as having a narrator escort the visitor through the environment, having an avatar give directions, or having a virtual menu system that acts as a signpost stating directions to read in both art and in science pieces. There is great potential for technologies to be used for creative and therapeutic purposes. Other research could explore Jung's theories of active imagination to expand on the discussion of the drawing practice I outlined in this paper. Finally, it would be worthwhile to research how the environments are exhibited and how curators might integrate virtual environments in the gallery and museum settings.

6.4.0.0 **Concluding remarks**

When we view a work of art, we formulate an opinion, a stance and a critical relationship to the work. In developing virtual environments, the visitor is situated within a framework that exploits perception in order to create an experience. We can learn how to create and design virtual environments by understanding how artists have historically developed their work to effect powerful experiences in the viewer. By understanding such experiences, we can understand how to create such experiences for others. Art is only one of many fields that can lend a diverse type of knowledge to creating virtual environments. The perspective of art lends a critical human element to the science of VR hardware and software development routines.

This thesis process has taught me to recognize the emotables and to understand them with a newfound complexity. The most satisfying experience for me would be to work in a six wall CAVE or a surround projection system that is shaped like a sphere. Such a space feels like a cocoon. That cocoon would contain me and my emotables somewhere where we are completely immersed in their world.

.

References

Addison, R. (1995). Detour: brain deconstruction ahead. *IEEE computer graphics and applications*, 15(2), 14-17.

Ahrens, M. B., Li, J. M., Orger, M. B., Robson, D. N., Schier, A. F., Engert, F., & Portugues, R. (2012). Brain-wide neuronal dynamics during motor adaptation in zebrafish. Nature, 485(7399), 471-477.

Ainsworth, R.A., Sandin, D.J., Schulze, J.P., Prudhomme, A., DeFanti, T.A., Srinivasan, M. (2011) Acquisition of stereo panoramas for display in VR environments, *Proceedings of SPIE* Vol. 7864, 786416

Allen W. (1999) Biochemicals and Brains: Natural Selection for Manipulators of Sexual Ecstasy and Fantasy *in* Cooke, B. and Turner, F. (eds) *Biopoetics: Evolutionary Explorations in the Arts* Lexington: ICUS, 157-174.

Anon. (2012) Highlight: Ursula Berlot - Vanitas *DELO* 3 July 2012 [online] Available at http://www.delo.si/arhiv/ursula-berlot-vanitas.html [26 August 2012]

Anstey, J., Pape, D., Sandin, D. (2000) The Thing Growing: Autonomous Characters in Virtual Reality Interactive Fiction *Proceedings of IEEE Virtual Reality 2000*, New Brunswick, NJ

Anstey, J., Pape, D. (2003, April) The trial the trail: Building a VR drama. In *Technologies for Interactive Digital Storytelling and Entertainment Conference* (pp. 394-402).

Anstey, J. (2007) Theater and Virtual Reality in *Noema, Special Section on Drama, Performance and Digital Multimedia*, at the 19th Cairo International Festival for Experimental Theater, Specials Arts http://org.noemalab.eu/sections/specials/cairo_drama_conference/Anstey_Cairo.pdf [8 June 2014]

Apollinaire, G., Eimert, D. (2012) *Art of Century: Cubism* New York, NY: Parkstone International

Arnheim, R. (1969) *Visual Thinking* Berkeley and Los Angeles: University of California Press

Arnheim, R. (1974) *Art and Visual Perception: A Psychology of the Creative Eye* Berkeley & Los Angeles: University of California Press

Arnheim, R. (1982) *The Power of the Center: A Study of Composition in the Visual Arts* Berkeley and Los Angeles: University of California Press

Arnheim, R. (2000) The Coming and Going of Images *Leonardo: Journal of the International Society for the Arts, Sciences and Technology* 33(3), 167-169

Ars Electronica Linz GmbH (n.d.) *Prix Ars Electronica 1992: Interactive Art* http://90.146.8.18/en/archives/prix_archive/prix_projekt.asp?iProjectID=2479&iCategoryID=2547# [30 August, 2012]

Artaud, A. (2001) *Artaud on Theatre* Schumacher, C. and Singleton, B. (eds) London, GBR: Methuen Drama

Ascott, R. (1990) Is There Love in the Telematic Embrace? *Art Journal* 49(3), 241-7

Ascott, R. (2003) *Telematic Embrace: Visionary Theories of Art, Technology, and Consciousness* Berkeley and Los Angeles: University of California Press

Ascott, R. (2011) Connectivity: Art and Interactive Telecommunications in *Leonardo Almanac* April 16, 2011 http://www.leoalmanac.org/connectivity-art-and-interactive-telecommunications-by-roy-ascott/ [29 July 2014]

Auer, A. (2012) *Second Life Marketplace – alpha.tribe by Alpha Auer* https://marketplace.secondlife.com/stores/15328 [18 August 2012]

Ayiter, E. (2009) *alpha.tribe* http://www.alphaauer.com/papers/ayiter_alpha-tribe.pdf [18 August 2012]

Ayiter, E. (2010). Embodied in a metaverse: Anatomia and body parts. *Technoetic Arts*, 8(2), 181-188.

Baars, B. (1988) *A Cognitive Theory of Consciousness* New York: Cambridge University Press

Baker, A. (2011) *bakermultimedia blog* http://bakermultimedia.wordpress.com/ [22 August 2012]

Barker, E. (2004) William Blake (1757-1827) in Heilbrunn timeline of Art History. New York: The Metropolitan Museum of Art 2000-. http://www.metmuseum.org/toah/hd_bike.htm (October 2004) [7 June 2014]

Barry, A.M.S. (1997) Visual Intelligence: Perception, Image, and Manipulation in Visual Communication Albany: SUNY Press

Barton, C. M., Clark, G. A., & Cohen, A. E. (1994). Art as information: explaining Upper Palaeolithic art in Western Europe. World Archaeology, 26(2), 185-207.
Begault, D. (1991) Challenges to the successful implementation of 3-D sound *Journal of the Audio Engineering Society* 39 (11), 864-870
Benayoun, M. (2012a) *selections and awards* http://www.moben.net/bio.php?id=39 [30 August 2012]
Benayoun, M. (2012b) *World Skin, a Photo Safari in the Land of War* http://www.benayoun.com/projet.php?id=16 [30 August 2012]
Benjamin, W. (1999) *The Arcades Project* Translated by H. Eiland and K. McLaughlin. London, GBR: Belnap Press
Berger, J. (1972) *Ways of Seeing* London, GBR: British Broadcasting Corporation and Penguin Books
Berlot, U. (2012) *Vanitas – Self Portrait* http://vimeo.com/45628424 [26 August 2012]
Biocca, F. and Delaney, B. (1995) Immersive Virtual Reality Technology *in* Biocca, F. and Levy, M. (eds) *Communication in the Age of Virtual Reality* Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc., 57
Bizri, H., Johnson, A., Vasilakis, C., (1998) Las Meninas in VR: Storytelling and Illusion in Art *Proceedings of Virtual Worlds* London, GBR: Springer-Verlag
Boden, M. A. (2004) *The Creative Mind: Myths and Mechanisms*, 2nd ed. London, GBR: Routledge.
Boden, M. A. (2009). Computer models of creativity. *AI Magazine*, 30(3), 23.
Bolter, J.D., Gromala, D. (2003) *Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency* Boston, MA: MIT Press.
Boulding, K.E. (1951) The Image: Knowledge in Life and Society. Ann Arbor: The University of Michigan Press (2e ed. 1961)
Bourgoin, S. (1997) *Encyclopedia of World Biography* Gale
Brague, R. (1990) Aristotle's Definition of Motion and its Ontological Implications *Graduate Faculty Philosophy Journal* 13(2), 1-22
Brandt, G. (2005) *Crossing the Threshold: A "Detour" Into Healing* http://www.virtualgalen.com/virtualhealing/braininjury.htm [18 August 2012]

Brill, L. (1992) Facing interface issues *Computer Graphics World* 15(4), 54-60

Brooks, F. Jr. (1987) Walkthrough—a dynamic graphics system for simulating virtual buildings *in* Crow, F. and Pizer, S. (eds) *Proceedings of the 1986 workshop on Interactive 3D graphics* New York: ACM, 9-21

Brooks, F. Jr. (1999) What's real about virtual reality? *Computer Graphics and Applications* 19(6) IEEE, 16 – 27

Browder, C. (1967) Andre Breton: Arbiter of Surrealism Paris: Librairie Droz 74-75.

Brown, S. (2014) http://sheldon-brown.net/index.html

Brown, S. (2014) Center for Hybrid Multicore Productivity Research http://chmpr.ucsd.edu/

Brundell, P., Knight, D., Tennent, P., Naeem, A., Adolphs, S., Ainsworth, S., Carter, R., Clarke, D., Crabtree, A., Greenhalgh, C., O'Malley, C., Pridmore, T. and Rodden, T. (2008) The experience of using the Digital Replay System for social science research in *Proceedings of the 4th International Conference on e-Social Science,* Paper Session 2b, Article No.1, NCeSS.

Bruno, F., Caruso, F., Li, K., Milite, A., & Muzzupappa, M. (2009) Dynamic simulation of virtual prototypes in immersive environments *The International Journal of Advanced Manufacturing Technology* 43(5-6), 620-630

Bull, D., Krekeler, A., Alfeld, M., Dik, J., & Janssens, K. (2011). An intrusive portrait by Goya. *Burlington Magazine*, *152*, 668-672.

Bull, Marcyn. (2005) Tech Boost for the Arcs in *The Times Higher Education Supplement*, 3 June 2005. Interview of Beacham.

Burnett, Ron. (2005) *How Images Think* Boston: MIT Press

Candy, L and Edmonds, E. (2002) *Explorations in Art and Technology* London, GBR: Springer-Verlag, 14-16.

Card, S. K., Robertson, G. G., & Mackinlay, J. D. (1991, March). The information visualizer, an information workspace. In Proceedings of the SIGCHI Conference on Human factors in computing systems (pp. 181-186). ACM.

Caroll, N (1999) *Philosophy of Art: A Contemporary Introduction* London, GBR: Routledge

Caroll, N (1991) Notes on the Sight Gag in Horton, A. *Comedy/Cinema/Theory* Berkeley, CA: University of California Press 25-42

Chalmers, D., French, R.M., Hofstadter, D.R., (1992) High-level perception, representation and analogy: A critique of artificial intelligence methodology *Journal of Experimental and Theoretical Artificial Intelligence* 4, 185-211

Chen, C. (2004) *Information Visualization* London, GBR: Springer-Verlag

Clark, A. (2003) *Natural Born Cyborgs* New York: Oxford University Press

Clarke, D. (2009) Simulation-based brain surgery in Halifax yields breakthrough in surgical training and rehearsal [6 June 2014] National Research Council Canada http://www.nrc-cnrc.gc.ca/eng/achievements/highlights/2009/virtual_surgery.html

Cornford, F.M. (1965) *The Republic of Plato* New York: Oxford University Press

Conrad, P. (1999). *Modern times, modern places*. 1st American ed. New York: Knopf.

Copeland, R. (1999) Cunningham, Collage, and the Computer in *PAJ: A Journal of Performance and Art* 21.3:42-54

Cordrescu, A. (2012) *The Muse Is Always Half-Dressed in New Orleans: And Other Essays* New Orleans, LA: Garrett County Press

Cornell, J., & Caws, M. Ann. (1993) *Joseph Cornell's theater of the mind: selected diaries, letters, and files*. New York: Thames and Hudson.

Coulter-Smith, G. (2006) *Deconstructing Installation Art* http://www.installationart.net/Chapter2Immersion/immersion05.html#prurientimmersiongregor CASIAD Publishing [30 August 2012]

Courchesne, L. (2013). Posture: An experiment in multifold reality. In Lorenzo-Eiroa, Pablo, Sprecher, A. (Ed.), *Architecture in Formation*. New York: Routledge.

Craig, A., Sherman, W.R., Will, J., (2009) *Developing Virtual Reality Applications: Foundations of Effective Design* Morgan Kaufmann

Crawford, L. (1984) Viktor Shklovskij: Différance in Defamiliarization. *Comparative Literature*, 209-219

Critchley, E. (1987) *Hallucinations and their Impact on Art* Cadlee: Carnegie Press

Cruz-Neira, C., Sandin, D. J., DeFanti, T. A., Kenyon, R. V., & Hart, J. C. (1992) The CAVE: audio visual experience automatic virtual environment. Communications of the ACM, 35(6), 64-72

Cruz-Neira, C. (1993) *The Cave* Paper presented at the Meckler Virtual Reality '93 Conference, San Jose, California

Cruz-Neira, C., Sandin, D.J., DeFanti, T.A., (1993) Surround-screen projection-based virtual reality: the design and implementation of the CAVE *SIGGRAPH '93: Proceedings of the 20th annual conference on computer graphics and interactive techniques* New York: ACM, 135-142

Csikszentmihalyi, M. (1988) Optimal experience: psychological studies of flow in consciousness. Cambridge University Press,.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the Psychology of Discovery and Invention*. New York: Harper Collins.

Dailey, P. (1997) Enigmatic Boxer in *The American Scholar* 66(4), 616-619

Darwin, C. (1864). *The origin of species by means of natural selection: or, the preservation of favored races in the struggle for life*. New York, NY: D. Appleton and Co.

Davies, C. (2008a) *Osmose* http://www.immersence.com/osmose/ [30 August 2012]

Davies, C. (2008b) *Ephémère* http://www.immersence.com/ephemere/ [30 August 2012]

Davies, C. (2004) Virtual Space in *Space: In Science, Art and Society* François Penz, Gregory Radick and Robert Howell, eds. Cambridge, England: Cambridge University Press

Database of Virtual Art (2011) http://www.virtualart.at/ [30 August 2012]

DeFanti, T., Sandin, D., & Cruz-Neira, C. (1993) A 'Room' with a View *IEEE Spectrum* 30(10), 30-33

Dennett, D. (1991) *Consciousness Explained* London, GBR: The Penguin Press

Dewey, John (1934) *Art as Experience* New York: Minton, Balch and Company

Dissanayake, E. (1980) Art as a human behavior: toward an ethological view of art *Journal of Aesthetics and Art Criticism* 38(4), 397-406

Dissayanake, E. (1992) *Homo Aestheticus: Where Art Came From and Why* Seattle: University of Washington Press

Dissayanake, E. (1999) “Making Special”-An Undescribed Human Universal and the Core of a Behavior of Art *in* Cooke, B. and Turner, F. (eds) *Biopoetics: Evolutionary Explorations in the Arts* Lexington: ICUS, 27-46

Dixon, S. (2011) Researching Digital Performance: Virtual Practices in Kershaw, B. and Nicholson, H. (Eds). *Research Methods in Theatre and Performance*. Edinburgh, GBR: Edinburgh University Press. 41-62 ebrary collections. 31 May. 2014 http://site.ebrary.com/lib/iub/Doc?id=10477155&ppg=50

Dixon, S. (2007) *Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation* Cambridge, MA: MIT Press, pp. 363-394,

Dolinsky, M. (1997) Creating art through virtual environments *ACM Computer Graphics* 31(4), 34-35, 82

Dolinsky, M. and Sehmisch, G. (1997) Dream Grrrls: Metaphors *Visual Proceedings of The Art and Interdisciplinary Programs of SIGGRAPH 97* ACM Special Interest Group on Computer Graphics, 129

Dolinsky, M. and Sehmisch, G. (1997b) *Dream Grrrls* documentation http://www.evl.uic.edu/dolinsky/sdpe/index.html [30 August 2012]

Dolinsky, M. (1998) *Strait Dope* http://www.evl.uic.edu/dolinsky/sdpe/index.html [30 August 2012]

Dolinsky, M. (1999) Blue Window Pane *Artists Using Science and Technology, YLEM Newsletter* San Francisco California, July/August

Dolinsky, M. (2000) Blue Window Pane: Seeing Into CAVE Virtual Environment Art *in* Griffin, R.E. (ed) *The 2001 International Visual Literacy Association (IVLA) Selected Readings* IVLA 2000, Exploring the Visual Future: Art, Design, Science and Technology, 32nd Annual International Visual Literacy Association Conference, Ames, Iowa

Dolinsky, M. (2001) Virtual Environment as Rebus *in* Ascott, R. (Ed.) *Reframing Consciousness: Art, Mind and Technology* Intellect

Dolinsky, M. (2001-2005) *Beat Box* http://dolinsky.fa.indiana.edu/beatbox/index.html

Dolinsky, M. (2004) Visual navigation structures in collaborative virtual environments *Stereoscopic Displays and Virtual Reality Systems XI, Proceedings of International Society of Optical Engineering's Electronic Imaging Science and Technology Technical Conference: The Engineering Reality of Virtual Reality 2004* SPIE, San Jose, California

Dolinsky, M., Anstey, J., Pape, D., Aguilera, J., Kostis, H., Tsoupikova, D. (2005) Collaborative Virtual Environment Art Exhibition in *Proceedings of International Society of Optical Engineering's Electronic Imaging Science and Technology Technical Conference: The Engineering Reality of Virtual Reality 2005* SPIE, San Jose, California

Dolinsky, M. (2005) *Cabinet of Dreams* http://dolinsky.fa.indiana.edu/cabinet/index.html

Dolinsky, M. (2011) *Figuratively Speaking* http://www.indiana.edu/~c3dvideo/interfacing/art/figSpeaking.html

Dolinsky, M. (2012) *Poking Holes in my Thoughts (Swimming at the Edge*)http://www.indiana.edu/~c3dvideo/interfacing/art/swim.html [18 August 2012]

Dolinsky, M., Sherman W., Wernert, E., Chi, Y.C., (2012) Reordering Virtual Reality: Recording and Recreating Real-Time Experiences *Proceedings of International Society of Optical Engineering's Electronic Imaging Science and Technology Technical Conference: The Engineering Reality of Virtual Reality 2012* SPIE, San Jose, California

Dove, T. (2014) Toni Dove http://www.tonidove.com/

Drouet, J. (1914) *The love letters of Juliette to Victor Hugo* NY, New York:McBride, Nast & Company

Dunn, J.W., Cowan, W.G., (2005) EVIADA: ethnomusicological video for instruction and analysis digital archive, 2005. JCDL '05. In *Proceedings of the 5th ACM/IEEE-CS Joint Conference on Digital Libraries*, Denver Colorado

Durlach, N. and Mavor, A. (eds) (1995) *Virtual Reality: Scientific and Technological Challenges* Washington, DC: The National

Academies Press
Dziekan, V. (2012) *Virtuality and the art of exhibition* Bristol: Intellect
Eberhart, R. (1993) *Glove Talk for $100* Paper presented at the 1993 Conference on Virtual Reality and Persons with Disabilities, San Francisco, CA
Edelmann, G. (2000) *The Universe of Consciousness: How Matter Becomes Imagination* New York: Basic Books
Eggertsson, G.T. and Forceville, C. (2009) Multimodal Expressions of the HUMAN VICTIM IS ANIMAL Metaphor in Horror Films', p.429- 449 in Forceville, C. and Aparasi, E.U. Eds. *Multimodal Metaphor,* Berlin, DEU: Mouton de Gruyter
Em, D. (2014) http://www.davidem.com/index.html
eventLAB Neuroscience and Technology (2011) www.event-lab.org [30 August 2012]
Feldman, J. and Narayanan, S. (2004) Embodied meaning in a neural theory of language *Brain and Language* 89(2), 385–392
Fleischmann, M. and Strauss, W., (2014) Aesthetics of Experience 1987-2014 http://fleischmann-strauss.de/works.html [30 August 2012]
Fleischmann, M. and Strauss, W. (2001) *Home of the Brain* http://netzspannung.org/cat/servlet/CatServlet?cmd=document&subCommand=show&forward=%2fnetzkollektor%2foutput%2fproject.xml&entryId=148753&section=base&lang=en [30 August 2012]
Fleischmann, M. and Strauss, W., (1992) "*Home of the Brain*" http://vimeo.com/7560336
Forceville, C.J., and Urios-Aparisi, E., Eds. (2009) *Applications of Cognitive Linguistics: Multimodal Metaphor*. Berlin, DEU: Mouton de Gruyter.
Ford, Ford Upgrades Virtual Reality Simulator to Help Develop Future Safety Technologies, Driver Aids (2012) http://media.ford.com/article_display.cfm?article_id=36009 [20 September 2012]
Fors, A.C. and Jakobsson, M. (2002) Beyond Use and Design: The Dialectics of Being in Virtual Worlds *Digital Creativity* 13(1), 1-14
Foster, J., Benford, S., Chamberlain, A., Rowland, D., & Giannachi, G. (2010) Riders Have Spoken: A Practice-Based Approach to Developing an Information Architecture for the Archiving and

Replay of a Mixed Reality Performance *International Journal of Performance Arts and Digital Media*, 6 (2), 209-223.

Franck, K. (2002) When I enter Virtual Reality, What Body will I leave behind? *in* Spiller, N. (ed) *Cyber Reader: Critical writings for the digital era* Phaidon Press Limited

Fraunhofer IAIS (2009) *About MARS-Media Arts Research Studies* http://netzspannung.org/about/mars/?lang=en [30 August 2012]

Friedberg, A. (2006*) The Virtual Window: from Alberti to Microsoft* Boston, MA: MIT Press

Frischer, B. (2008) The Rome Reborn Project: How Technology is Helping us to Study History *University of Virginia OpEd* November 10

Gamble, C. (1980) Information Exchange in the Palaeolithic *Nature* 283, 522-523

Gamble, C. (1982) Interaction and Alliance in Palaeolithic Society *Man* (NS) 17, 92-107

Gamble, C. (1999) *The Palaeolithic Societies of Europe* Cambridge: Cambridge University Press

Gibbs, R. Jr. (2003) Embodied Experience and Linguistic Meaning *Brain and Language* 84, 1–15

Gibson, E., Walk, R. (1960) The "Visual Cliff" *Scientific American* 202, 67-71

Gigliotti, C. (1995) Aesthetics of a Virtual World *Leonardo: Journal of the International Society for the Arts, Sciences and Technology* 28 (4), 289-295

Gilman, A. and Thornes, J. (1984) *Land-use and prehistory in south-east Spain* London, GBR: Allen and Unwin

Goldstone, R. (2006) *Research in the Percepts and Concepts Laboratory* http://cognitrn.psych.indiana.edu/rgoldsto/ [30 August 2012]

Grodal, T. (2003) Stories for eye, ear, and muscles. In Wolf, M.J.P., Perron, B., Eds., *The video game theory reader*, New York, NY: Routledge 129-155.

Grau, O. (2002) The Art of the Interface in Mixed Realities: Predecessors and Visions *Proceedings, ISEA 2002, 11th International Symposium on Electronic Art*, 97-100

Grau, O. (2003) *Virtual Art: From Illusion to Immersion* Boston: MIT Press

Greenhalgh, C., French, A., Tennent, P., Humble, J., & Crabtree, A. (2007) From Replay Tool to Digital Replay System. in *Proceedings of the International Conference on e-Social Science*, October (pp. 7-9).

Hansen, M. (2004) *New Philosophy for New Media* Boston, MA: MIT Press

Hart, J. C., Kauffman, L. H., & Sandin, D. J. (1990, October). Interactive visualization of quaternion Julia sets. In *Proceedings of the 1st conference on Visualization'90* (pp. 209-218). IEEE Computer Society Press.

Heim, M, (1998) *Virtual Realism* New York: Oxford University Press

Hernandez, P., (2012) She Tried To Make Good Video Games For Girls, Whatever That Meant http://kotaku.com/5913019/she-tried-to-make-good-video-games-for-girls-whatever-that-meant [24 July 2014]

Hoberman, P., Druckrey, T., Zielinski, S., Viveros-Faune, C., (2001) *Symptomatic: Recent Works by Perry Hoberman* NY, New York: National Museum of Photography, Film & Television

Hollands, R. (1995) Essential garage peripherals *Virtual Reality World* 2(1), 56-57

Hamit, F. (1993) *Virtual reality and the exploration of cyberspace* Carmel, Indiana: Sams

Hendrickson, A., Carvalho, P. F., & Goldstone, R. L. (2012) Going to extremes: The influence of unsupervised categories on the mental caricaturization of faces and asymmetries in perceptual discrimination *Proceedings of the Thirty-Fourth Annual Conference of the Cognitive Science Society*, 1662-1667

Hill, J. and Mannheim, B. (1992) Language and World View *Annual Review of Anthropology* 21, 381-406

Hoffman, H. G., Sharar, S. R., Coda, B., Everett, J. J., Ciol, M., Richards, T., & Patterson, D. R. (2004) Manipulating presence influences the magnitude of virtual reality analgesia. Pain, 111(1), 162-168.

Hofstadter, D. (1995) *Fluid Concepts and Creative Analogies* New York: Basic Books

Hofstadter, D. (2000) Analogy as the core of cognition *in* Gleick, J. (ed) *The Best American Science Writing* New York: Harper Collins, 116-144

Hofstadter, D. (2006) *Stanford Presidential Lecture* http://www.youtube.com/watch?v=n8m7lFQ3njk [18 August 2012]

Holmes, O.W., (1899) *Autocrat of the breakfast table* Boston, MA: Houghton, Mifflin

Horton, A. (2002) Going for Both Laughter and Tears: The Craft of Mixing Humor and Pain *Screentalk* September/October, 60-61

Jacobson, L. (1993) Welcome to the virtual world *in* Swadley, R. (ed) *On the cutting edge of technology* Carmel, IN: Sams, 69-79

Jacobson, L. (1994) *Garage Virtual Reality* Carmel, IN: Sams

James, W. (1892) *Psychology* New York, NY:H.Holt

Jazbec, M. (2012) *Monolith* http://cargocollective.com/masajazbec/MONOLITH [26 August 2012]

Jochim, M.A (1983) Palaeolithic cave art in ecological perspective *in* Bailey, G. (ed) *Hunter- Gatherer Economy and Prehistory: A European Perspective* Cambridge: Cambridge University Press, 212-219

Johnston, J. (2005) Airborne Abstraction *Art in America*, 93(11), 130

Jung, C. G. (1936). The concept of the collective unconscious. *Collected works*, 9(1), 42. P.99-104.

Jung, C. (1966) *The Spirit in Man, Art, and Literature* Translated by R.F.C. Hull. Bollingen series XX. Princeton University Press New Jersey c1978 Fourth Edition

Kac, E. (1996) "Ornitorrinco" and "Rara Avis": Telepresence Art on the Internet. *Leonardo*, 389-400.

Kac, E. (1996) Ornitorrinco in the Sahara http://www.ekac.org/sahara2.html [28 July 2014]

Kaye,N., Giannachi, G. (2011) Acts of Presence: Performance, Mediation, Virtual Reality in *TDR: The Drama Review* Volume 55, Number 4, Winter 2011 (T212) pp. 88-9 http://muse.jhu.edu/journals/tdr/summary/v055/55.4.kaye.html [9 June 2014]

Keefe, D. F., Feliz A, Moscovich T, Laidlaw D H., LaViola, Jr J. J. (2001) CavePainting: a fully immersive 3D artistic medium and interactive experience. In *Proceedings of the 2001 symposium on Interactive 3D graphics (I3D '01*). ACM, New York, NY, USA, 85-93. http://doi.acm.org/10.1145/364338.364370

Kilteni, K., Normand, J. M., Sanchez-Vives, M. V., & Slater, M. (2012). Extending body space in immersive virtual reality: a very long arm illusion. PloS one, 7(7), e40867.
Klee, P (1961) *The notebooks of Paul Klee: The Thinking Eye* Spiller, J. (Ed.) by Manheim, R. (Transl.) New York: G. Wittenborn
Krueger, M. (1983) *Artificial Reality* Reading, MA: Addison Wesley
Krueger, M. (1991) *Artificial Reality II* Reading, MA: Addison Wesley
Kreylos, O. (2006) Enabling scientific workflows in virtual reality *VRCIA '06: Proceedings of the 2006 ACM International Conference on Virtual Reality Continuum and its Applications* ACM, New York, 155-162
Kreylos, O. (2010) Kinect Hacking http://idav.ucdavis.edu/~okreylos/ResDev/Kinect/index.html [13 May 2014]
Lakoff, G. and Johnson, M. (1980) *Metaphors We Live By* Chicago: University of Chicago Press
Lakoff, G. (1992) The Contemporary Theory of Metaphor http://terpconnect.umd.edu/~israel/lakoff-ConTheorMetaphor.pdf [5 June 2014] in Ortony, A. (1993). Metaphor and thought. 2nd ed. Cambridge [England]: Cambridge University Press. Pp. 202-251.
Lanier, J. (2010) *You are Not a Gadget: A Manifesto* NY, New York: Alfred A. Knopf
Lanier, J. (2010) *Brief Biography of Jaron Lanier* http://www.jaronlanier.com/general.html [30 August 2012]
Lanier, J. (2013) *Who Owns the Future?* London, GBR: Penguin
Lanier, J. (2014) *Jaron Lanier* http://www.jaronlanier.com/general.html [23 July 2014]
Lantz, E. (1992) Virtual reality in science museums *Instructional Delivery Systems* 6(4), 10–12
Laurel, B., Ed., (1990) *The Art of Human-Computer Interface Design* Reading, MA: Addison Wesley
Laurel, B. (1991) *Computers as Theater* Reading, MA: Addison Wesley
Laurel, B., Strickland, R., Tow, R. (1994) Placeholder: Landscape and Narrative In Virtual Environments in *ACM Computer Graphics Quarterly* Volume 28 Number 2 May 1994 [27 May 2014] http://www.tauzero.com/Brenda_Laurel/Severed_Heads/CGQ_Placeholder.html

Laurel, B with Lunenfeld, P. (Ed.) (2001) *Utopian Entrepreneur* Boston, MA: MIT Press

Laurel, B., Ed., (2003) *Design Research: Methods and Perspectives* Boston, MA: MIT Press

Laurel, B. (2013) *Computers as Theater* Upper Saddle River, NJ: Pearson Education

Laurel, B. (2014) *Brenda Laurel* http://www.tauzero.com/Brenda_Laurel/BrendaBio.html

Lehmann, W. (1993) *Theoretical Bases of Indo-European Linguistics* London, GBR: Routledge

Lewis-Williams, D. (2002) *The Mind in the Cave: Consciousness and the Origins of Art* London, GBR: Thames and Hudson

Linden Research, Inc. (2012) *What is Second Life?* http://secondlife.com/whatis/ [26 August 2012]

Lovejoy, M. (1996) *Postmodern Currents: Art and Artists in the Age of Electronic Media* 2nd edition, New Jersey: Prentice Hall

Lund, A and Waterworth, J A (1998) Experiential Design: Reflecting Embodiment at the Interface in *Computation for Metaphors, Analogy and Agents: A Workshop*, University of Aizu, Japan, April 1998 http://www8.informatik.umu.se/~jwworth/MetaDesign.html [10 June 2014]

Mack, A. (2003) Inattentional Blindness: Looking Without Seeing *Current Directions in Psychological Science* 12(5), 179-184

Maïm, J., Haegler, S., Yersin, B., Mueller, P., Thalmann, D., & Van Gool, L. (2007, November). Populating ancient pompeii with crowds of virtual romans. In Proceedings of the 8th International conference on Virtual Reality, Archaeology and Intelligent Cultural Heritage (pp. 109-116). Eurographics Association.

Mäkelä, W., Ilmonen, T. (2004) Drawing, Painting, and Sculpting in the Air: Development Studies about an Immersive Free-Hand Interface for Artists *IEEE VR 2004 Workshop: Beyond Wand and Glove Based Interaction* Chicago, IEEE, 89-92

Manovich Lev (1997) *Cinema as a Cultural Interface* http://www.manovich.net/TEXT/cinema-cultural.html [30 August 2012]

McCarty, N. (2005) *Toying with Obsolescence: Pixelvision Filmmakers and the Fisher Price PXL 2000 Camera* MS Thesis, MIT Comparative Media Studies Program

McCloud, S. (1993) *Understanding Comics* Northampton, MA: Tundra Publishing

McLellan, H. (1998) Cognitive Issues in Virtual Reality *Journal of Visual Literacy* 18(2), 175–199

Meehan, M., Insko, B., Whitton, M., & Brooks Jr, F. P. (2002, July). Physiological measures of presence in stressful virtual environments. In ACM Transactions on Graphics (TOG) (Vol. 21, No. 3, pp. 645-652). ACM.

Mithen, S. (1988) Looking and Learning: Upper Paleolithic Art and Information Gathering *World Archaeology* 19, 297-327

Modjeska, D., & Waterworth, J. (2000). Effects of desktop 3D world design on user navigation and search performance. In Information Visualization, 2000. Proceedings. IEEE International Conference on (pp. 215-220). IEEE.

Mondloch, K. (2004) A Symphony of Sensations in the Spectator: Le Corbusier's Poeme electronique and the Historicization of New Media Arts. *Leonardo* 37(1), 57-61.

Mondloch, K. (2010) Screens : Viewing Media Installation Art. Minneapolis, MN, USA: University of Minnesota Press,. ProQuest ebrary. Web. 9 August 2014.

Morie, J. (2007) *Meaning and Emplacement in Expressive Immersive Virtual Environments* PhD Thesis, University of East London

Morse, M. (1998) *Virtualities: television, media art and cyberculture* Bloomington and Indianapolis: Indiana University Press

Moser, M., MacLeod D., (1996) *Immersed in Technology: Art and Virtual Environments* Cambridge, MA: MIT Press

Mulder A. (2010) *From Image to Interaction: Meaning and agency in the arts* VR_ Publishing / NAi Publishers

Munsterberg, M. (2009) *Writing about art* CreateSpace Independent Publishing Platform

Naccache, L. (2005) Visual phenomenal consciousness: a neurological guided tour *in* Laureys, S. (ed) *Progress in Brain Research* 150, 185-95

Naimark, M. (2014) *Michael Naimark* http://naimark.net

Naimark, M. (2014) *Why VR Headsets Will Stick* keynote International Symposium on Immersive Creativity Montreal May 2014 http://naimark.net/writing/vrheadsets.html [23 July 2014]

Needham, J. (1750) *Nouvelles Observations microscopiques* Transl. by Lavirotte, L., Paris

Newton, I. (1729) *The Mathematical Principles of Natural Philosophy, Volume 1, "Principia"* http://books.google.com/books?id=Tm0FAAAAQAAJ&pg=PA20#v=onepage&q&f=false [26 September, 2012]

Norman, D. (1993) *Things that make us smart* Reading, MA: Addison Wesley

Novak, M. (2002) Liquid Architectures in Cyberspace *in* Spiller, N. (ed) *Cyber Reader: Critical writings for the digital era* Phaidon Press Limited

Pallasmaa, J., *Landscapes of Architectural Education: Architecture, Knowledge and Existential Wisdom* - February 19, 2014 at New School of Architecture and Design. https://www.youtube.com/watch?v=5HlUgoGIhgs [7 August 2014]

Pape, D., Anstey, J., Carter, B., Leigh, J., Roussou, M., & Portlock, T. (2001, June). Virtual heritage at iGrid 2000. In the *Proceedings of INET* http://www.makebelieve.gr/mr/research/papers/INET_01/INET01_final.pdf [7 August 2014]

Pape, D., Sandin, D. (2002) Alive on the Grid in *SCI 2002 - 6th World Multiconference on Systemics, Cybernetics and Informatics*, Orlando, FL, 14-18 July. http://resumbrae.com/archive/papers/sci02/AliveOnTheGrid.pdf [10 June 2012]

Pausch, R., Snoddy, J., Taylor, R., Watson, S., & Haseltine, E. (1996, August). Disney's Aladdin: first steps toward storytelling in virtual reality. In *Proceedings of the 23rd annual conference on Computer graphics and interactive techniques* (pp. 193-203). ACM.

Pfeiffer, J. (1982) *The Creative Explosion: An inquiry into the Origin of Art and Religion* New York: Harper and Row

Pirandello, L. (1998) *Pirandello: Plays* Transl. by Bentley, E. Evanston: Northwestern University Press

Placeholder Virtual Reality Project (n.d.) http://www.tauzero.com/Brenda_Laurel/Placeholder/Placeholder.html [28 September 2012]
Portlock, T. (2004) Email conversation with the artist [15 April 2004]
Pota, H., Katupitiya, J., & Eaton, R. (2007) Simulation of a tractor-implement model under the influence of lateral disturbances *Proceedings of 46th IEEE Conference on Decision and Control* 12-14 Dec. 2007, New South Wales Univ., Sydney, 596 – 601
Ramachandran, V., Hirstein, W. (1998) The perception of phantom limbs *Brain* 121, 1603-30
Ralph, N. (2010) VR Gets Real *PCWorld* http://www.pcworld.com/article/196802/vr_gets_real.html [28 August 2012]
Regian, J. W., Shebilske, W. L., & Monk, J. M. (1992). Virtual Reality: An Instructional Medium for Visual ‐ Spatial Tasks. Journal of Communication, 42(4), 136-149. Revonsuo, A. Consciousness: The Science of Subjectivity London, GBR: Psychology Press, 2009. ebrary collections. 29 May 2014 http://site.ebrary.com/lib/iub/Doc?id=10361630&ppg=326
Rheingold, H. (1994) "Rheingold's Reality." *CyberStage* vol.1 no1. [31 May 2014] http://www.bornyesterday.ca/cyberstage-archives/2011/3/23/howard-rheingolds-virtual-reality.html
Rheingold, H. (1991) *Virtual Reality* London, GBR: Secker and Warbug
Riva, G., Bacchetta, M., Cesa, G., Conti, S., Molinari, E., (2003) Virtual Reality and Telemedicine Based Experiential Cognitive Therapy: Rationale and Clinical Protocol *in* Riva, G. and Galimberti, C. (eds) *Towards CyberPsychology: Mind, Cognition and Society in the Internet Age* Amsterdam: IOS Press
Robertson, B. Immersed in art *Computer Graphics World* 24(11) November 2001
Rohdin, M. (2009) Multimodal Metaphor in Classical Film Theory From the 1920s to the 1850s', p.403-428 in Forceville, C. and Urios-Aparasi, E., Eds. *Multimodal Metaphor* Berlin, DEU: Mouton de Gruyter
Rosen, S., Bricken W, Martinez R, Laurel B. (1994) Determinants of immersivity in virtual reality: graphics vs. action *Proceedings of the 21st annual conference on Computer graphics and interactive techniques (SIGGRAPH '94)* New York: ACM, 496

Rozin, D. (2006) *Snow Mirror* documentation http://www.smoothware.com/danny/snowmirror.html [30 August 2012]
Rush, M. (1999) *New Media in Late 20th-Century Art* NY, New York: thames aNd Hudson, Inc.
Sandin, D. (1998) Digital Illusion, Virtual Reality and Cinema *in* Dodsworth, C. Jr. (ed) *Digital Illusion* Addison Wesley, 3-26
Sandin, D. (2001) EVL: Alive on the Grid *Ars Electronica Festival Archive* http://90.146.8.18/de/archives/festival_archive/festival_catalogs/festival_artikel.asp?iProjectID=8239 [30 August 2012]
Sapir, E. (1929) The status of linguistics as science *Language* 5, 207-214
Satava, R. (1992) *Telepresence surgery* Paper presented at the 1992 EFDPMA Conference on Virtual Reality. Education Foundation of the Data Processing Management Association, Washington, D.C.
Satava, R. (1993) Virtual reality surgical simulator *Surgical Endoscopy* 7(3), 203-205
Saunders, G. (2014) *Acts of Consciousness: A Social Psychology Standpoint*. Cambridge, UK: Cambridge University Press
Seymour, N. E., Gallagher, A. G., Roman, S. A., O'Brien, M. K., Bansal, V. K., Andersen, D. K., & Satava, R. M. (2002). Virtual reality training improves operating room performance: results of a randomized, double-blinded study. Annals of surgery, 236(4), 458.
Shaw, Jeffrey (1989) *The Legible City* http://tinyurl.com/bwxhb24 [22 September 2012]
Shaw, C. D., Gromala, D., & Seay, A. F. (2007). The meditation chamber: Enacting autonomic senses. *Proc. of ENACTIVE/07*.
Shaw, J. (1994-1997) *artintact* - Artists' Interactive CD-ROMagazine CD-ROM series Berlin, Germany: Hatje Cantz
Shaw, J. (1997) *Hardware Software Artware. Confluence of Art and Technology Art Practice at the ZKM-Institute for Visual Media 1992-1997* Berlin, Germany: Hatje Cantz
Shaw, J. (1998-2003) *ZKM digital arts edition* CD-ROM and DVD-ROM series, 1998-2003 Berlin, Germany: Hatje Cantz
Shaw, J., Weibel, P., Eds., *Future Cinema. The Cinematic Imaginary after Film* ZKM Karlsruhe and Massachusetts Institute of

Technology, Cambridge, Mass., Cambridge Mass./London, GBR: MIT Press

Shaw, J. (2014) *Jeffrey Shaw* http://www.icinema.unsw.edu.au/

Sherman, W. R., Adams, N., Addison, R., Loftin, R. B., Britton, B., Cox, D., & Patterson, R. (1997, August) Experiences with virtual reality applications (panel). In *Proceedings of the 24th annual conference on Computer graphics and interactive techniques* (pp. 473-476). ACM Press/Addison-Wesley Publishing Co.

Shklovsky, V. (1965). Art as technique. In Lemon, L.T., Reis, M.J., (Eds.), *Russian formalist criticism: Four essays*, *3*. Lincoln: University of Nebraska Press, pp.12-18 http://tinyurl.com/l6wpjgj [13 May 2013]

Shklovsky, V. (2001) *ZOO or Letters Not about Love* Champaign, IL: Dalkey Archive Press

Simons, D., Chabris, C. (1999) Gorillas in our midst: sustained inattentional blindness for dynamic events *Perception* 28, 1059-1074

Skwarek, M., (2013) arOCCUPY MAY DAY http://aroccupymayday.blogspot.com/ 15 July 2014

Slater, M. and M. Usoh (1993) Presence in Immersive Virtual Environments, IEEE Virtual Reality Annual International Symposium (VRAIS), September 18-22, Seattle, Washington, 90-96

Snibbe, S. (2002) *"Deep Walls"* documentation http://www.snibbe.com/projects/interactive/deepwalls [30 August 2012]

Solmsen, F. (ed) (1954) *Rhetoric and Poetics of Aristotle* Translated by Ingram Bywater. New York: The Modern Library

Sommerer, C. and Mignonneau, L. (2011) The Living Room in *Database of Virtual Art* http://tinyurl.com/mg6qqfr [30 August 2012]

Sorensen, V. (2000) *Animation is the art of motion, and art in motion* http://visualmusic.org/Biography/DADA-philosophy.htm [26 August 2012]

Sorensen, V. (2011) Rewiring Culture, the Brain and Digital Media *in* Bartscherer, B. and Coover, R. (eds) *Switching Codes: Thinking Through Digital Technology in the Humanities and the Arts* Chicago: University of Chicago Press, 239-246

Stafford, B. and Terpak F. (2002) *Devices of wonder* Los Angeles: Getty Research Institute

Stampe, D., Roehl, B., & Eagan, J. (1993). Virtual reality creations. The Waite Group.

Starobinski, J. (2003) *Action and Reaction: The Life and Adventure of a Couple* Transl. by Hawkes, S. with Fort, J. New York: Zone Books

Stocker, G., Sommerer, C., & Mignonneau, L. (Eds.). (2009). Christa Sommerer and Laurent Mignonneau: Interactive Art Research. Springer.

Sutherland, I. (2003) Sketchpad, A Man-Machine Graphical Communication System *University of Cambridge Technical Report Number 574*

Taubes, G. (1994) Surgery in cyberspace *Discover* 15(12), 84-94

Taylor, T. (2002) Living Digitally: Embodiment in Virtual Worlds *in* Schroeder, R. (ed) *The Social Life of Avatars: Presence and Interaction in Shared Virtual Environments* London, GBR: Springer-Verlag

Thwaites Hal (2006) The Immersive Experience of Osmose and Ephémère: An Audience Study *in* Ascott, R. (ed) *Engineering Nature – Art & Consciousness in the Post-Biological Era* Bristol, UK: Intellect Books, 291 – 297

Thurman, R. and Mattoon, J. (1994) Virtual Reality: toward fundamental improvements in simulation-based training Educational Technology 34, 56-64

Tolstoy, L. (1998) What is Art? in Harrison, C., Wood, P. J., & Gaiger, J. (2000). Art in Theory 1648-1815: An anthology of changing ideas. Blackwell. 816

Torczyner, H. (1979) Magritte: Ideas and Images New York: New American Library

Tsoupikova, D. (2003) "*Animagina :: (life+imagination)*" http://www.evl.uic.edu/core.php?mod=4&type=2&indi=241

Tsoupikova, D. (2006a) Framing the Magic Proceedings, *The Engineering Reality of Virtual Reality 2006* SPIE, San Jose, California

Tsoupikova, D. (2006b) Rutopia2 In *EVA 2006 London Conference Proceedings*, 2 Park Gate Court, 68-79 Hight Street, Hampton Hill, Middx TW12 1PB, EVA 2006 Conferences International, pp. 231-239

Tsoupikova, D. (2007, August). Rutopia 2. In *ACM SIGGRAPH 2007 art gallery* (p. 224). ACM.
Turner, F. (1999) An Ecopoetics of Beauty and Meaning *in* Cooke, B. and Turner, F. (eds) *Biopoetics: Evolutionary Explorations in the Arts* Lexington, KY: Paragon House
Turner, J. (2002) Myron Krueger Live in Kroker, A., Kroker, M., Eds., *cTheory* www.ctheory.net/articles.aspx?id=328 [23 July 2014]
Van Dam, A. (1997) Post-Wimp User Interfaces: The Human Connection *Communications of the ACM* 40(2), 63-67
Van Dam, A., Forsberg, A., Laidlaw, D. H., LaViola, J. J., & Simpson, R. M. (2000). Immersive VR for scientific visualization: A progress report. Computer Graphics and Applications, IEEE, 20(6), 26-52.
Venkataraman, S., Leigh, J., Coffin, T., (2003) Kites flying in and out of space - distributed physically based art on the grid *Journal of Future Generation Computer Systems* 19(6), 973-982 , Elsevier Science Press
Virilio, P. (2002) The Aesthetics of Disappearance *in* Spiller, N. (ed) *Cyber Reader: Critical writings for the digital era* Phaidon Press Limited
Vlahos, James, (2006) The Smell of War. *Popular Science* magazine. 269 (2), August 2006. http://www.popsci.com/scitech/article/2006-08/smell-war
Whorf, B. L., Carroll, J. B., Levinson, S. C., & Lee, P. (2012). Language, thought, and reality: Selected writings of Benjamin Lee Whorf. Mit Press.
Wilson, S. (2002) *Information Arts: Intersections of Art, Science and Technology* MIT Press
Witkin, A., Baraff, D., M. Kass, “Physically based modeling," in SIGGRAPH 2001 Course Notes, ACM SIGGRAPH 2001. Witmer, B., Singer, M. (1998) Measuring Presence in Virtual Environments: A Presence Questionnaire *Presence* 7(3), 225-240
Wolfe, Art (2005) *Vanishing Act* New York: Bulfinch Press
Yisa, M. G., Terao, H. (1995). Dynamics of Tractor-implement Combinations on Slopes (Part Ⅰ): State-of-the-art Review. Journal of the Faculty of Agriculture, Hokkaido University= 北海道大學農學部紀要, 66(2), 240-262.