

The Immersant Experience of Osmose and Ephémère

Harold Thwaites

Associate Professor, Communication Studies, Concordia University,
7141 Sherbrooke St. West, Montreal, Quebec, Canada H4B 1R6
h.thwaites@sympatico.ca

Abstract

This paper outlines a study on the audience impact of the immersive virtual artworks, namely Osmose and Ephémère, created by artist Char Davies. The first half of the results from Osmose and Ephémère are discussed here. The study was undertaken at two different exhibit locations in Perth and Melbourne Australia, in 2002 and 2004 respectively. A shorter and limited report on this project was presented in July of 2003 at the Consciousness Reframed Conference, University College Newport Wales.

Key words: Immersion, audience study, Osmose, Ephémère, immersant, virtual reality.

1. Introduction

It is still relatively unknown what impact virtual reality (VR) experiences may have on the imagination and on the development of human consciousness, as discussed by researchers such as Heim [1], Cartwright [2], Attree et al. [3], and Hansen [4]. To date, VR technologies have seen relatively widespread applications in education, research and medicine, therapy and rehabilitation, business and design and—especially—entertainment. On the other hand, very little investment has been made in VR applications that are designed to promote imaginative skills such as aesthetic sensitivity, reflection, artistic creativity, or emotional insight. This lack parallels an equally important lack of research into fundamental questions about the effects of VR experiences and their impact on the audience of them. The immersive VR works of Char Davies are uniquely different from other VR applications in that they are designed specifically to facilitate processes of the imagination and they have been shown in museums to over 20,000 individuals worldwide, as described by Davis [5], Pesce [6] and most recently by Grau [7].

This research project on Davies' two works, Osmose and Ephémère, examined issues of the imaginative process, "shifting awareness", consciousness as a subjective experience, and as an element of discovery while immersed, as described by Davies [8], [9], [13]. It also looked into the overall "information impact" of the immersive VR experience [10]. A large majority of participants undergoing a visit to the works describe the experience as enriching, thrilling, inspiring, and even rapturous, based on accounts from the Osmose Book of Visitor Comments, Museum of Contemporary Art,

Montreal in 1995 as summarized by Treadwell [11]. It is from these departure points that the audience study of Osmose and Ephémère was conceived and designed. This project represents a major collaboration between an artist and a communication researcher in developing research tools to evaluate and better understand the audience/visitor experience within the gallery, art exhibit environment.

Due to space limitations this paper presents a summary analysis of half the research data starting with Osmose and then Ephémère. The results of the project compare and contrast the audience experience of both immersive environments. The data analysis, and interviews with participants contribute to the now small body of knowledge on the effects of artistic immersive virtual environments on the user, audience/participant. It was the first formalized research study on either Osmose or Ephémère.

2. The Study

The audience sample of the Osmose and Ephémère artworks was comprised of individual visitors to the John Curtin Gallery BEAP (Biennale Electronic Arts Perth) exhibition in Perth Australia, (part one). The study was conducted in the first 2 weeks of September 2002. The second part of the project was done at the *Transfigure* Exhibit at the ACMI in Melbourne, in February of 2004. Approximately 20-30 people per day could view Osmose that alternated with Ephémère about half of the time. Over a period of 14 days, this made for a maximum potential audience sample of between 140 to 210 subjects (part one). The final sample consisted of 91 completed questionnaires, in Perth (44 from Osmose and 47 from Ephémère). The research questionnaire was comprised of 27 questions exploring the audience's reactions to, and feelings from, the immersion process. It was designed after consultation with Char Davies, John Harrison (programmer), a reading of the various museum comment books and the relevant VR literature. Questions included were both content and technology based, specific to the works and general on the field of virtual reality overall. They were based on both cognitive and affective domains of the visitor experience, as described by Bruner [12]. Some of the areas covered were: emotional and physical feelings, sense of time and navigation, body awareness, overall enjoyment, and recall of sounds and visuals. Subjects were also asked to draw their journey on a map of each work.

The entire project, sampling both artworks, resulted in an incredible amount of rich data. The *Osmose* portion of the study alone generated approximately 1,188 discrete written responses and 41 immersion journey drawn “paths”. There were 1,222 responses to *Ephémère* and 34 motion paths. This was from part one alone. The responses were both Likert scaled items and open-ended replies. The latter exerted the least amount of control over the respondents and captured a wide variety of idiosyncratic differences. The question responses were analyzed both quantitatively and qualitatively. Individual differences by sex and age groups were also looked for. Specific trends and remarkable factors were looked for in each area and the similarities/differences of the works are being analyzed further.

3. Method of Recruitment of Participants:

Visitors were asked if they would like to fill in the questionnaire, after they had experienced the artworks on exhibit at each of the Galleries. All visitors to the exhibits had to make appointments in advance to view the works, since each is an individual experience and required a reserved time block of 30 minutes. The gallery organized and ran the performance of the works completely independent of this study on their schedule. It was a voluntary, informed activity, which was clearly stated on the first page of the questionnaire.

4. Treatment of the Research Subjects

This research activity was non-invasive, non-intrusive and of free consent. Subjects were informed of the nature of the research and that the study was undertaken by the author. They were told that it would take about 10 to 15 minutes to complete the written questionnaire, comprised of short answer or multiple choice type question, that they were free to refuse if they so desired, and that it was not required of them to participate. Some subjects asked to take the questionnaire home returning it to the Gallery the next day.

Since these exhibits were in Australia and open to the public, cultural differences were respected completely. Subjects were not paid as this study was on a 100% voluntary basis. The questionnaires did not require names, and there were only 3 questions that asked any personal demographic information: Sex, age range, country of origin, and occupation (optional).

The research project was thoroughly explained to each participant, both verbally and in writing. Participants were told that the anonymous results would be published. Individual or personal information was not asked for and basic demographic information was kept to a minimum. Each subject signed a release form. The research did not involve any follow-up procedure and was a one-time survey, in place, at each location.

5. The Artworks (artist’s summary) [13]

For those readers not familiar with either of the artworks discussed in this paper, a brief summary by the artist is provided below. Images and details can be found on the Immersence website, (see the URL in notes).

Osmose and *Ephémère* are my (Davies) attempts to distill and amplify the sensations and emotions of being conscious, embodied, and mortal—that is, how it feels to be alive here now among all this, immersed in the vast, multi-channeled flow of life through space and time. In these works, I seek to remind people of their biological, spiritual, and psychological connections to the natural (rather than human-made) environment and of the regenerative source and mythological ground of those connections. Both works are an immersive interactive virtual realty environment installation with 3D computer graphics and interactive 3D sound, a head-mounted display and real-time motion tracking based on breathing and balance.

The first virtual realm encountered by the immersant in *Osmose* is a three-dimensional Cartesian grid that functions as an orientation space and makes reference to the technology's origins. With the immersant's first breaths, the grid gives way to a clearing. In the center of the clearing is a tree, into whose leaves it is possible to enter. See figure 1.

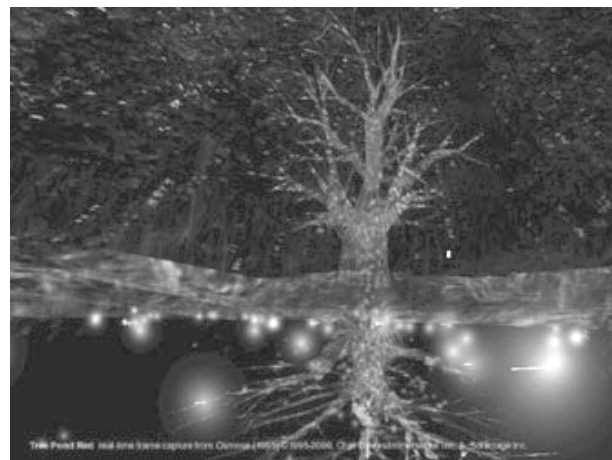


Figure 1. Char Davies, Tree Pond
real-time frame capture from *Osmose*, 1995.
Char Davies/Immersence Inc. & Softimage Inc. ©

Surrounding the clearing is a forest, which when entered is never-ending in all directions including up or down, except by following a stream or by becoming still and waiting for time to pass. In the clearing there is also a pond into which one can sink (by breathing out) and then descend deeper into an oceanic abyss in which a symbolic life-world appears through which one can return to the clearing with its pond, stream, and tree. It is also possible (by breathing in) to ascend into white cloud—or, by breathing out again, to descend into subterranean earth, passing roots and rocks and underground streams. Two other realms—above and

below, of text on nature, technology, and the body and of software code—function as the conceptual substratum and superstratum parenthesizing the work.

In *Ephémère*, the iconographic repertoire is extended beyond the trees and rocks and streams of *Osmose* to include body organs, blood vessels, and bones, suggesting a symbolic correspondence between the chthonic presences of the interior body and the subterranean earth. While *Osmose* consisted of nearly a dozen realms situated around a central clearing, *Ephémère* is structured spatially into three levels—landscape, earth, and interior body. The body functions as the metaphoric substratum under the fecund earth and the lush bloomings and witherings of the land. Unlike *Osmose*, *Ephémère* is also structured temporally. Even as the immersant roams among all three realms, no realm remains the same. The landscape changes continually, passing through cycles of dawn, day, evening, and night, from the pale of winter through spring and summer to the climatic decay of autumn. While participants may spend an entire session in one realm, it is more likely that they will pass constantly between them, immersed in transformation. Throughout the work, the various rocks, roots, seeds, and so on come into being, linger, and pass away. See figure 2. Their appearances depend on the immersant's vertical level, proximity, slowness of movement and steadiness and duration of gaze. immersant's vertical level, proximity, slowness of movement and steadiness and duration of gaze.

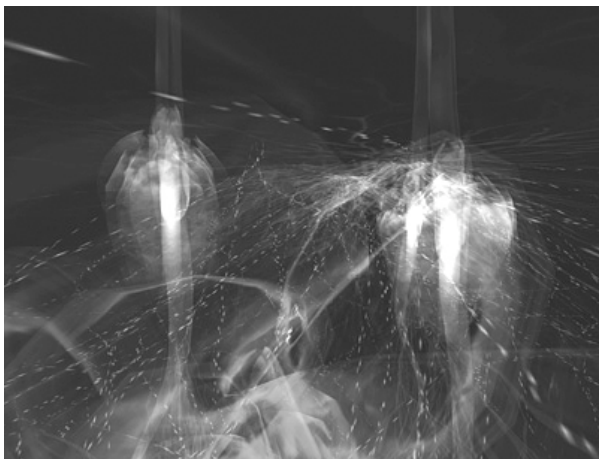


Figure 2. Char Davies, Seed
real-time frame capture from *Ephémère*, 1998.
Char Davies/Immersence Inc. & Softimage Inc. ©

5.1 Interface

The user-interface is based on full-body immersion in 360 degree spherical, enveloping space, through use of a wide field-of-view head mounted display. In contrast to manually based interface techniques such as joysticks and trackballs, *Osmose* incorporates the intuitive processes of breathing and balance as the primary means of navigating within the virtual world. By breathing in, the immersant is able to float upward, by breathing out,

to fall, and by subtly altering the body's centre of balance, to change direction, a method inspired by the scuba diving practice of buoyancy control. Whereas in conventional VR, the body is often reduced to little more than a probing hand and roving eye, immersion in *Osmose* and *Ephémère* depends on the body's most essential living act, that of breath -- not only to navigate, but more importantly -- to attain a particular state-of-being within the virtual world [13].

5.2 Technology and Exhibit Space

Initial development of *Osmose* 1995 and *Ephémère* 1998 was done using the SOFTIMAGE® 3D modeling, animation and development environment running on a Silicon Graphics Onyx2 Infinite Reality visualization computer. Other equipment included a Mac computer, sound synthesizers and processors, stereoscopic head-mounted display with 3D localized sound, breathing/balance interface vest, motion capture devices, video projectors, and silhouette screen. Since 2002, both works have been ported onto a PC. See figure 6. During public installations of the works, such those cited in this study, immersion takes place in a private chamber facing a large darkened space where museum visitors can witness the immersive performances as they take place in real time: aurally, as sound is generated by the participant's behaviour within the work; and visually, as imagery generated from the immersant's point-of-view is projected in real time onto a large-scale video screen. See figure 7. The shadow-silhouette of the immersant is projected live onto another screen, emphasizing the relationship between bodily presence and the immersive experience [13].

6. Results

The *Osmose* visitor sample was comprised of 44 subjects, 24 female and 20 male. They were mainly between the ages of 15-24 yrs. (n=21), and 25-34 yrs., (n=14). The remaining nine subjects were 35+ years of age. This was understandable due to the location of the BEAP exhibit within a University context. Overall there were no initial differences found between male/female responses to the majority of the questions. The *Ephémère* sample consisted of 47 subjects, 20 female and 27 male; 19 subjects were 15-24yrs, 13 between 25-34 and 15 were 35+ years of age.

The Melbourne *Transfigure* portion of the project took place at the Australian Center for the Moving Image (ACMI), and resulted in a slightly older demographic sample. The number of responses to the questionnaires was slightly higher for *Ephémère* than *Osmose* as it was screened less during the exhibit run. Overall the numbers were close enough to do a comparison report. The selected results of the ten Likert scale questions (multiple choice answers) and the seven Yes/No answer questions are presented in Table 1 and Table 3. Some questions are combined both types of answers. The questions are numbered (from the questionnaire) and summarized in order to save space here. Missing responses account for any totals not adding to 100%.

The open-ended type questions provided a rich amount of information on the audience effects of both Osmose and Ephémère. Respondents were very articulate in describing what they experienced in their own words, as summarized below in Table 2 and Table 4. Figure 3 presents the overall structure of the Osmose world, with the beginning and ending points. Figure 8 shows the structure of Ephémère combined with a sample motion path. Audience responses, particularly in the Osmose questionnaires, often related directly back to the specific parts of the world, the forest, tree, pond, leaves, abyss, etc. Participants in the study were also asked to trace what they could remember of their immersion, on the map/diagram of the two worlds. Two examples from Osmose are shown in Figures 4 and 5.

In addition to the written questionnaires, visitors were asked to volunteer for a video interview after their immersion experience. This aspect of the project proved

more difficult, since many people were less willing to be videotaped, than to answer an anonymous questionnaire. However, approximately 2 hours of video interviews were carried out over the two weeks of the project. Some of this material is available on the project website and will be reported on at a later date.

The answers from the open-ended questions revealed a wide variety of rich, idiosyncratic replies. Each questionnaire was entered, exactly as written by the subjects in their own words, into a spreadsheet for archival and analysis purposes. The responses were read and coded for common phrases, themes, locations and variables. The instances of each were tabulated and converted to a percentage of the overall subjects, n=44 (Osmose) and n=47 (Ephémère). The data in Table 2 shows a summary of common grouped responses to the individual questions.

Table 2. Summary of the **Osmose** Open-ended responses. (N=44)

1. How did you feel after Osmose?	25% Relaxed, 30% dreamy, 32% elated, joyous feeling 25% neg/sick feelings
2. If you close your eyes and remember being inside Osmose, what do you see, or feel, or hear?	57% Sounds/insects, voices, birds, crickets, chords 55% Tree/leaves/forest/clearing, 32% Floating/ tranquil calm/airy, weightless, 27% Lights/dragonflies/fireflies
3. Has Osmose affected you in any way?	20% Calm/refreshed, 18% dreamy, 16% sick/dizzy
7. Does using breath and balance for navigation contribute to the experience? (98% answered)	73% Positive: easy/heightened awareness/new experience/effective/control great/fantastic/immersive 23% Negative: hard to control/frustrating/dizzy
8. Does the use of transparency contribute to your immersive experience, positively or negatively?	86% Positive: easy/refreshing/weird/softer feel/favorite part/loved it/new space/freedom/amazing/lack of boundaries. 16% Negative: less real/disorienting, /confusing/annoying
11. Places that caused emotion or physical sensation? (90% answered the question, 75% positively)	39% Lights, fireflies/wonderment, peace, joy, delight 32% Underground/scary, unfamiliar, spooky, off balance 20% Tree, forest, pond/awe, curiosity, exhilaration, floating, fantasy
13. Part you enjoyed the most, and why? (95% answered the question)	48% tree/leaves/forest, 32% moving/floating/passing through things, 20% calmness/beauty/pleasure, 16% lights/ dragonflies, 14% roots/code/text, 11% pond, the abyss, various surfaces
14. Part you enjoyed the least? (90% answered the question)	27% HMD/navigation/lack interaction/resolution, 20% code/ text, 11% underground/roots, 9% trees/leaves/stuck in one place
15. Is there any aspect of Osmose that you unexpected or disturbing?	55% nothing, 20% lost way/HMD/balance/out of time/music/darkness closing, 11% nausea/dizzy
16. What sounds did you enjoy the most, the least?	36% harsh, text/code, screeching/underground 30% forest, trees 18% birds/chirping 14% water, drops, pond, abyss, 11% codeworld, text, music, change of locations.

From an overview of the Table 2 responses, it becomes evident that the subjects were extremely taken with the visual/physical organic structure of the Osmose world. They frequently cited exact locations, colours, sounds and feelings relating to the clearing-forest setting. They felt calm and refreshed, enjoying the contemplative experience of exploration on their own. The environment also elicited emotional feelings, fantasy and reverie in the ability to float and pass through leaves, rocks, roots and trees. Many subjects cited the “fireflies” in the clearing, and the “lights” in the pond as life sources and wanted to follow them.

They found it an enthralling and safe environment with no disturbing aspects at all, due in part to our human ability to visually relate to nature easily. Many did however report that they found the technology disturbing due to heaviness of the HMD. There were a very small number who experienced cybersickness, and those who did were easily prone to motion sickness already. Subjects seemed to find the “text/code” sections, which “bracket”, (see figure 3) above and below, the natural setting of the clearing, to be less enjoyable. They enjoyed the sounds of “nature” and disliked the more “hash” sounds of the text and codeworlds.

Table 3. Yes/no & scaled **Ephémère** (N=47) [*same, **higher, *-lower than Osmose]

3. Did Ephemere affect on you in any way?	*-*57% Yes [% = 27/47] 43% No
4. How long did you feel you were immersed?	71% 15 min. or less, 29% no idea
5. Awareness of your body <u>while</u> immersed?	44% more, 20% same, 34% less
6. Awareness of your body <u>after</u> immersion?	35% more, **62% same, 2% less
11. Did you ever feel lost or confused?	42% once, 24% more than, 34% never
17. Did you remain aware you were in an art exhibit?	50% always, 39% start/end, 11% forgot all
18. Moving around inside Ephémère was?	37% easy/very easy, **45% easy/hard to hard
20. Did you ever feel sick or uncomfortable?	*76% no, 24% yes
21. Describe the headmounted display?	48% uncomfortable, **52% adequately comfort/not comfortable
22. Is Ephémère what you expected of a VR?	**74% yes, 26% no
23. Have you ever experienced a VR before this?	*-*85% no, 15% yes
24. Go back into Ephemere, when would you go?	*-*60% immediately - 1 hour, 13% in a week, 11% month, 13% never

Table 4. Summary of the **Ephémère** (N=47) Open-ended responses. [*same, **higher, *-lower than Osmose]

1. How did you feel after Ephemere?	**39% Relaxed, dreamy, light, 23% elated, **38% neg/sick
2. If you close your eyes and remember being inside Ephemere, what do you see, or feel, or hear?	13% High pitch, robotic, pinging, beeping 20% water, heartbeat. 46% Lights/colours/energy/stars 9% Tree/leaves/forest/clearing, 24% Floating/ tranquil calm/airy, weightless, 4.5%dizzy, 2% small
3. Has Ephemere affected you?	**44% Small/humble, 17% dreamy, 13% aware, 4.5%sick/dizzy
7. Does using breath and balance for navigation contribute to the experience? (95% answered)	*65% Positive: easy/heightened awareness/new experience/effective/control great/fantastic/immersive 11% Negative: hard to control/frustrating/dizzy, remaining % mixed.
8. Does the use of <i>transparency</i> contribute to your immersive experience, positively or negatively?	*-*56.5% Positive: easy/refreshing/weird/softer feel/favorite part/loved it/new space/freedom/amazing/lack of boundaries. 21% Negative: less real/disorienting or confusing/annoying
10. Places that caused emotion or physical sensation? (*-*70% answered , 34% positively)	**20% Lovely/wonderment, mystery, stimulating, calm 11% weightlessness/flying, floating, 4% church feeling 21% stress, vertigo, scared, alone, uneasy.
12. Part you enjoyed the most, why? (96% answered the question)	55% red graphics, winter, rivers, lights/stars, speed 34% moving/floating/passing through things, 13% trees, 20% calmness/beauty/pleasure, 11% audio/sounds,
13. Part you enjoyed the least? (89% answered the question)	*24% HMD/navigation/lack resolution, 11% interior/body/blood, 11% the space/dark/twisty, 7% the place all of it.
15. Is there any aspect of Ephemere that you unexpected or disturbing?	*50% nothing, 9% sounds/cries/blood pumping, 9% floating through things/free movements, 3% losing balance
16. What sounds did you enjoy the most, the least?	37% nothing, 15% water related sounds, 7% bloodstream related 7% scraping/high pitch sound, 3% white seed pods.

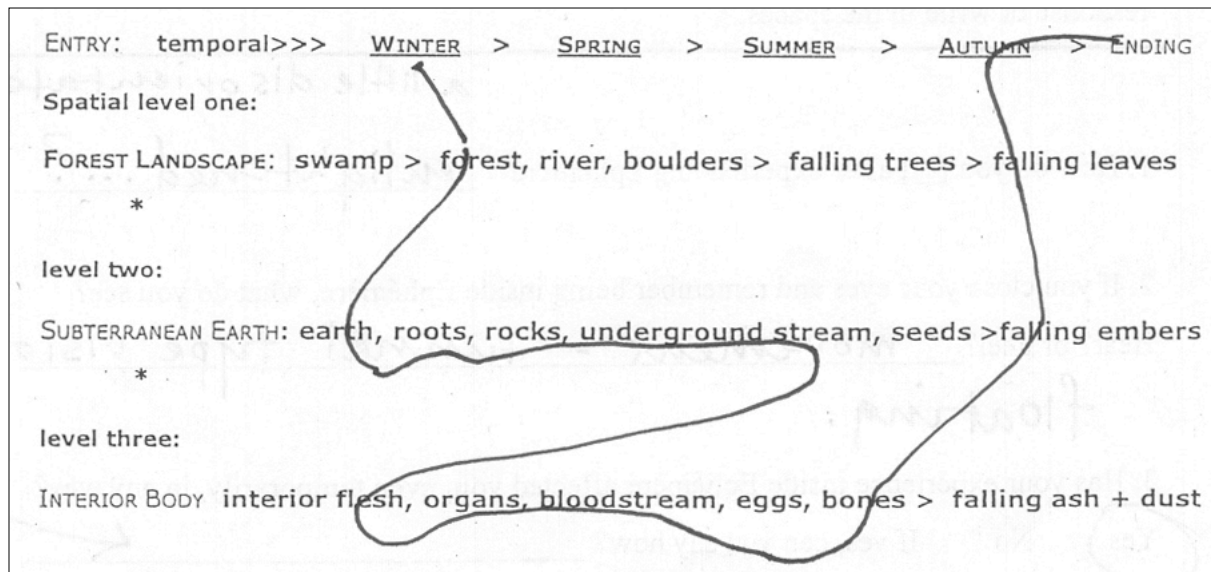


Figure 8. Spatial structure/motion path of the Ephémère world (details)

7. Conclusion

This paper presents the second report on a project using Char Davies' artworks as a virtual reality "test bed" as discussed by Lauria [14]. Many of Davies' personal reflections on the audience impact of her works and the reliability of the many quotes from the museum Comment Books are initially validated by this first group of subjects. A comprehensive final analysis of all data, parts 1 and 2, is now being completed.

It was evident during the project that immersive virtual art environments are still a very new experience for the majority of visitors, figure 9. Osmose had a strong and definite emotional and cognitive impact on the audience as evidenced by the richness of the response data presented here. Visitors found rapture and pleasure in the immersive experience, many anxious to explore further and again. They remembered very small details of both the imagery and soundscape. The major visual elements were predominant in the replies (the tree, leaves, pond, texts and lights). Subjects often related the *experience of immersion* to situations in their own lives and personal histories. Davies' breath and balance-based navigation system was a positive innovation for the user. It provided them with an increased awareness of their bodies while immersed, causing little or no instances of cybersickness, although it was not easy for everyone to use at first. Most subjects found the artwork easy to explore and appreciated the transparent ambiguity of the imagery. Many found it thrilling to move through things and not just around them. From a technical/equipment standpoint, it was quite apparent that the HMD (Head mounted display) in current use was often cited as a negative factor in the overall experience. However the "immersion" it afforded, due to a wide field-of-view, was found to be important. 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 personal 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. They could be related back to the actual journey, if each immersion were recorded. Overall the research subjects were articulate, detailed in their replies and willing to participate in this study on the immersive experience of both Osmose and Ephémère.



Figure 9. Immersant image superimposed in the Grid/Leaves of Osmose. ©

The Ephémère environment was found to create more "uneasy" or negative feelings in individuals, mostly due to the "unfamiliar" nature of the more abstract visuals. People felt more "lonely", humble, or small, while in this environment. It had less of an "affect" on them (57% vs. 91%). Many of them found it harder to navigate in than Osmose, (but at the same time, they got lost less). Most immersants felt they were less likely to

immediately want to go back into it. Transparency was also much less a positive factor than it was in Osmose. The questionnaire revealed that more people visiting Ephémère had previously experienced a VR (many had been into Osmose previously). The Ephémère motion paths were much harder for immersants to remember and draw accurately, (less were done of those than Osmose), perhaps due to the less structured or familiar nature of the environment. Sounds were also reported as less remarkable than in Osmose.

This project was the first formalized audience study on Davies' two artworks. It revealed an immense wealth of data from gallery visitors and presented an opportunity to document an audience sample on location, interacting with the works. The project helped to begin to understand the audience, visitor experience of immersive VR art. The two locations presented an exhibit with both artworks at the same time and thus it was able to yield both interviews and written results.

"Thinking is more interesting than knowing, but less interesting than looking". Goethe.

~~~~~

#### Notes:

1. This project was made possible through a research grant from the Hexagram Institute in Montreal, Canada. [www.hexagram.org](http://www.hexagram.org) Further details are available on the Osmose and Ephémère Immersion Project Website <http://www.scootersan.org/study.html>
2. My sincere thanks to Char Davies for granting me access to her works during this project.
3. For a comprehensive listing of writings on both Char Davies' works; Osmose and Ephémère, please consult the Immersence Inc. website: [www.immersence.com](http://www.immersence.com)
4. I would like to thank Professor Ted Snell, Curtin University Dean of Art, the entire staff of the John Curtin Gallery, Perth Australia, and Alessio Carvallero and his staff at ACMI, Melbourne Australia, for their help in making my research stays so rewarding.
5. Currently, at Concordia University in Montreal, the artist is collaborating with an engineering research team on the evaluation and development of a new wide field-of-view immersive HMD. The project is supported by a grant from the New Media Initiative of the Canada Council and the National Science and Engineering Research Council of Canada.
6. Not everything in VR is new, but stems from concerted research over time. The references cited in this paper are specific to the aspects of the project and make connections to the historical development of the field.
7. Images 1, 2, 6 & 7 courtesy of Immersence Inc. ©

#### References

1. Heim, Michael. 1993 *The Metaphysics Of Virtual Reality*, Oxford University Press.
2. Jones, Stephen. 2002. Breathing/diving/dreaming/dancing BEAP in Perth (you can't buy these emotions off the Hollywood shelf). *Artlink*. Vol. 22 (4) (new museums | new art) pp. 36-37
3. Cartwright, Glenn. 1994. Virtual or Real? The mind in Cyberspace. *The Futurist*. Vol. 28-2, pp.22-26
4. Attree, E.A., Brooks, B.M., Rose, F.D., Andrews, T.K., Leadbetter, A.G. and Clifford, B.R. 1996. Memory processes and virtual environments: I can't remember what was there but I can remember how I got there. Implications for people with disabilities. Proceedings of the First European Conference on Disability, Virtual Reality and Associated Technologies, Maidenhead, UK.
5. Hansen, Mark. 2001. Embodying Virtual Reality: Touch and Self-Movement in the work of Char Davies. *Critical Matrix: The Princeton Journal of Women, Gender and Culture*. Vol. 12 (1-2) Making Sense, 112-147
6. Davis, Erik. 1996. Osmose. *Wired Magazine*. Vol. 4 (08), pp. 138-140, 190-192
7. Pesce, Mark 2001. *The Playful World: How Technology Is Transforming Our Imagination*. New York: Ballentine Books, pp. 248-255, 267
8. Grau, Oliver. 2003. *Charlotte Davies: Osmose*. Virtual Art, From Illusion To Immersion. Cambridge, Massachusetts: MIT Press, pp.193-211
9. Davies, Char 1997. Changing Space: VR as an Arena of Being. *Consciousness Reframed: Art and Consciousness in the Post-biological Era*. Proceedings of the First International CAiiA Research Conference. Roy Ascott, ed. Newport: University of Wales College, Centre for Advanced Inquiry into the Interactive Arts.
10. Davies, Char 1998. Osmose: Notes on Being in Immersive Virtual Space. *Digital Creativity*. Vol. IX (2), pp. 65-74
11. Thwaites, H. & Malik, M. 1991. Toward Virtual Realities: A Biocybernetic View of Communication Media of the 21st Century, in (G. Lasker, T. Koizumi & J. Pohl, Eds.) *Advances in Information Systems Research*, The International Institute for Advanced Studies in Systems Research and Cybernetics, Windsor Ontario, pp. 473-480 ISBN 0-921-836-08-2
12. Treadwell, Andrew. 2002. *Virtual Transcendence*. [Online] Oxford, UK: Oxford Brookes University.
13. Bruner, J. 1991. *Acts of Meaning*. Cambridge, MA: Harvard University Press.
14. Davies, Char. 2003. Landscape, Earth, Body, Being, Space, and Time in the Immersive Virtual Environments Osmose and Ephémère. In: *Women, Art, and Technology*. Judy Malloy, (ed.) London, England: The MIT Press, pp. 322-337,
15. Lauria, Rita. 1997. Virtual Reality: An Empirical-Metaphysical Testbed. *Journal of Computer Mediated Communication*. 3 (2), pp. 1-25