

**Man in the Mirror:**  
*A Mythology-Driven Exploration of Multiple User-  
Interpretations  
in a Multimedia Space*

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## **ABSTRACT**

Artists, designers and writers have long employed ambiguity as a tool in compelling their audience to deduce a personal meaning to their work. As computing becomes less of a strictly workspace, task-oriented phenomenon and more of a ubiquitous, life-space one, it is increasingly important to consider the intelligence of the user in the design of everyday computer-based things. Support of multiple user interpretation through ambiguity is an element whose appropriate inclusion in system design can compel the user to deduce a personal interpretation of the system's meaning and utility.

The work in this paper explores the process by which users may come to deduce a meaning to an ambiguous work, both as individuals and collaboratively. Incorporating elements of ambiguity, we created *SenSpace*, an immersive physical environment that *embeds* the Greek myth of Narcissus within itself. The subsequent user study provided insight on the *process* by which naïve visitors may come to deduce their meanings of a work, both individually and collaboratively. Our results showed that there exists a trade-off between a user's level of interaction and depth of the interpretation of the multimedia environment. We also show how ambiguity can be used as a design method, by incorporating observed user expectations into the system. This paper uses experimental evidence to advocate the design of systems that support not only the system goal the designer has in mind, but also the multiple perspectives and meanings that the user often brings to the system.

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# Chapter 1

## Introduction

Artists, designers and writers have long employed ambiguity as a tool in compelling their audience to deduce a personal meaning to their work. French artist Marcel Duchamp employed it strongly in his *readymades* and, most notably, in his heavily analyzed mechanical piece *The Bride Stripped Bare of her Bachelors, Even* (1915-1923). Industrial designer Philippe Starck uses it in the designs of his widely acclaimed everyday things, including the *Juicy Salif* lemon squeezer, which graces the front cover of the second edition of Donald Norman's text, *The Design of Everyday Things*. Of the *Juicy Salif*, Norman famously said, "I do not use my *Juicy Salif* to squeeze lemons; I use it to start conversations." Literature by writers like Ernest Hemmingway have provoked decades-long controversies over their intended meaning, because these writers decided to apply ambiguity to their work, instead of foregoing inferred metaphor, parallelism, and other ambiguity-laden elements, for the clear, concise, and often boring writing style of their long-forgotten contemporaries.



**Figure 1.1: Is there a code behind Mona Lisa's smile? Over the ages, artists, designers and writers have used ambiguity to compel their audience to pay closer attention. (Photo taken by the author).**

Computing has become less of a strictly workspace, task-oriented phenomenon and more of a ubiquitous, life-space one. It is thus increasingly necessary to design systems that draw upon user intelligence in addition to that of the designer, by eliciting and supporting the individual user's meanings and uses. Requirements elicitation, a vital phase in software engineering, and the traditional means of gaining insight into the user's purposes for the system, only occurs in the near-beginning stages of the process. It also only considers and hard-codes the requirements specified by few stakeholders, who define desired system functions based on a set of desired end-goals. However, several HCI specialists (Gaver et al. 2003; Aoki et al. 2005; Sengers et al. 2006; Bannon et al. 2005) have also created systems which draw upon the intelligence of the user, in addition to that of the designer, by eliciting and supporting the individual user's meanings in the end product. As in the arts, such user consideration allows for increased user creativity. It simultaneously gives the designer space to improve the system interface and functionality, with information gathered from users' various interpretations and uses of it.

### ***1.1 Problem Statement***

Although previous research has proposed and proven several benefits to allowing certain systems to support multiple user interpretation (Gaver 2003; Murray 1998), little work has been done to inquire into the *process* by which users try to understand the particular meanings or purposes of a system (Dourish 2001 p. 171). In his explorations of the use of Lotus Notes, Orlikowski (1992) found the process of appropriation to be important to users' determination of how a technology would be incorporated into their working practice. For our work, we know that naïve users may have several responses to a system whose purpose is not immediately evident. They may

1. Dismiss the system
2. Fiddle with the system but resign with a feeling of having “missed the point”
3. Try to understand the system for its surface or literal value, and succeed to some degree
- 4a. Through their engagement with the system, permit themselves to be engaged in a reflection about themselves.

4b. Construct their own meaning for the system (often resultant from 4a)

In incorporating ambiguity into system design, the goal of designers, artists, architects, writers is often to elicit either 4a or 4b as a final reaction to the system. The work described in this paper seeks to understand the process by which users deduce their own meaning to a digital art environment whose meaning and purpose are not immediately apparent. Understanding this process will guide HCI specialists and people interested in using ambiguity in their work, on how to support multiple user interpretation while leaving the user engaged, and satisfied (as opposed to frustrated) with the system.

### ***1.2 Relevance of this Research***

Meaning, according to Dourish (2001) is an aspect of use, interaction and practice. Thus meaning-making is in the hands of the user, not the designer, because the user appropriates a product's use. The research in this paper seeks to expand the boundaries of "interactivity" to include meaning-making and meaning-understanding. Interactivity currently suggests use which involves physical manipulation of a system or device, using our hands (as with a game console) or even our feet (as in Dance Dance Revolution) to affect an outcome. However, the argument here is that interactivity can also include any activity that engages the mind to produce meaning. Through ambiguity, the user affects the outcome, by making the system mean what she wants it to mean. The environment upon which this research is based, involved minimal physical interaction. Instead, we engage the user in a process of meaning-making, and meaning-understanding, leading her to interact with the system through

1. Observation
2. Relation of present stimuli with past experiences,
3. Through the post-experiment questionnaire, conversation.

The research presented in this paper is also important because increased insight into the meaning-making process would allow us to create systems that elicit desirable responses (4a or 4b above) to the systems' ambiguity from most or all of its users. Unlike writings and paintings where users are comfortable with the involved media, people often

approach computer technology with a feeling of fear of the unknown, coupled with restraint. Thus if the goals of a system are not immediately clear, the users may be more prompted to dismiss the system as “un-user-friendly”, or to dismiss themselves as “dumb” and “missing the point”. The same users may encounter no difficulty in engaging with an abstract painting to a point of personal reflection, or relating a story’s morals to their personal lives.

### ***1.3 Research Questions***

The research questions asked in this experiment were:

A. How can the designer better guide the user towards deducing her personal interpretation of an ambiguous work?

The corresponding hypothesis was:

By understanding how users *approach* such a work, as well as their reactions, and how these change over time, and how they seek and use cues in the work, useful insight can be gained on the process of personal interpretation. A hypothesized was also that users undergo some combination of the following reactions:

They may dismiss the information. If the message is not immediately clear, they may think, it is not worth knowing. They may try to get the idea but feel like they have missed the point. They may try to understand the art as a narrative. The art may engage the user in reflection. Finally, some users may go as far as to construct their own meaning for the art. Designers can be aided in building systems which, despite their ambiguity, engage the users’ attention and elicit a positive reaction. They can be placed in a better position to elicit the types of responses (construction of self-relevant meaning, engagement in literal or metaphoric reflection) that they often want their users to have.

B. How does working *together* to deduce meaning, influence the depth of meaning-making?

Our hypothesis was that working together would significantly increase users' ability to come up with a coherent interpretation of a work. This is because discussion helps us to complete our thought, by compelling us to put them into words.

## Chapter 2

### Literature Review

Most research done in the field of ambiguity has been in understanding it as an increasingly important resource in the design of certain computer-based systems. By studying the use of artifacts such as the History Tablecloth, Key Table, Drift Table, Office Plant; the Double-Deck Desk, and Miro (Sengers 2005; 2006), installations like Desert Rain, the Sloganbench, the Imagebank, and the Home Health Monitor (Gaver 2003) as well as the mixed-reality GPS-based game *Bystander* (Gaver 2003), HCI researchers have come up with various benefits of including ambiguity in design. Aoki and Woodruff (2005) take another approach to ambiguity by proposing it as a tool for improving social relationships. They propose that ambiguity can be introduced in the design of personal communication systems such as cell phones, to help maintain relationships that may otherwise be damaged, e.g. through one person's numerous unreturned phone calls to another (Aoki et al. 2005). Some advantages of ambiguity are stated below.

### Advantages of Ambiguity

1. Ambiguity induces individuals to provide their own interpretation to situations.
2. It allows users to *think* of the concepts behind a system and its space-time concepts.
3. Ambiguity helps the user to form deeper and more personal relationship with the meanings offered by the system.
4. It lets designers engage their users in issues relating to the system, without constraining how the users respond.
5. Ambiguity serves as a tool for cultural expression through the same medium.
6. Ambiguity is advantageous because it allows individuals' interpretations to supplement technical limitations that may exist in a system.

7. Ambiguity of context, whereby an object or idea may lend itself to several interpretations depending on the context in which it is placed, evokes tension, which may lead to dialogue or positive change that would not have occurred otherwise.
8. By enabling designers to exceed the limits of their technologies, ambiguity provides a context that makes it permissible to use “inaccurate sensors, inaccurate mappings, and low-resolution displays. It does so by encouraging users to supplement limitations with their own interpretations and beliefs.
9. Ambiguity allows designers to suggest issues for consideration, without imposing solutions. One of the applications of this is product improvement.
10. Ambiguity is a vital element in creating space for experience, rather than telling stories (Murray 1998).

### **Disadvantages of Ambiguity**

Clearly, these advantages counter traditional HCI thinking. In echoing the concerns of many regarding ambiguity, Gaver (2003) states, “It is difficult to see how an interface can be usable if the information it conveys is unclear, or useful if its purpose is uncertain.” However, it is important to understand that not all systems will benefit from ambiguity. Gaver suggests its application in systems that are designed to support activities outside of work, due to the “need to provide rich resources for experience that can be appropriated by users” (Gaver 2003). This need goes beyond traditional HCI concerns for clarity and precision.

Ambiguity can also present frustrations for the user. However, gaining a better understanding of how users derive meaning, will help us to design ambiguity into systems, in ways that provide some or all of the aforementioned advantages to the user.

## ***2.1 Designing for Multiple User Interpretations (DMUI)***

Sengers and Gaver are two researchers who have done extensive work in the area of design for free user interpretation. In their paper (2006), they propose that designers should allow users of their systems to come up with their own interpretations and uses of certain systems. Thus they challenge HCI tenets which preach clarity of system use. To prove their point, they document user interaction with some systems like the History Tablecloth, which they designed using their principles. In the section *Designing for Multiple Interpretation*, the authors list and explain six methods by which designers can engage multiple meanings in the design of their systems. This paper presents HCI specialists with a *creative* alternative to the cookie-cutter way of designing systems. Its authors propose that instead of designing with just the formal requirements and a set of designer-defined system goals in mind, designers should also take advantage of their users' creativity and ability to invent uses for the system. This thinking is similar to art, where each viewer is free to interpret and critique a piece of work as she deems fit. The difference is that this time, it is functional. The paper reminds me of Phillippe Starck's Juicy Salif lemon juicer, of which usability specialist Donald Norman famously admitted, "I do not use my juicer to squeeze lemons, I use it to start conversations." It supports the contemporary design goal of moving from product-centered design to user-centered design. Engaging multiple meanings in design may revolutionize workers current apathetic approach to work, by providing systems that allow the user to exercise her individuality and intelligence.

One of the tenets of HCI is non-ambiguity of a system's purpose. In his paper on user interface affordances, St. Amant (1998) explains that the user acts on the visual, auditory, tactile, and other cues perceived from the interface. He, Norman (1988), and the makers of the Macintosh User Interface (Apple Computer), provide some guidelines for ensuring affordance in user interface design:

- i. **Consistency:** A user action under a well-defined set of conditions should always produce the same effect (Norman).

- ii. **User Control:** Conventionally, interface should not initiate actions, but rather respond like a tool. User control should be absolute (Apple Computer).
- iii. **Perceived Stability:** User should be able to depend on stability (e.g. visual layout) of the user interface (Apple Computer).
- iv. **Forgiveness:** Actions should generally be reversible through an undo capability (Apple Computer).
- v. **Continuous Representation:** Objects and actions of interest should be continuously visible (St. Amant).
- vi. **Serial Execution:** User attention and decision-making should focus on one task at a time (Norman).

However, as Sengers et al found from their experiments on user interaction with the History Tablecloth and the Key Table (2006) users often find their own uses for a system. These uses hardly bear any resemblance to what the designers had in mind. Based on this finding, Sengers and Gaver argue that while lower levels of interpretation tend to involve usability issues, higher levels of interpretation involve personal decisions about values and meaning that appear less amenable to, and appropriate for, designer control (2006). Our system supports a space of interpretation around the topic of Narcissus, but leaves the user to interpret the system as she deems fit. This work ties the papers by Sengers, and the ideas of UI design put forth by Don Norman (1988), and elucidated upon by St. Amant. It does so by showing the contradictory nature of the points of view presented by both parties.

## ***2.2 Types of Ambiguity***

In their paper on ambiguity as a resource for design, Gaver et al. (2003) identify three types of ambiguity: Ambiguity of context, ambiguity of relationship, and ambiguity of information. Although we focus on ambiguity of information, ambiguity of relationship also manifested itself strongly, through the guilt felt by some users as reported in the *Results* section. Here we explain the relation of Gaver's findings on ambiguity of information.

### **2.2.1. Ambiguity of Information**

SenSpace widely employs ambiguity of information. According to Gaver, et al. (2003), this type of ambiguity arises in the way the information is presented. It can be enhanced in several ways. By enhancement, we mean development of ways to help designers recognize and use ambiguity, such that it would facilitate desirable user responses.

- i. **Using imprecise representations to emphasize uncertainty:** We do this by blurring the information in SenSpace. The sound is obscured so that it merely suggests voices in the background, leaving the users to decide how (s)he would interpret the voices, and what level of attention to pay to them.
- ii. **Over-interpreting data to encourage speculation:** In Senspace, the different changes in the video correspond to the occurrences in the narrated myth. For example, when Narcissus flees from Echo, a progressively increasing horizontal motion blur was applied to the image of the forest setting. This suggests the way motion parallax distorts what we see when we are running or in a fast-moving vehicle. When Narcissus reaches a pond, ripples are created on the image to reflect this. When, in the narration, he notices his reflection in the water, the image becomes symmetric, imitating reflection. This over-interpretation enhanced ambiguity because the system suggested that the changes in the video might *not* be random, but may correspond to something else in the environment. In our case, it corresponded to the audio. As we would see, many users thought it corresponded to their actions and motions within the SenSpace environment.
- iii. **Exposing inconsistencies to create a space of interpretation:** Inconsistency is antithetical to fundamental HCI thinking (Norman 1988). However, in this case, we use it to enhance ambiguity, to further support users' interpretations. The inconsistency here existed in interactivity. Although two similarly projected images were seen on adjacent walls, one changed based on the user's actions, while the other was independent of user action. This created an interesting interpretation space: many users reasoned that since they could change the first projection (by forming ripples, patterns, and shadows in the

mirror-lined water holder), they could perhaps also influence the second projection, which was just of a pre-recorded morphing scene of a forest.

- iv. Casting doubt on sources to promote independent assessment:** Many users were surprised to learn that it was okay for them not to hear clearly, the stream sound-drowned voices of the narrators of the story of Narcissus. Perhaps after spending a few seconds trying unsuccessfully to make meaning of what they were seeing, they had decided that the voice in the background held the key to unraveling the environment. However, its incomprehensibility (besides being drowned by stream sounds, it was also in Italian) raised doubts about its reliability as a source of meaning, in turn provoking the user to assess the environment further, for meaning.

### ***2.3 Collaborative meaning-making***

A lot of work has been done on the topic of collaborative meaning-making. Bannon et al created museum artifacts to help visitors engage and interact with museum artifacts, in collaboration with their friends and family (2005). The artifacts included paper clues, floor projections, and radio-frequency identification (RFID) tags. By encouraging collaborative learning through such as the “history hunt” in the Nottingham Castle and the “Storytent” at the Hunt Museum in Limerick, Bannon et al sought to achieve the following goals.

1. To provoke visitors’ imaginations
2. To show that several perspectives exist from which the mysterious artifacts can be understood.
3. To record users’ personal opinions on the nature and possible uses of these mysterious objects.

These goals are similar to those established in this thesis work, and are also in line with the study of ambiguity done by Sengers & Gaver (2006), and Janet Murray (1998).

In an experiment conducted to understand meaning-making in small computer-supported collaborative learning (CSCL) environments, Stahl (2007) found that the group of three users often had to spend considerable time establishing a consensus on the object that was being referenced. However, they were soon able to exploit the various resources available

to them, e.g. the communication media, to establish a common understanding of what was being referenced at any point. Stahl notes that the collaborative meaning-making process that produces the shared group meaning, tends to produce in parallel individual interpretations of this meaning. That is, in collaborative processes, individual interpretations are aligned to a gradually shared meaning, which is itself co-constructed in the process. Group cognition is a result of group-discourse, and it exists within the interaction. Although the collaborative tasks in Stahl's research were mathematical in nature, his findings still provide a framework for understanding meaning-making.

### ***2.4 Use of Calm Technology***

In their paper, Weiser and Brown illustrate the concept of Calm Technology through artist Natalie Jeremijenko's "Dangling String." Calm Technology comes from the belief that despite our idea of "un-calm" cell phone, television and radio technologies which bombard us with noise, some technologies do lead to calm and comfort. Such technologies do this by alternately engaging the *periphery* of our attention (which we are attuned to without attending to explicitly) and the *center* of our attention. The Dangling String is a piece of 8-foot plastic spaghetti hanging from the ceiling, whose intensity of movement is used to detect the level of traffic in a local ethernet network. Any change in the peripheral sensory input will shift it into the center of our attention. This alternation is encalming because it enables attunement to multiple things, by making some of them secondary and others central. By connecting us to a myriad of familiar details in this way, we gain a "locatedness", or a connection to the world around us. The sudden re-centering of information also empowers us to act on that information. Calmness as described in this paper is an important consideration in technology design because its results, locatedness and empowerment to action, facilitate enriched interaction among people and the artifacts in a space.

Weiser and Brown state that calm technology shifts back and forth between the periphery of our attention (what we are attuned to without attending to explicitly), and the center of our attention. By juxtaposing gradually-evolving sound and gradually-transforming visuals onto each other, SenSpace urges the user to make a choice of what would be at the center

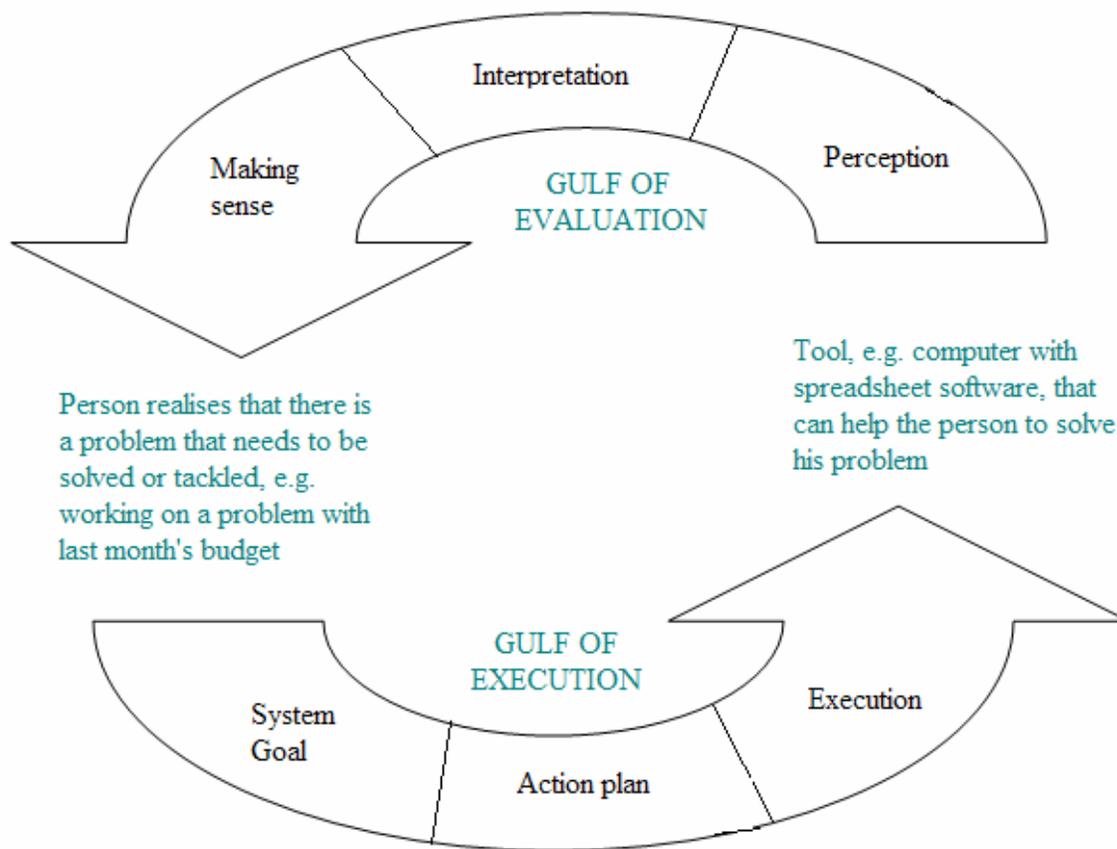
of her attention at any given time. We hypothesize that this back-and-forth shift will increase the user's awareness of the environment, and empower her to take an active cognitive engagement in what is being perceived. In other words, through the juxtaposition of changing sounds and visuals, we hope to gently coerce the user into deducing her personal interpretation of the thesis piece.

## ***2.5 Information and Interaction Design***

Don Norman categorizes human action into two: execution, which involves *doing* something, and evaluation, which involves *comparing* what happened with what we wanted to happen (1988 p. 47). He goes on to define two corresponding gulfs: the Gulf of Execution and the Gulf of Evaluation (Figure 2.1).

1. The Gulf of Execution: this is a measure of the difference between the intentions and the allowable actions. In the Gulf of Execution, we ask the question, "Do the actions which the system provides match the actions intended by the user?" (p. 51).
2. The Gulf of Evaluation: in this gulf, we measure how much effort the person must exert to interpret the physical state of the system, and how well the expectations and intentions have been met. The easier it is to understand and interpret the system, the smaller the gulf of evaluation (p. 51).

While interaction design is concerned with the Gulf of Execution, information design focuses on the Gulf of Evaluation (Rosson & Carroll 2002 p. 110). In the Gulf of Evaluation, the user perceives the information, interprets it, and then makes sense of it. The focus of this study is user interpretation and meaning-making, thus making Norman's Gulf of Evaluation of particular interest.



**Figure 2.1: The gulfs of evaluation and execution**

The Gulf of evaluation, as shown in Figure 2.1, has three stages. While Norman (1988) and Carroll and Rosson (2002) seemed to focus on 2-dimensional user interfaces, we are concerned with sound and visual elements within a three-dimensional space. *Perception of information* occurs when the user first enters the SenSpace environment. Most users try to understand how the network of projections and reflections work. They look around to see what is creating the images they see. They also look for sources of the sound. Then *interpretation of information* occurs. Here, the participant tries to comprehend what the narrator is saying, often wondering out loud if she is supposed to hear what is being said. The user also pays closer attention to the video, to make meaning of what she is seeing. While perceptual processing identifies the major display and sound structures in the environment, interpretation of these elements within the environment is necessary for the user to act on this information (Rosson & Carroll p. 119). Familiarity comes into play here: a lot of our interpretative ability depends on being able to relate what we experience to what we have

experienced before. For example, participants might use their prior knowledge of the reflective properties of a mirror, to rationalize that the image they saw on the left wall was a reflection, not a direct projection. *Making sense of information* involves relating the information perceived to what they already understand about the task. In SenSpace, this is where things get interesting. While some users were told of the relation of the installation to the myth of Narcissus, others were simply instructed to observe the environment as if they were visiting an art installation. So this made it difficult to relate the information perceived to any tangible “task.” Well, this is where the ambiguity comes in. Carroll and Rosson allow for this by stating that if users cannot make sense of the information, they may try out new interpretations. They may also be willing to put things “on hold” until they have gathered more information to better grasp the big picture (p. 125). During the post-experiment questionnaire session, questions were posed to see how users had attempted to or succeeded in making sense of the information. As we see in the *Results* section, while some users tried out new interpretations to reconcile all they had seen and heard, other users simply restated what they had perceived.

As we stated earlier, information design focuses on the Gulf of Evaluation while interaction design is concerned with the Gulf of Execution. It is difficult to apply Norman’s Gulf of Execution (System Goal -> Action Plan -> Execution) to our work on ambiguity, because the user does not go into the environment with a predefined task; the system goal is whatever the user deems it to be during and after her experience of the system. Instead, we look to Klemmer, Hartmann and Takayama for a framework for defining the user’s process of interaction with the system. In their paper on five themes for interaction design, Klemmer et al. (2006) present their view of the affordances of physicality and concreteness, for the design of interactive systems. They present five themes necessary for the design of interactive systems: thinking through doing, performance, visibility, risk, and thick practice.

- i. *Thinking through doing* supports the idea that reason grows out of bodily capacities. The authors state that being able to move around in the world and interact with pieces of the world enables learning in ways that reading books and listening to words do not. They also give the example of children, who learn best by direct physical interaction with the world.

- ii. *Performance* refers to the skilled use of certain tools and body parts (e.g. a surgeon's hands). Hands are so tied to the task of performing a surgical operation that it would be insane to ask a surgeon to perform the operation using something else, e.g. a mouse and a keyboard. Under this theme, the authors also posit that one of the most powerful human capabilities relevant to designers is the intimate incorporation of an artifact into bodily practice, to the point where people perceive that artifact as an extension of themselves, by acting *through* it instead of *on* it.
- iii. *Visibility* presents the idea that we learn by seeing. The production and manipulation of visible artifacts in the workplace helps collaborating groups in the coordination of their activities. For the theme of visibility, the authors give the example of packed concert performances, even though music is meant to be enjoyed by ear. Visibility permits listeners to witness of performance, and co-produce it through mutual feedback with the performer.
- iv. *Risk* is greatly involved in in-person social communication, but often absent in distance communication such as flaming, where there is less chance of being identified. The authors believe that the reduced risk posed by distance collaboration makes trust more difficult to build.
- v. *Thick practice* argument is based on Mark Weiser's "exhortation to design for 'embodied virtuality' rather than virtual reality." The authors argue that interfaces that *are* the real world would remove the need to model the real world. Or to explain it using Mark Weiser's terms, if computers are embedded seamlessly within our immediate environment (embodied virtuality), then we would have less need to build virtual environments to immerse ourselves in.

Klemmer's work is geared towards the design of systems that are a combination of virtual representations and physical artifacts, such as SenSpace. *Thinking through doing* and *Thick practice* particularly apply to it. In presenting the story of Narcissus to the user through a space, as opposed to through a book or a video, we are encouraging the user to think, learn, and observe in ways that are more evocative than the conventional means. By allowing the user to directly interact with the water and see how the interaction affects the space, thick practice is carried out. As Klemmer et al posit, being able to embed the

story within an immersive physical space, in this case, lessens the virtual elements in the environment and provides instead, real, tangible objects and sound.

Although participants can influence the content of the installation by playing with the water in the mirror-lined water-holder, this study also focuses on **meaning-making as a form of interactivity**. Thus interaction also comes in the form of deducing a personal interpretation of the piece, developed through observation, and relation of present stimuli with past experiences among other means. This type of interaction is of foremost interest to us because it enabled us to study the various outcomes of the ambiguous experience, as seen in the user study.

## ***2.6 Ambiguity for Posterity***

In her book on Marcel Duchamp, Caroline Cros narrates how Duchamp “played the game of posterity” by posthumously revealing a new work *Etant Données*, which led his audience to question what they had already come to understand about Duchamp and his works (Cros 2006 p. 163). Duchamp also introduced ambiguity by sometimes representing himself as “Rose Sélavy”, a female pseudonym under which he penned poems such as *Man Before the Mirror*. The names of his works also incited a lot of controversy and questioning. Many a historian has struggled to put forth an undisputable explanation for the “even” appended to the end of Duchamp’s work, *The Bride Stripped Bare of her Bachelors, Even*. The title raises even more speculation when its original French title is used, as the French word for “even” presents a play on words.

Not everyone is crazy about Duchamp’s attempts at preserving his memory through ambiguity. In his essay *Marcel Duchamp And/Or Rose Sélavy*, Donald Judd comments that neither Duchamp’s retirement nor his role as conservator of his own work is admirable. He says it would have been better if Duchamp had developed his ideas to completion, instead of merely “inventing several fires, but not doing much after that.” (Masheck 1975 p. 121).

With Leonardo da Vinci however, it is a different story. The fifteenth century Italian continues to influence contemporary life through his scientific discoveries, his inventions, his music, but most of all, his art. According to Wikipedia, “it is primarily as a painter that Leonardo was and is renowned. Two of his works, the *Mona Lisa* and *The Last Supper* occupy unique positions as the most famous, the most illustrated and most imitated portrait and religious painting of all time. Their fame is approached only by Michelangelo's *Creation of Adam*” (Wikipedia). It is their ambiguity that makes these works so controversial, and consequently, so popular. Art historians and critics still seek to categorize the Mona Lisa smile, and controversy remains whether the person to Jesus’ right is Mary Magdalene or the apostle John. Besides da Vinci’s artistic talent, the ambiguities in his works have definitely contributed to their popularity.

### ***2.7 Myth as a Tool for the Study of Meaning-making***

Myths are imaginative traditions about the nature, history and destiny of the world, the gods, man, and society (Cavendish, 1980 p. 8). In using the myth of Narcissus as a tool that drives our research, we are employing the pedagogical function of mythology, whereby the individual must find an aspect of myth that relates to his own life (Sartore 1984 p. 4). Joseph Campbell, in *Myths to Live By*, describes a universal formula for the journey of the typical mythological hero (p. 208-209). This formula is given below, and specifically related to Narcissus:

- i. **A break away or departure from the local social order or context:** This happens when Narcissus, unlike other creatures of Greek Mythology who fall in love with others, spurns all advances made towards him.
- ii. **A long, deep retreat inward into the psyche, and backward in time:** For Narcissus, this occurs by the pool of water where he reflects upon his attraction for the being he sees in the pool. After spurning others, he finally finds something that he desires. He contemplates upon and expresses the features that make this creature desirable to him. Finally, he is frustrated by its refusal to respond to his advances.
- iii. **A chaotic series of encounters, and if the victim is fortunate, a fulfilling, harmonizing encounter that gives new courage:** Narcissus’ chaotic

encounters occurred in his period of “blindness”, before he realized that the one he was wooing was merely a reflection of himself. This encounter is reversed when Narcissus realizes, “Oh, I am he! I have felt it, I know now my own image. I burn with love of my own self; I both kindle the flames and suffer them.” However, rather than give him courage to continue living, using the lessons he has learned, this encounter gives him the courage to embrace death.

- iv. **If the victim is fortunate, a return journey of rebirth to life:** We may regard Narcissus’ rebirth as occurring in the afterlife.

## Chapter 3

### Design Process

The idea of using Narcissus to drive our research, was conceived in November 2005. Since then, the idea has evolved, from building a literal representation of the myth as a course project to engaging individual interpretations through thesis work. In this chapter, the design process from conception to realization is documented.

#### *3.1 November 12, 2005: Idea conception*

Concept proposals for a *CS 4984: CyberArts* course at Virginia Tech led the author to conceive an idea whereby the story of Narcissus would be animated, then projected onto a body of water, within an enclosed space. Text vital to the story would be dynamically projected on the water, borrowing from the XFR: eXperiments in the Future of Reading (Harrison et al. 2001). The original idea is presented here.

*“NARCISSISM IN LCD SCREENS AND DISTORTED REFLECTIONS*  
*A combined idea I have is to create an animated sequence of Narcissus' life and death, using a body of water. Narcissus is a character in Greek mythology that was obsessed with his own reflection. He fell in love with his reflection in the water and soon (according to some versions of the myth), he literally fell into the water, in an attempt to meet this being which he did not realize was a reflection of himself.*

*So an idea can be to show this whole animated film sequence in a body of water. It would be so real because water and reflections play such a large role in the story itself. And the water can be made to be an integral part of the animation, and not merely a reflecting surface for it. So for instance, when Narcissus waxes poetic to this image of his ("You nod and beckon when I do, your lips, it seems, answer when I am talking though what you*

*say I cannot hear" ...or later, "He is myself! I feel it, I know myself now."), it can be projected onto the real body of water surrounding the LCD image of Narcissus. Also, Ovid's words, which can serve as admonitions to the audience, can be projected: "what you seek is nowhere. The vision is only shadow, only reflection, lacking any substance. It comes with you, it stays with you, it goes away with you, if you can go away." When he weeps out of frustration, tear drops can cause ripples in the actual water, and when he dies and is replaced by the narcissus flower, this flower can appear in the actual body of water (dropped in by a puppet master, perhaps; figuring out how to take care of these details should be good fun).*

*The relevance of this story to today (self image, our unhealthy obsession with our selves, what we eat, drive, wear, the people we are seen with) can be factored into this story somehow. Unhealthy because like Narcissus, we sometimes focus on these things so much that we leave the core of our being to atrophy. It does not have to be the story of Narcissus but the main idea is to PROJECT A STORY ON AN LCD SCREEN ONTO A BODY OF WATER, AND HAVE THAT BODY OF WATER PLAY A VITAL ROLE IN THE STORY AND IN THE TELLING OF THE STORY.*

*Water music can be played in the background, eg a panpipes tune or water echoes, seeing that Echo played a pivotal role in the myth.*

*This project ties into a fellow classmate's idea of a screen which shows a real time recording of the user standing in front of what seems like a mirror but is not one because of the delay that is introduced. Maybe in addition to delay, a gradual distortion can also be introduced (eg if you have ever looked at your reflection on the convex side of a spoon, then you know what I mean), to see the viewer's reaction as he realizes that this is not a reflection of him/her at all. Thus the viewer will become fascinated by this image of himself, the same way that Narcissus was, but perhaps for a*

*different reason this time. I am excited to see what the end result of this project may be.”*



**Figure 3.1: Initial SenSpace prototype**

### ***3.2 Development***

The idea in 3.1 gradually developed into a thesis topic. Besides building the environment, it was necessary to make it do *something*, to make it serve a research purpose. According to a research journal entry dated August 27, 2006, one of the early ideas for the thesis was to “explore the way information is presented, and how it affects user response, understanding, and retention” (Otitoju, 2006). The proposed process was to study different groups of users who had no prior knowledge of the myth of Narcissus. The first group would be exposed to the myth in form of a text they would read; the second group would watch a movie on the myth, and the third group would be exposed to the story through the environment that embedded the myth within itself. The hypothesis was that experiencing the myth as opposed to reading or watching it, would lead to greater

understanding and evoke deeper response to, and retention of, the subject matter. This hypothesis is supported by Klemmer et al. (2006), who state that “thought (mind) and action (body) are deeply integrated and...co-produce learning and reasoning.” As early as August 2006, the prominent elements of the work had been identified to be water, mirrors, narcissus flower, droplets, stars, disturbance in water, text on an organic surface (this idea was influenced by XFR), birds chirping, leaves, bare feet, emulation of drowning (a different account of Narcissus has it that Narcissus drowned in an attempt to meet with his reflection. However, Ovid’s account was eventually used, and this states that Narcissus did not drown, but died by the river and turned into a Narcissus flower or daffodil). Looking back, the author cannot understand the rationale that led to the inclusion of stars and bare feet in the list.

This idea was discarded because

1. Effectively controlling for users’ prior knowledge, innate retention rate, and other factors would be difficult. Failing to control for these would result in unreliable outcomes.
2. The area of retention and learning, and how we do it best, has been studied for decades by psychologists. As a computer scientist, it would be more viable to study something narrower, and which is contributing to the body of knowledge within my field, not reinventing the wheel within another.
3. The idea of allowing the user to deduce her own meaning within a space became more appealing than the idea of trying by all means to let the user “get” the intended story within a space.
4. Point #3 arose through a discussion with Professor Steve Harrison on the difference between the artist’s approach to a work and a designer’s. The idea to allow the user deduce her own meaning was primarily influenced by the paper, *Staying Open to Interpretation: Engaging Multiple Meanings in Design and Evaluation* written by Phoebe Sengers and Bill Gaver (2006).

### **3.3 Development of ideas at the lower level**

Implementation and prototyping of ideas led to an understanding of what was practical, and what wasn't. Around September 13, 2006, it was decided that the sound should be obscured by narrating the myth of Narcissus in a different language. A research journal entry from that date reads,

*“It would be interesting to have Ovid’s Narcissus being read in another language. Languages I have access to (know people who can speak them) include French, Spanish, Italian. I favor Italian. I can find the Italian text version of Narcissus, I am sure.*

*“The effect I hope this will have is that the user will not focus so much on the words he hears as in the manner in which they are delivered. So they may not even know that it is the myth of Narcissus that they are experiencing, except if they can pick out ‘Narcissus’ from the muddle of Italian they hear.*

*“Sound is powerful. So much about it can convey a message: not merely language, but also tone, pitch, inflection. I feel like some background sound (a humming noise? Water?) may also be in place in the background. But we will see how things go. Will the sound be echoed? Will it wither like Echo’s sound did in the story?”*

Propositions were also made for user position and pose within the environment. By this point, it had been established that the work would take the form of a computer-based art installation. Thus users may observe things, as opposed to interacting with them. The user’s stance while observing the installation, inspired the following research journal entry.

*“User Position*

*User can stand, sit, or kneel.*

*I do not favor standing because it is too much like a regular museum [or gallery] experience, where you stand and view artworks. I feel standing distances the user/viewer from the work. Dane [Webster, committee*

*member] does not favor standing because he feels that the user can walk away at any time.*

*“I do not favor sitting because it is so associated with spectator sports: watching a movie or sports on television; sitting in a cinema. It is as if the medium is saying, ‘get comfortable. Let me entertain you.’ Dane does not favor sitting because then, the type of seat would be an issue to be resolved. Great point: you do not want to ‘take away’ from the environment by introducing an incongruous element, like a plush modern sofa, into this classical setting.*

*“I favor kneeling because at Catholic Masses, some of the most serene and powerful moments occur while the congregation is kneeling. Dane agrees that kneeling has a quasi-religious feel to it. He also thinks that kneeling or sitting evoke a good type of discomfort in the user: she is constrained to a place and cannot easily leave.”*



**Figure 3.2: Prototype of SenSpace, done in Maya**

Here, it is good to note that although the prototype (Figure 3.2) included a kneeler to create the affordance of kneeling, this idea was later discarded. Interestingly enough, when users realized that the water-holder did not just hold a mirror but also contained water, they often ended up kneeling, to play with the water (Figure 3.3). The playful mood reported by these users was antithetical to the serenity of kneeling at Mass; however kneeling likely played a role in the feeling of intimacy with the environment that was not recorded by participants who stood all through the viewing.

## Chapter 4

### The Body of Work

To help us study how naïve users derive their own understanding of an ambiguous work, we built an art installation called SenSpace. SenSpace uses visuals, sounds, and haptics to convey an environment and scenario similar to that in which Narcissus may have found himself. We also provided in the environment, cues that may help the user to pick up on the main themes of the story: reflection, and a preoccupation with self. Other themes such as echo, the cycle of life, and change were embedded along with the two aforementioned themes.



**Figure 4.1: A user in the final SenSpace environment**

## **4.1 Sound**

In his book, *The Design of Everyday Things*, Norman points out the importance of sound in communication. He does this perhaps most eloquently by quoting the words of Gaver, who points out that real, natural sound is as essential as visual information, because sound tells us about things we cannot see, and it does so while our eyes are occupied elsewhere (p. 103). This statement describes precisely, the role of the steady stream sound in SenSpace. While the video suggests to the user that she is in a forest setting, with trees, and light that fades from day into night, the sound of the flowing stream completes this setting, even though an actual stream of water is not seen. Perhaps the stream is behind the user, and thus out of her field of view. Indeed, this is suggested, as the audio came from behind the user, in the opposite direction from the visual elements in the space. There was also another sound within the space: the sound of the narrator reading the myth of Narcissus. This is explained in more detail in the following section. In summary, sound in SenSpace was created from two sources:

1. A recoding of voices reading Ovid's account of Echo and Narcissus, in Italian
2. A recording of a steady stream

### **4.1.1 The Myth of Narcissus**

We presented the user with an obscured version of the myth of Narcissus. The myth was presented in Italian, as opposed to English, which is the spoken language of the USA, where the study was conducted. The goal of this obscurity was to shift the participant's focus from what was being said to *how* it was being said. To this effect, we simulated, through the voice of the reader, a person at different stages of his life. This is illustrated in Table 4.1. The table also shows the Italian version of the myth as narrated, as well as the corresponding English translations, and notes on the author's interpretation of the myth. The myth was edited to keep the installation running-time down to four minutes.

The reader's voice ages through the story, to convey the cycle of life from youth to death, from ignorance to realization, which many people undergo. Other allusions to the myth of Narcissus include a reverberation effect in the words spoken by Echo. The reader's voice

also often conveyed the emotion in the story, notably the sense of realization that Narcissus felt, at the climax of the myth.

<p><b>Age 11</b></p> <p>Di un anno aveva ormai superato i quindici il figlio di Cefiso e poteva sembrare tanto un fanciullo che un giovane: più di un giovane, più di una fanciulla lo desiderava, ma in quella tenera bellezza v'era una superbia così ingrata, che nessun giovane, nessuna fanciulla mai lo toccò. Mentre spaventava i cervi per spingerli dentro le reti, lo vide quella ninfa canora, che non sa tacere se parli, ma nemmeno sa parlare per prima: Eco che ripete i suoni.</p>	<p><b>Age 11</b></p> <p>For Narcissus had reached his sixteenth year and might seem either boy or man. Many youths and many maidens sought his love; but in that slender form was pride so cold that no youth, no maiden touched his heart. Once as he was driving the frightened deer into his nets, a certain nymph of strange speech beheld him, resounding Echo, who could neither hold her peace when others spoke, nor yet begin to speak till others had addressed her.</p>
<p><u>Notes</u></p> <p>The beginning is read by an eleven year-old boy, with a vibrant and high-pitched voice. This represents the beginning of the story, whence Narcissus was young; handsome, yet still innocent. He does not know what tragedy lies ahead of him, and in what difficult way he would come to learn the lesson which is identified by Freud as extreme love of the self.</p>	
<p><b>Age 16</b></p> <p>Per caso il fanciullo, separatosi dai suoi fedeli compagni, aveva urlato: «C'è qualcuno?» ed Eco: «Qualcuno» risponde. Stupito, lui cerca con gli occhi in tutti i luoghi, grida a gran voce: «Vieni!»; e lei chiama chi l'ha chiamata. Intorno si guarda, ma non mostrandosi</p>	<p><b>Age 16</b></p> <p>By chance the boy, separated from his faithful companions, had cried: "Is anyone here?" and "Here!" cried Echo back. Amazed, he looks around in all directions and with loud voice cries "Come!"; and "Come!" she calls him calling. He looks behind him and, seeing no one coming,</p>

<p>nessuno: «Perché», chiede, «mi sfuggi?», e quante parole dice altrettante ne ottiene in risposta.</p> <p>Insiste e, ingannato dal rimbalzare della voce: «Qui riuniamoci!» esclama, ed Eco che a nessun invito mai risponderrebbe più volentieri: «Uniamoci!» ripete.</p> <p>E decisa a far quel che dice, uscendo dal bosco, gli viene incontro per gettargli, come sogna, le braccia al collo.</p> <p>Lui fugge e fuggendo: «Togli queste mani, non abbracciarmi!» grida. «Possa piuttosto morire che darmi a te!».</p> <p>E lei nient'altro risponde che: «Darmi a te!&gt;&gt;</p>	<p>calls again: "Why do you run from me?" and hears in answer his own words again. He stands still, deceived by the answering voice, and "Here let us meet," he cries. Echo, never to answer other sound more gladly, cries: "Let us meet"; and to help her own words she comes forth from the woods that she may throw her arms around the neck she longs to clasp. But he flees at her approach and fleeing, says: "Hands off! Embrace me not. May I die before I give you power o'er me!" "I give you power o'er me!" she says, and nothing more.</p>
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Notes

The next stage of the story, Narcissus' encounter with Echo, is read by a sixteen year-old boy. This is the age Narcissus was, when our story begins. Ovid describes the sixteen year-old Narcissus thus: "in that slender form was pride so cold that no youth, no maiden touched his heart." Echo was another nymph, who repeated ("echoed") the words of others, but could not initiate her own speech. As we would see, the gods in Greek mythology were very much into placing curses on the mortals of the earth, often, I have assumed, for the sheer amusement of it. I imagine that Echo's peculiar situation was a result of one of such curses.

Proud Narcissus spurned the advances of Echo, leading to the curse that we would see in the next stage of the story, as read by a man in his thirties.

<p><b>Age 30</b></p> <p>Così di lei, così d'altre ninfe nate in mezzo alle onde o sui monti s'era beffato Narciso, come prima d'una folla di giovani.</p>	<p><b>Age 30</b></p> <p>Thus had Narcissus mocked her, thus had he mocked other nymphs of the waves or mountains; thus had he mocked the</p>
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<p>Finché una vittima del suo disprezzo non levò al cielo le mani: «Che possa innamorarsi anche lui e non possedere chi ama!».</p> <p>Così disse, e la dea di Ramnunte assenti a quella giusta preghiera.</p> <p>C'era una fonte limpida, dalle acque argentee e trasparenti, che mai pastori, caprette portate al pascolo sui monti o altro bestiame avevano toccato, che nessun uccello, fiera o ramo staccatosi da un albero aveva intorbidita.</p> <p>Qui il ragazzo, venne a sdraiarsi, attratto dalla bellezza del posto e dalla fonte, ma, rapito nel porsi a bere dall'immagine che vede riflessa, s'innamora d'una chimera: corpo crede ciò che solo è ombra.</p>	<p>companies of men. At last one of these scorned youth, lifting up his hands to heaven, prayed: "So may he himself love, and not gain the thing he loves!" The goddess, Nemesis, heard his righteous prayer. There was a clear pool with silvery bright water, to which no shepherds ever came, or she-goats feeding on the mountain-side, or any other cattle; whose smooth surface neither bird nor beast nor falling bough ever ruffled. Here the youth lies down, attracted thither by the appearance of the place and by the spring. While he drinks he is smitten by the sight of the beautiful form he sees. He loves an unsubstantial hope and thinks that substance which is only shadow.</p>
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Notes

Narcissus was accustomed to getting away with his mean behavior towards his suitors. However, Nemesis was about to catch up with him, literally. Ovid tells us that one of the youth he had earlier scorned, decided after the Echo-Narcissus encounter, that Narcissus had done enough harm to the hearts of his suitors. Thus the scorned youth prayed to the goddess Nemesis: "So may he himself love, and not gain the thing he loves!" Nemesis heard his prayer. Narcissus, still fleeing the nymph that had voice but no physical form, stopped by a pool of water to quench his thirst. This drink would change his life forever.

<p><b>Age 50</b></p> <p>Disteso a terra, contempla quelle due stelle che sono i suoi occhi, i capelli degni di Bacco, degni persino di Apollo, e le guance lisce, il collo d'avorio, la bellezza della</p>	<p><b>Age 50</b></p> <p>Prone on the ground, he gazes at his eyes, twin stars, and his locks, worthy of Bacchus, worthy of Apollo; on his smooth cheeks, his ivory neck, the glorious beauty</p>
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<p>bocca, il rosa soffuso sul niveo candore, e tutto quanto ammira è ciò che rende lui meraviglioso.</p> <p>Quante volte lancia inutili baci alla finzione della fonte!</p> <p>Quella che scorgi non è che il fantasma di una figura riflessa: nulla ha di suo; con te venne e con te rimane; con te se ne andrebbe, se ad andartene tu riuscissi.</p> <p>Ma né il bisogno di cibo o il bisogno di riposo riescono a staccarlo di lì.</p> <p>Ogni volta che accosto i miei baci allo specchio d'acqua, verso di me ogni volta si protende offrendomi la bocca.</p> <p>Diresti che si può toccare; un nulla, sì, si oppone al nostro amore.</p> <p>Chiunque tu sia, qui vieni! Perché m'illudi, fanciullo senza uguali?</p>	<p>of his face, the blush mingled with snowy white: all things, in short he admires for which he is himself admired. How often did he offer vain kisses on the elusive pool? That which you behold is but the shadow of a reflected form and has no substance of its own. With you it comes, with you it stays, and it will go with you--if you can go. No thought of food or rest can draw him from the spot.</p> <p>For, often as I stretch my lips towards the lucent wave, so often with upturned face he strives to lift his lips to mine. You would think he could be touched--so small a thing it is that separates our loving hearts.</p> <p>Whoever you are, come forth higher! Why, O peerless youth, do you elude me?</p>
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Notes

The reader's voice advances in years, to that of a man in his fifties. This is befitting, because at this point in the myth, Narcissus had lived out a greater portion of his life. He bent down to drink...and fell in love with his reflection in the pool of water. "Why, O peerless youth, do you elude me?" he cried, echoing the frustration that his past suitors must have felt. In a very poetic passage, he notices this water-being's eyes (twin stars), hair (like that of the gods Bacchus and Apollo), the "glorious beauty" of his face, and other qualities of pulchritude that he possesses. It is important to note that this portion of the story really illustrates Narcissus' extreme focus on himself. This obsessive love, which continues to exhibit itself in contemporary world, was termed as the Narcissistic Personality Disorder by Heinz Kohut, in 1971. All this while, though, Narcissus does not realize that the being on the other side of "this small thing that separates [their] loving hearts," is his own reflection. He thinks he has finally met another being worthy of his

<p>love. He neither eats nor drinks, but spends endless days trying to woo his elusive reflection to come and meet him.</p>	
<p><b>Age 75</b>  Io, sono io! l'ho capito, l'immagine mia non m'inganna più! Per me stesso brucio d'amore, accendo e subisco la fiamma! Poi reclinò il suo capo stanco sull'erba verde e la morte chiuse quegli occhi incantati sulle fattezze del loro padrone. E anche quando fu accolto negli Inferi, mai smise di contemplarsi nelle acque dello Stige.  Già approntavano il rogo, il corpo era scomparso; al posto suo scorsero un fiore, giallo nel mezzo e tutto circondato di petali bianchi.</p>	<p><b>Age 75</b>  Oh, I am he! I have felt it, I know now my own image. I burn with love of my own self; I both kindle the flames and suffer them.  He drooped his weary head on the green grass and death sealed the eyes that marvelled at their master's beauty. And even when he had been received into the infernal abodes, he kept on gazing on his image in the Stygian pool. And now they were preparing the funeral pile, but his body was nowhere to be found. In place of his body they find a flower, its yellow center girt with white petals.</p>
<p><u>Notes</u>  The final stage of the story, the stage of death, is conveyed by the hoarse, barely intelligible voice of a seventy-five year-old man. Here, Narcissus exclaims, “Oh, I am he! I burn with love of my own self.” It is too late to pick up his life from where he left off, due to the atrophy of mind and body that occurred during his frustrating encounter with his reflection. Now, he just wants to die, which he does. However, so locked in this state of self-love is he, that Ovid records, “Even when he had been received into the infernal abodes, he kept on gazing on his image in the Stygian pool.” Even in death, Narcissus could not tear his eyes off his image. The Stygian pool may refer to the river Styx, recurrent in Greek Mythology as the river that formed the boundary between the Earth and the Underworld.</p>	

**Table 4.1: The Myth of Narcissus as narrated, and with translations and notes.**

### ***4.1.2 Ambient Stream Sound***

The stream sound track was included to further create an immersive nature environment for the participant, and to drown the readers' voices. We wanted the participant to create in her mind, a convincing nature environment. This necessitated the inclusion of a sound that would corroborate the nature scene that we were conveying to the user, as explained in Section 4.2 below. We used the river sound to bring the readers' voices to a level where they were audible without being comprehensible. The reason was that we wanted the participant to focus, not on deciphering what was being said, but on observing how it was being said (aging of the voice with time, change in tone at different points in the story, reverberation of Echo's voice).



**Figure 4.2: Playing with the water (right image) causes ripples in the projected image of the user (left).**

### ***4.2 Display***

For the display, we used two adjacent walls of the room. The displays converged at the vertical edge between them. To the left, the participant saw her own image. Disturbances to the pool caused ripples which distorted the image of the participant. The wall screen space was about 4 feet in height by 3 feet in width.

On the right wall, the participant saw a pre-recorded video of a morphing forest setting. This video covered a 4-foot by 4-foot wall area.

#### 4.2.1 Projection, Reflection, Distortion

The wall display covered a total area of about 4 feet by 7 feet on two adjacent white walls. The walls converged at a right-angle. The participant's image on the left was fed from a standing camera to a projector, in real-time. The projector pointed downwards to a mirror-lined pool of water held by a 17" X 11.5" X 1" tray. This caused the **projected** image to be **reflected** onto the wall, in a size directly proportional to the distance between the mirror and the reflecting surface. The image was grainy. Depending on the amount of light entering the camera, the image was also sometimes indecipherable. Light entering the camera was primarily determined by the amount of light coming from the video on the adjacent wall. The transformations in the video often involved changes in color and saturation. These all fed into the camera, and in turn affected the clearness of the participant's image on the wall.

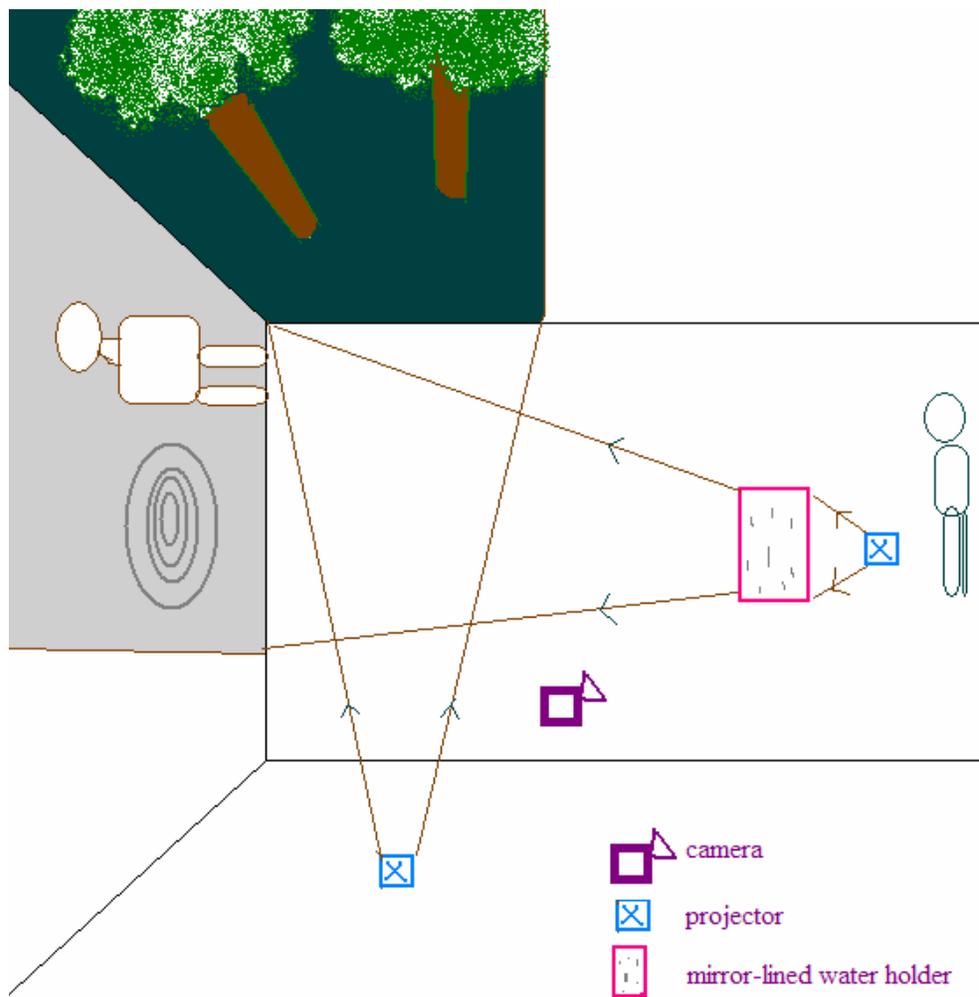
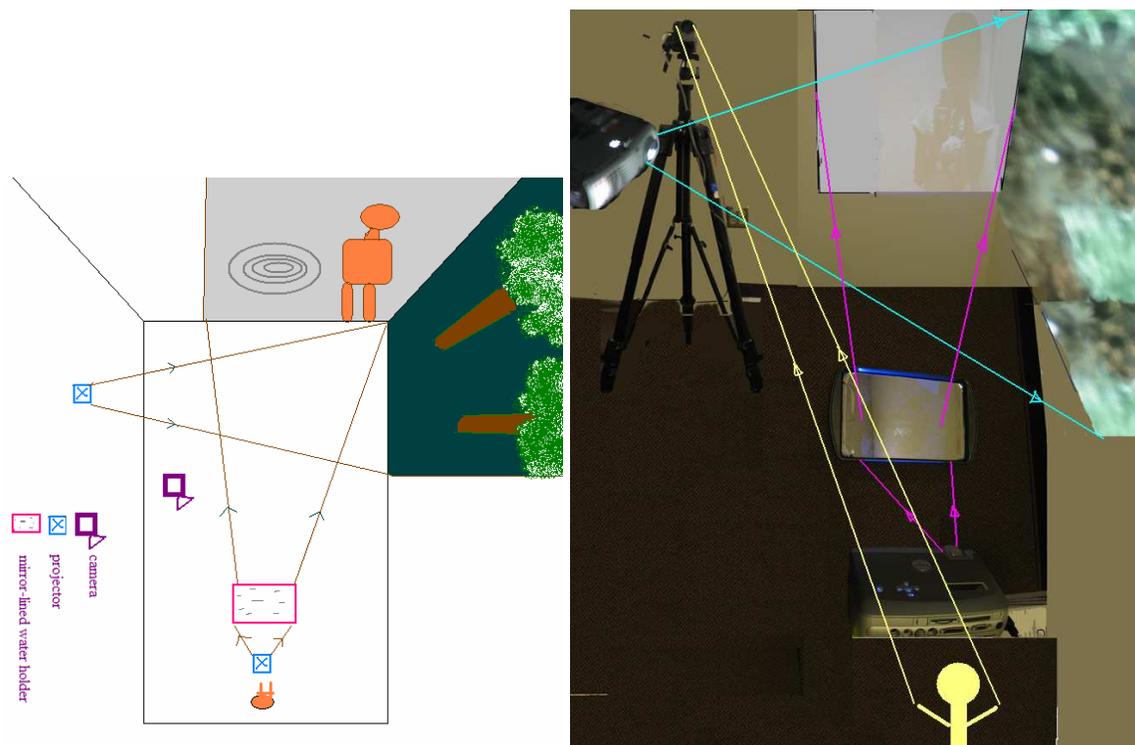


Figure 4.3: SenSpace set-up (aerial diagram)



**Figure 4.4 (a) and (b): Senspace Set-up diagram and composite photo, showing projections and reflections. Touching the water in the mirror-lined tray would result in distortion of the user's image on the wall.**

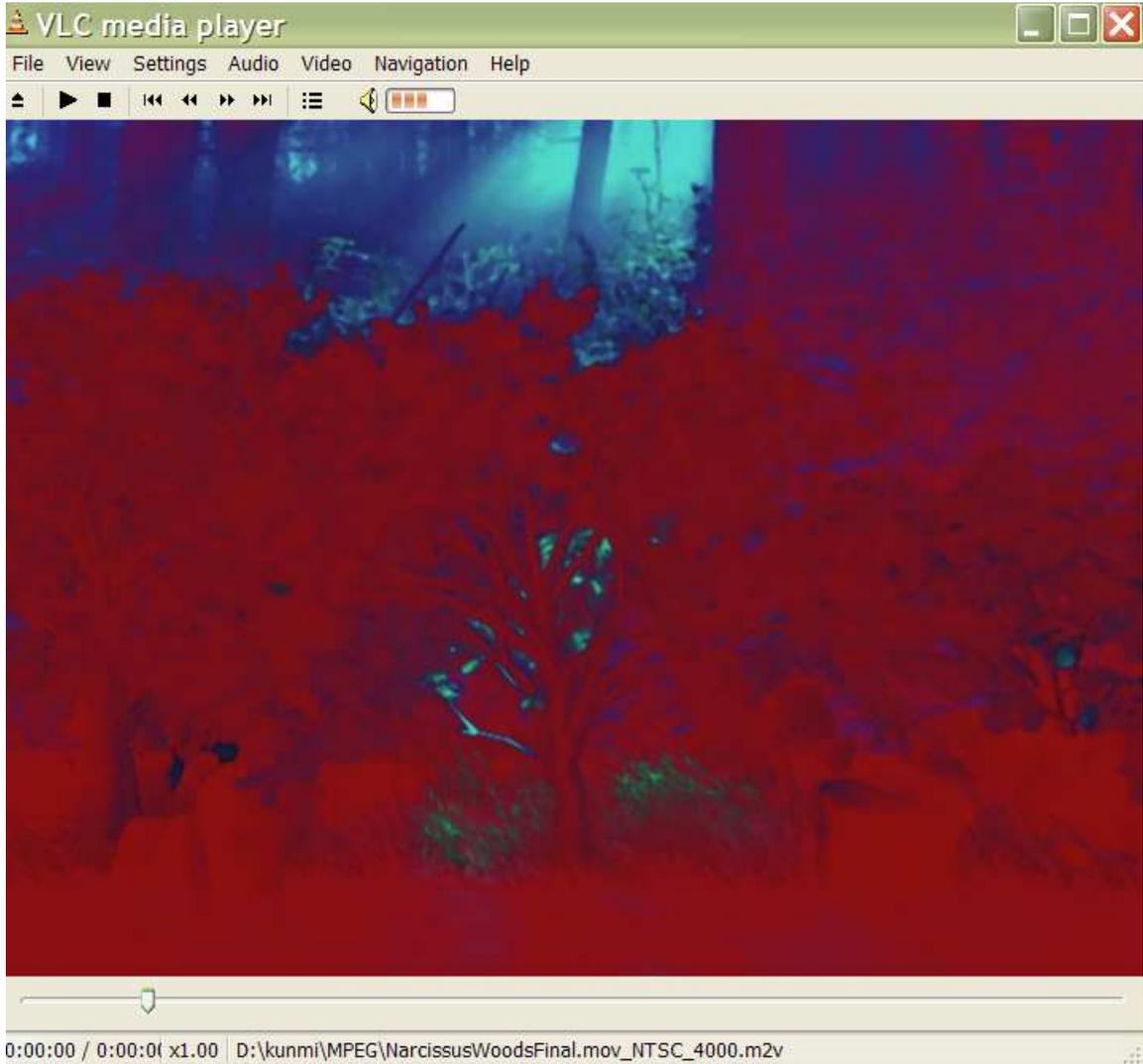
We mentioned earlier that the participant's image was reflected from a mirror-lined *pool of water*. The purpose of the water was to create ripples that would appear on the image. Disturbances to the pool caused ripples which **distorted** the wall-image of the participant. For Narcissus, these ripples may have been formed when he tried to kiss or reach out to his reflection, or when his tears dropped into the pool, or by the debris that likely dropped into the pool in the duration that he was by it. It was necessary for us to convey the idea of water as a reflecting surface to the participant. Merely reflecting her image from a mirror would not have conveyed this idea adequately. Therefore, we placed the mirror in a pool of water, so that the sight of the ripples would trigger an association with water, in the mind of the participant. This reinforces the idea of water that was simultaneously being suggested by the sound of the flowing stream, as explained in Section 4.1.2.



**Figure 4.5: Picture of forest setting which was used to create After-Effects video.**

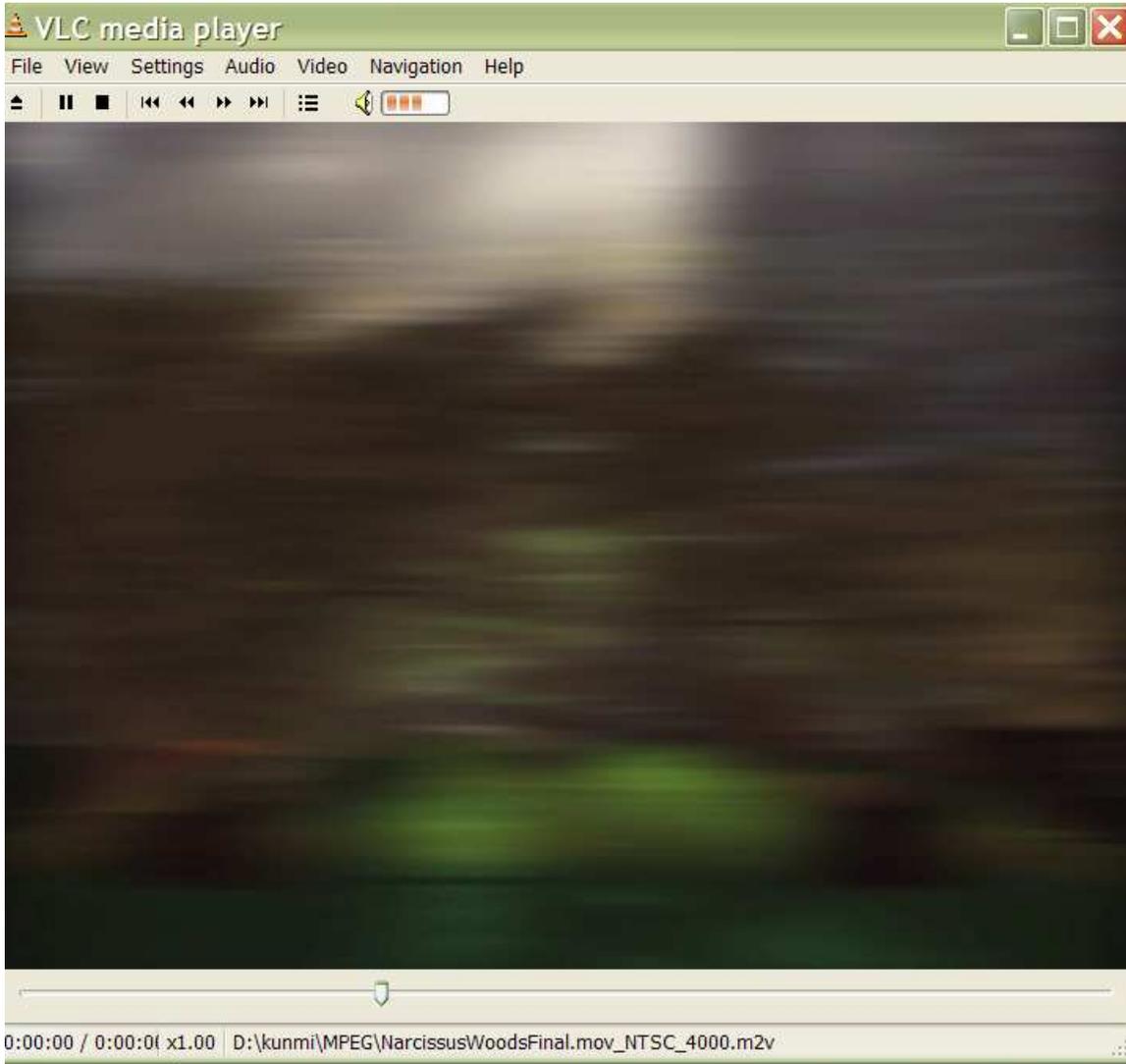
The video projected on the wall lasted for four-and-a-half minutes. It portrayed the cycle of Narcissus' life, using an image of a forest scene (Figure 4.5). The forest scene was created in a three-dimensional virtual space, using Maya 3D software. Then a screen capture of it was modified in Adobe AfterEffects to achieve various distortions in the image. The designer's discretion was used to map effects to phases in Narcissus' life; the phases corresponded with the narration of the story in Italian. The phases are shown on the following pages.

At the beginning of the story, the entire image is saturated with red, to represent youth and a passion for life. The red gives way to purple, until the forest clearing is seen in its natural colors (lots of greens, with a bright ray of light hitting the clearing through the trees).



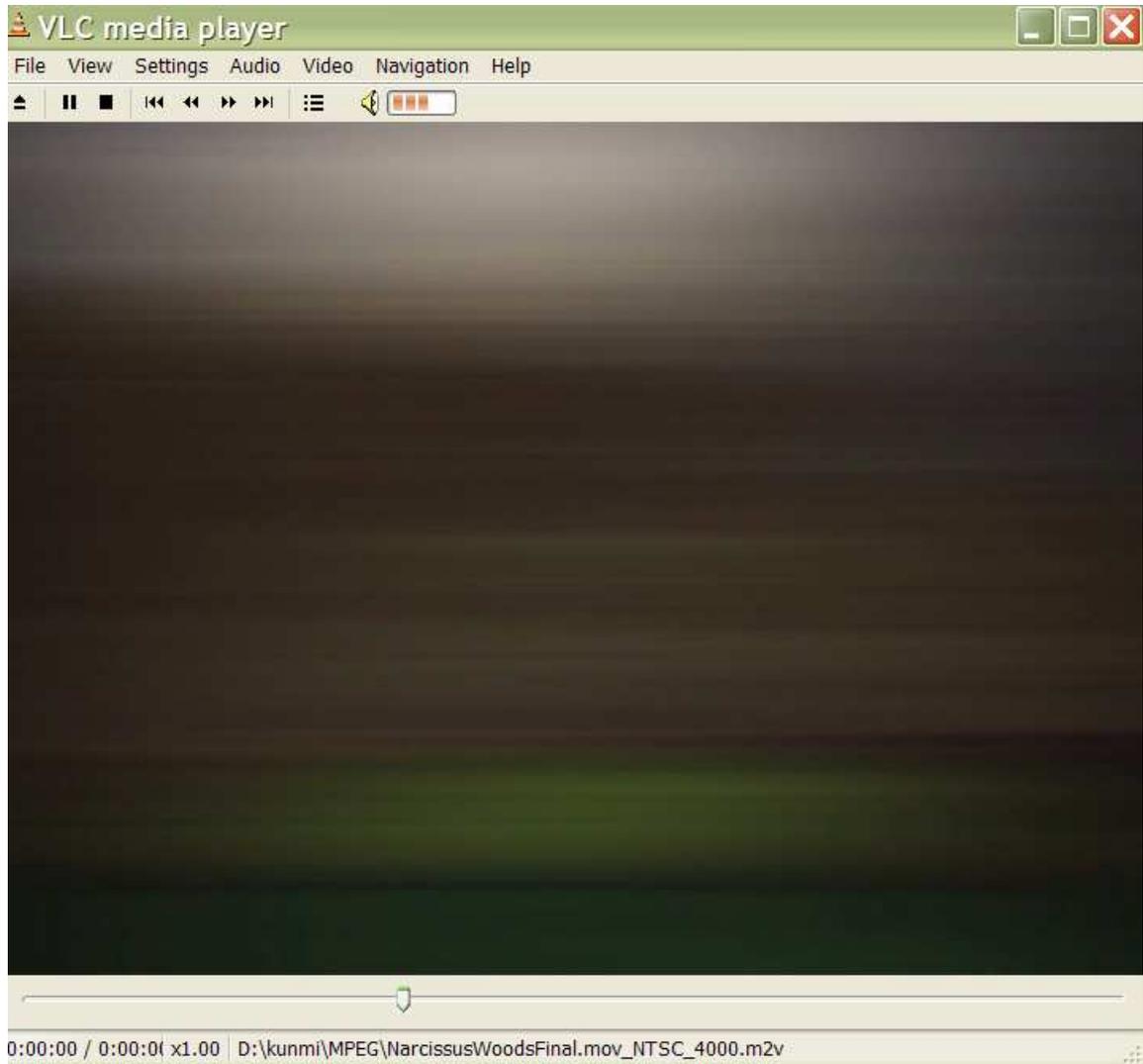
**Figure 4.6: In the beginning**

Narcissus hears the voice of Echo, and begins to flee from her. When you run, motion parallax (apparent shift of an object against a background caused by a change in observer position) causes a horizontal motion blur.



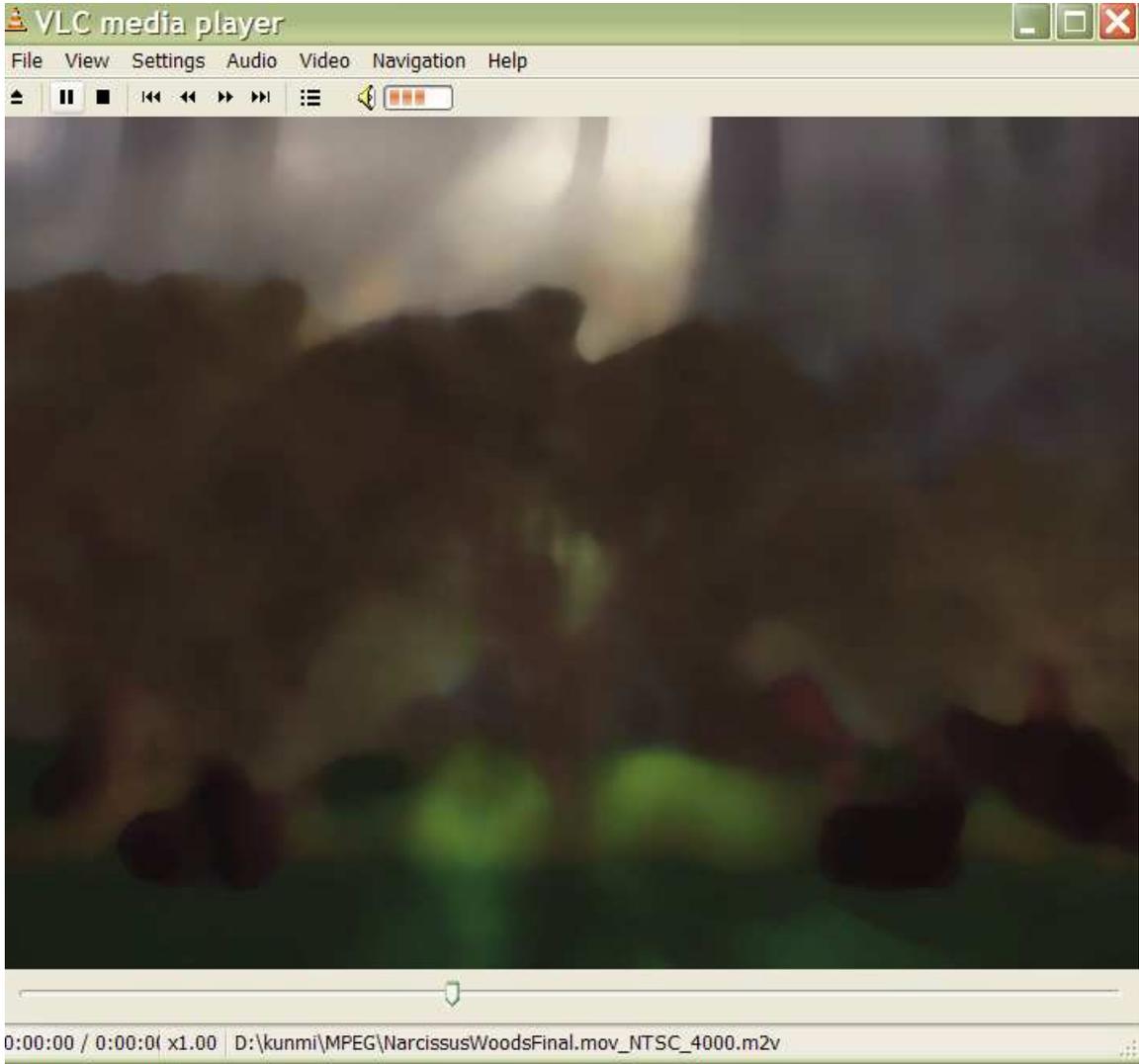
**Figure 4.7: Narcissus flees Echo**

This motion blur intensified with time to suggest an increase in Narcissus' speed, then slowly declined up to the point where he believed he was out of Echo's sight, and stopped running.



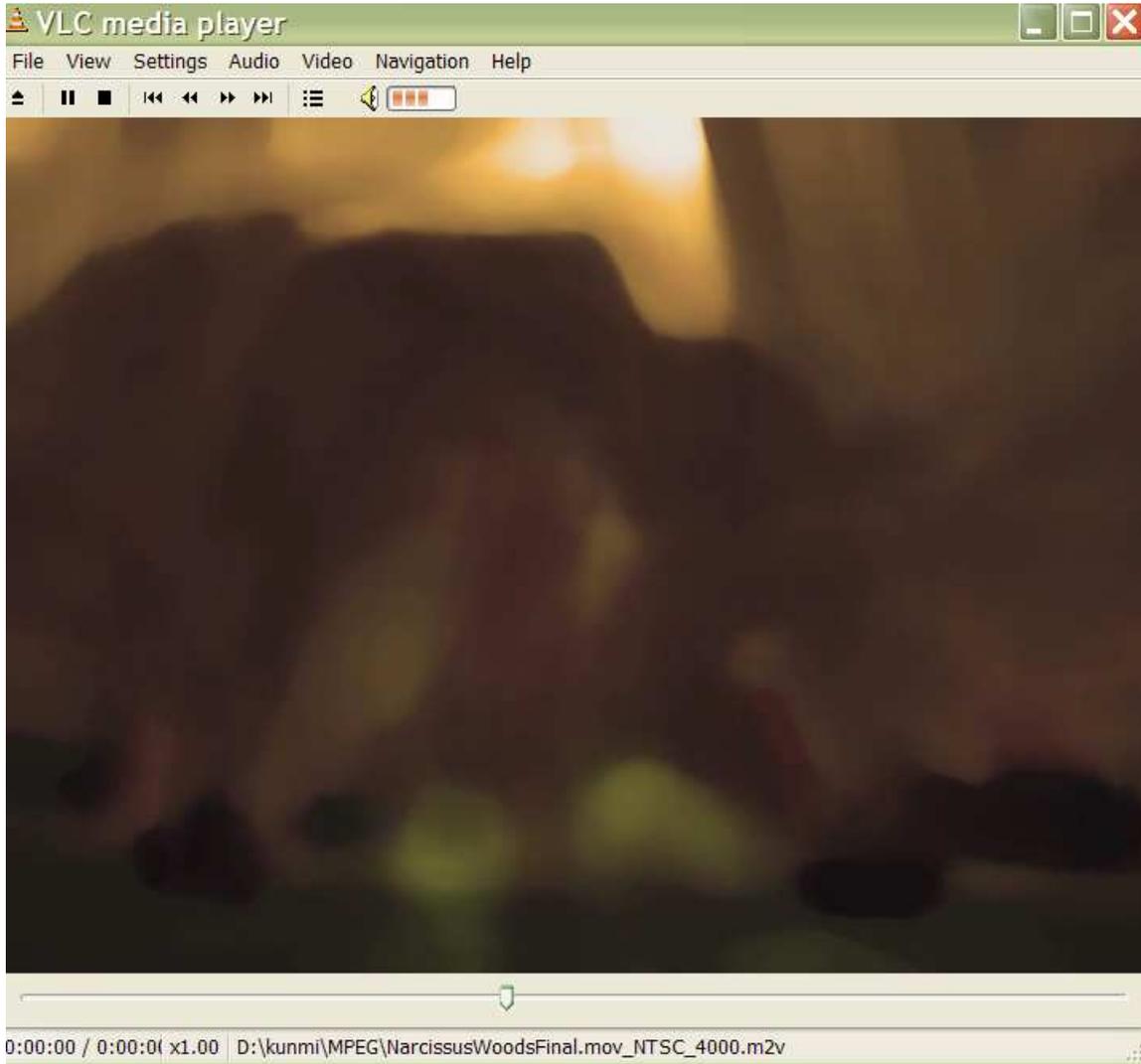
**Figure 4.8: Narcissus flees Echo, still**

We imagine that Narcissus became dizzy from all that running, so a dust and speckles effect is added, and the forest scene is one huge blur of colors.



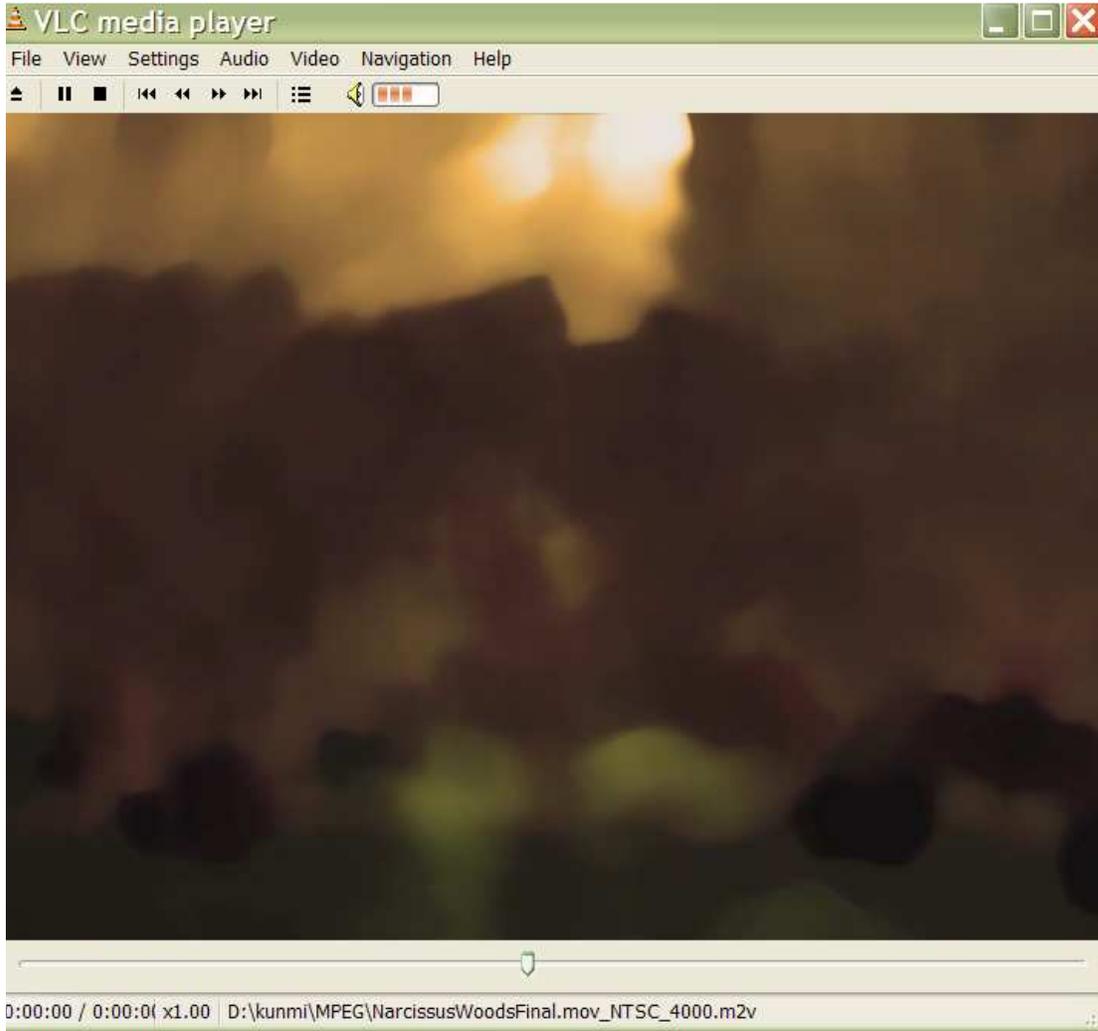
**Figure 4.9: Dizziness from running**

Around this time, Nemesis plants a curse on Narcissus at the request of a spurned youth. Things are not looking good for Narcissus. A turbulent effect is used to visually represent the way Narcissus' life becomes thrown off its axis at this point. The turbulence stops as Narcissus reaches a pool.



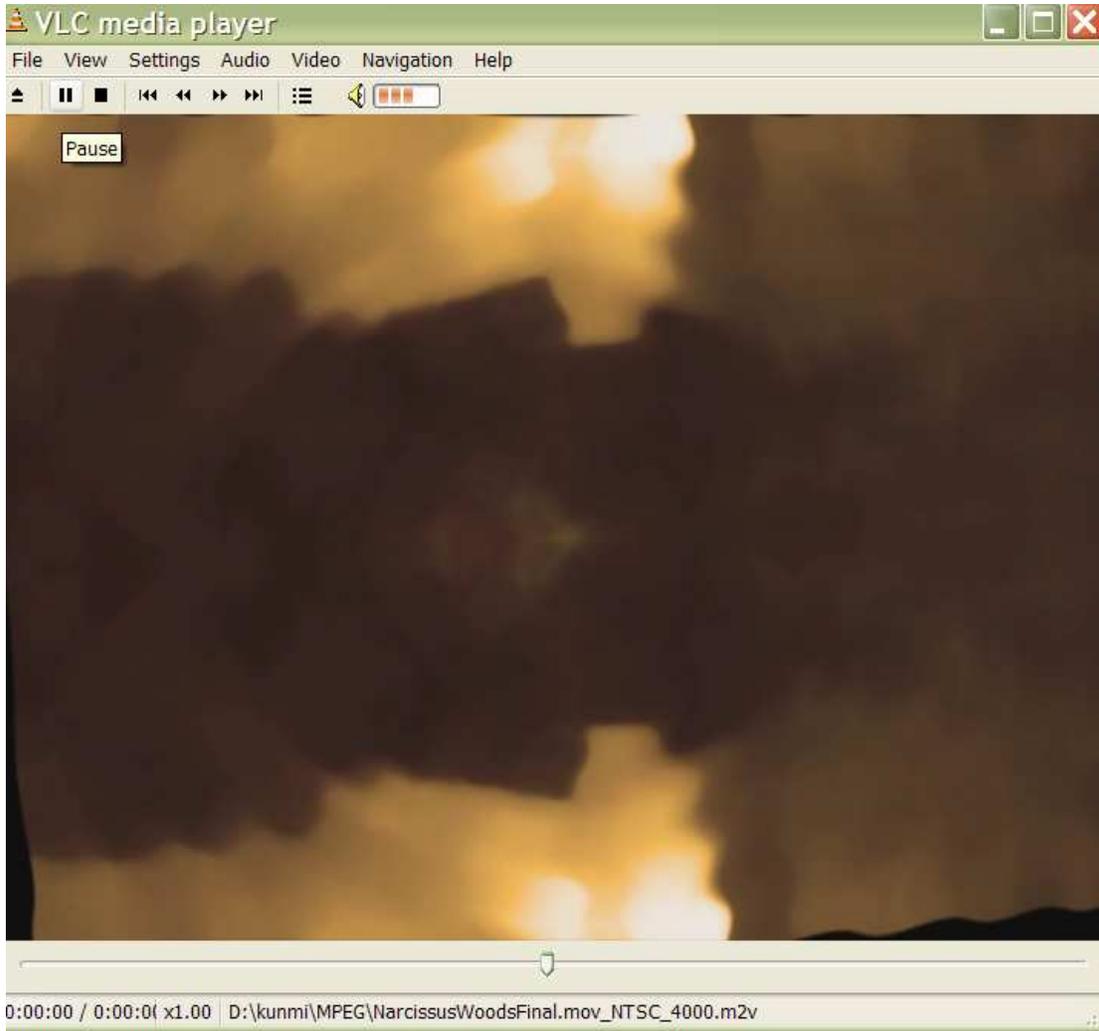
**Figure 4.10: A curse throws Narcissus' life off balance.**

The forest scene remains the same; it is still a big color blur, and in addition, it has ripples in it. Narcissus was so tired from fleeing Echo that his sweat dropped into the pool as he drank from it.



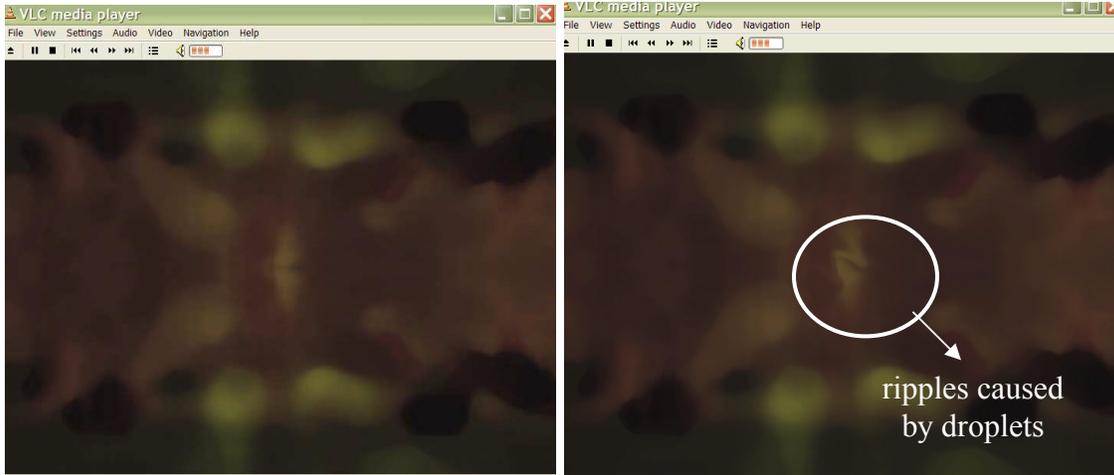
**Figure 4.11: droplets of sweat form ripples in the pool**

After quenching his thirst, he is faced with his own reflection in the pool. At this point, the blurry image of the forest begins to mirror itself, leading to a symmetric image. The light from the video becomes brighter, making the image of the participant even more visible in the left wall. This is a prelude to the point in the story when Narcissus admires in his reflection, all the things “for which he is himself admired.”



**Figure 4.12: The image turns symmetric to illustrate reflection.**

Droplets land in the mirror-image of the blurry forest, perhaps representing Narcissus' tears as he pleads with the beautiful creature beneath the thin separating film to "come forth higher."

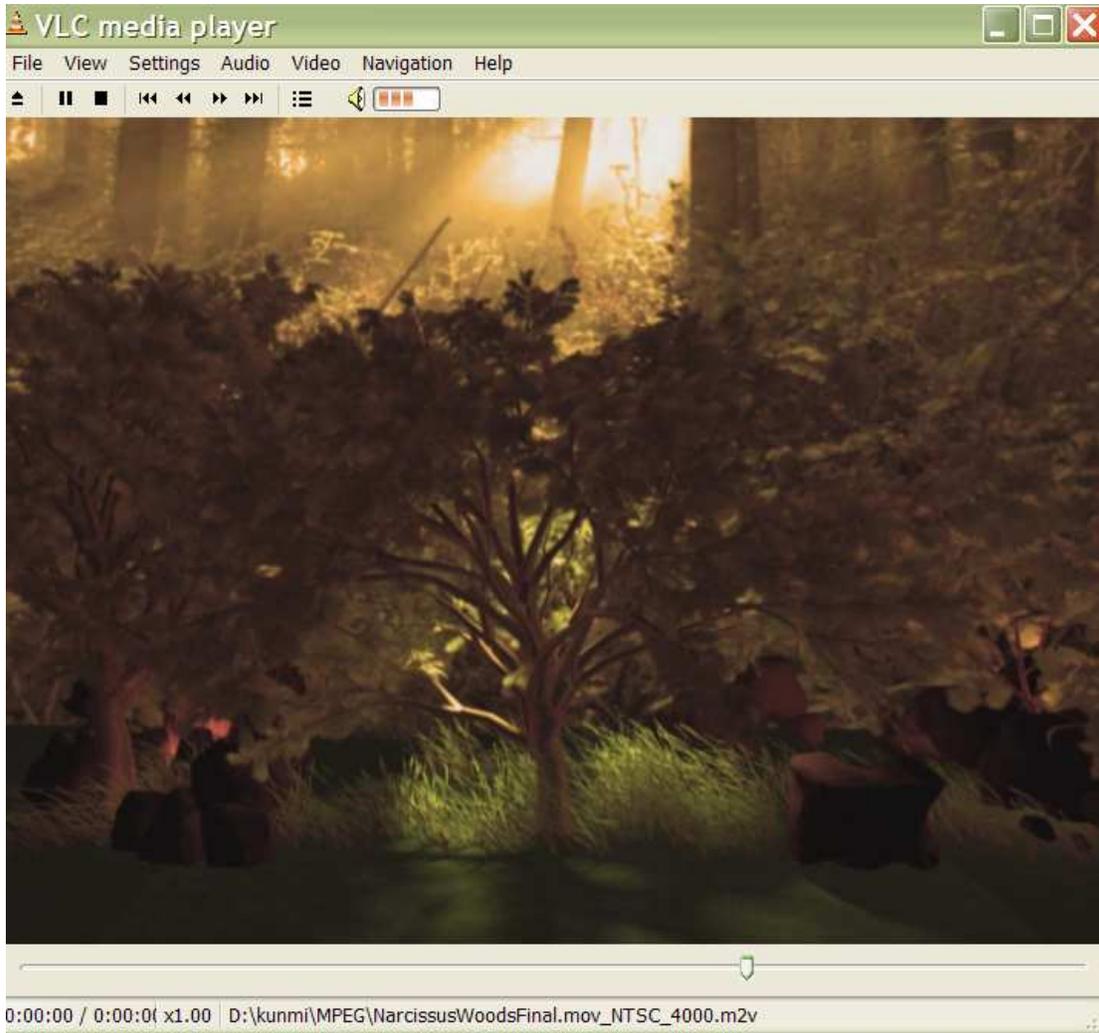


**Figure 4.13: Narcissus is confronted with his own reflection in the pool. He pleads tearfully for the 'being' to come forth higher and meet him.**



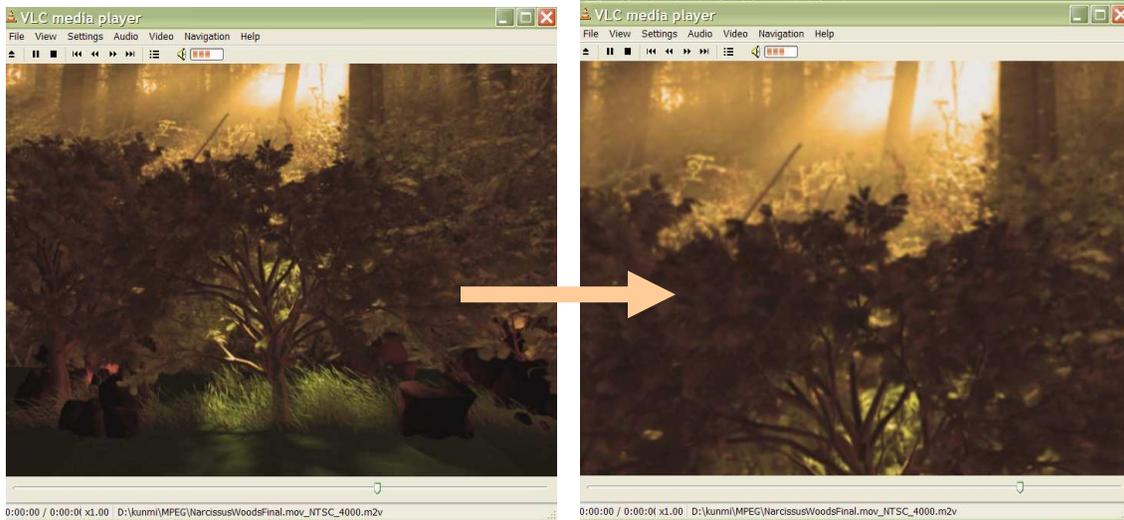
**Figure 4.14: A user in SenSpace**

Then the mirror image becomes a whole image again, and the blurriness suddenly fades away. The participant is faced with a clear image of a forest clearing, same as in the beginning. This is the moment of clarity, coinciding with the time in the voice recording when the reader exclaims, “Oh, I am he! I have felt it, I know now my own image. I burn with love of my own self; I both kindle the flames and suffer them.”



**Figure 4.15: Narcissus is hit by a moment of sudden clarity. He realizes that the ‘being’ is indeed him.**

The image begins to zoom in to the sky, suggesting that Narcissus' last moments are here.



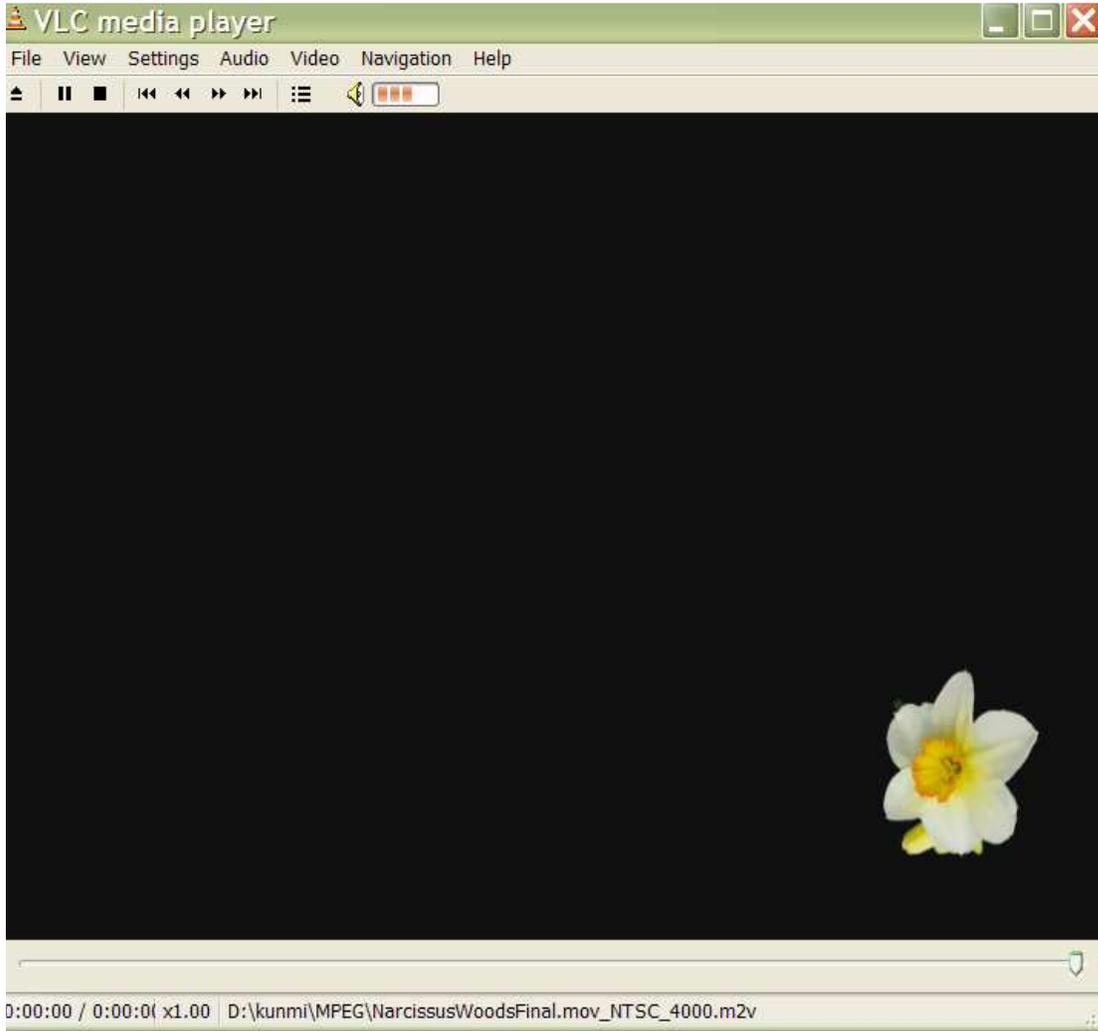
**Figure 4.16: The image zooms into the sky. Many civilizations believe that the supreme beings dwell in the sky. Zooming in on the sky symbolizes Narcissus looking up to the gods in his last moments.**

Although I have never experienced death, I imagine that people see the world in monochromes just before everything goes dark. So the sky changes hue from green to blue to purple to pink to red to orange, and then goes black, as Narcissus dies. This change in hues creates an interesting effect on the image of the participant on the adjacent wall.



**Figure 4.17: Narcissus sees things in monochromes before everything goes dark.**

The screen is black for a few seconds, while the old reader’s voice continues to tell of the extents of Narcissus’ post-death vanity, as seen by his continued obsession with his reflection, this time in the River Styx. A narcissus flower (daffodil) floats across the screen, in the concluding scene of the video.



**Figure 4.18: “In place of his body they find a flower, its yellow center girth with white petals” (Ovid).**

# Chapter 5

## User Study

### *5.1 Motivation*

Our user study was motivated by various goals. First, we wanted to explore the process by which users understand a work whose meaning and purpose are not immediately apparent.

We also wanted to aid the design of useful, if ambiguous systems. While some users dismiss an ambiguous work, others seek to understand and personalize it. Through our study of meaning-making and meaning-understanding, we wanted to discover ways to help more users do the latter.

Finally, we wanted to explore how users work *together* to understand a meaning.

### *5.2 Method*

For this process, we built an immersive, single-user multimedia environment, and named it SenSpace. SenSpace was used to convey the Greek myth of Narcissus to the user, through sights, sounds, and the general ambience. Although it can support more than one user, we designed it with one user in mind, to isolate a user's interpretation and keep it from being "contaminated" through communication with another user existing simultaneously within the space.

#### *5.2.1 Hardware and Software Used*

To build the environment, we used the following hardware: two Dell 1200MP DLP projectors, a tray containing water and lined at the bottom with a mirror, and a digital camera on a tripod.

Software consisted of a video with soundtrack, which we created for the purpose. The video was created using the following steps. First we created a 3-dimensional forest setting using Maya 8.0. This allowed for easy manipulation of the lighting and relative sizes of objects within the forest scene, until we were satisfied with the appearance. Maya also served as a prototyping tool for the entire SenSpace environment. Then we took an appropriate screenshot of the 3D environment. This screenshot was saved as a .TIFF image (Figure 4.5). Adobe AfterEffects filters were used to create different effects on the image, as explained in Section 4.2.1. For the soundtrack, we asked a friend from Sicily to obtain recordings of his younger cousins reading the Narcissus script in Table 4.1. We also recorded his voice for the three older readers' voices, directing him to make his voice sound progressively older for each section. However, since the connection to Narcissus would still not be obvious to the study participants (due to language obscurity), we did not want them to spend too much time trying to decipher what was being said. It was more important for them to get a sense for what was being said, through the tone of voice and age progression. We added the soundtrack of a stream, to tone down the narrators' voices a bit, while contributing to the feeling of immersion within a forest setting. We used Sonic Foundry Sound Forge 6.0 sound editing software to edit the voices of the narrators and the sound of the river.

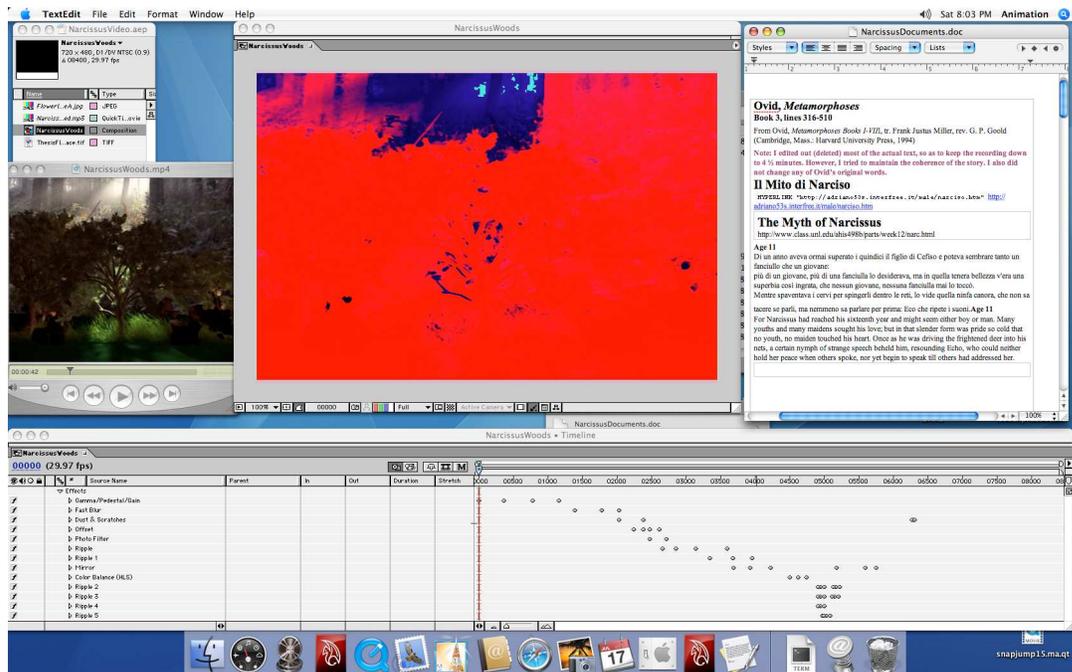


Figure 5.1: Adobe AfterEffects was used to add effects to the video sequence.

The camera served to capture the image of the user. This image was sent to a projector which pointed downwards, thus projecting the user's image onto a mirror-lined water tray. The mirror reflected the image onto the left wall (Figure 5.2). Disturbances in the water, which were created either by the user touching it or by water dripping from a strategically-placed flower prop, created ripples that were projected along with the user's image, onto the left wall. The second projector simultaneously projected the video of the morphing forest setting, and the narrative and stream sounds.

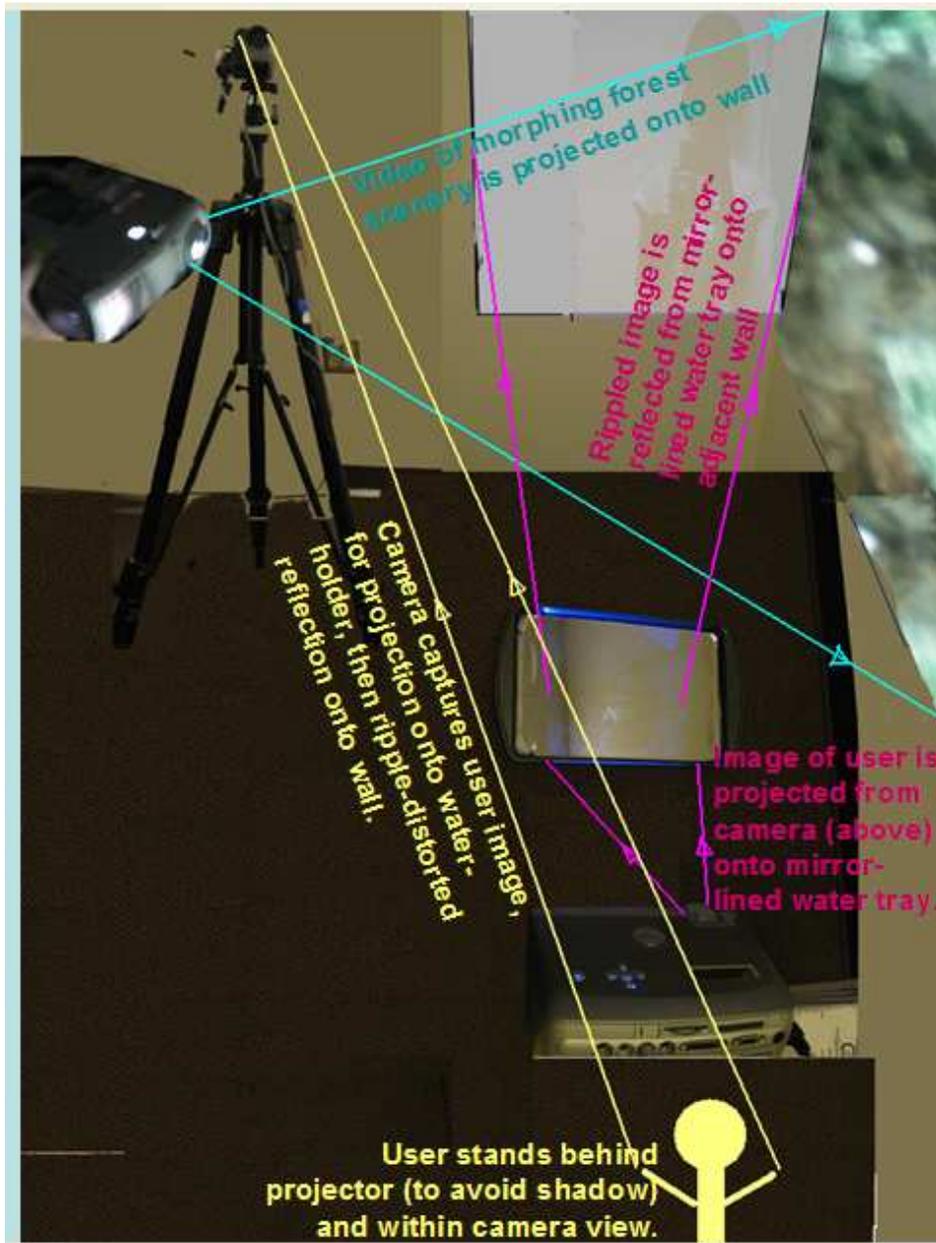


Figure 5.2: Experimental set-up

### 5.2.2 Experimental Design

Motivated by our goals, we designed a questionnaire that would help us to understand how the user made meaning of the environment. We divided our users into four groups:

<p><b>User group 1</b> consists of visitors who ARE NOT guided to a specific meaning for the piece, but are left to come up with their own. They also fill the questionnaire individually.</p>	<p><b>User group 2</b> consists of visitors who ARE told of the association between the environment and the Narcissus myth. They fill the questionnaire individually.</p>
<p><b>User group 3</b> consists of visitors who experience the environment separately, but fill the questionnaire jointly. They ARE NOT told of an association between the environment and narcissus myth.</p>	<p><b>User group 4</b> consists of visitors who experience the environment separately, but fill the questionnaire jointly. They ARE told of an association between the environment and narcissus myth.</p>

**Table 5.1: Users were placed in one of four groups for this experiment.**

We were interested in whether the discussion involved in filling the questionnaire jointly would noticeably enhance users’ meaning-making and meaning-understanding. We also wanted to study the importance of prompting the user with the story of Narcissus beforehand, and how that affected their ability to make sense of the environment. Our hypothesis was that users who were told that SenSpace conveyed the myth of Narcissus, would gear their interpretation of the space towards that myth.

For this experiment, we recruited twenty-four participants. Fifteen of them were male, and nine were female. Eight participants were from the Department of Art and Art History. One participant was from the Department of Agricultural Economics, one from the Department of Mechanical Engineering, and the remaining fourteen were students from the Department of Computer Science, all at Virginia Tech. All users had moderate to high interest in viewing art created by others. The table below represents the

participants' demographics. n/d means 'not disclosed.' If users were uncomfortable disclosing their age, we did not force them to, as age bears no real relation to the goal of our study, as far as we know.

User	Gender	Major	Age
1	M	Graphic Design	22
2	M	Graphic Design	22
3	M	Computer Science	28
4	F	Agricultural Economics	27
5	M	Computer Science	23
6	M	Computer Science	23
7	F	Computer Science	n/d
8	F	Graphic Design	21
9	F	Graphic Design	21
10	F	Computer Science	n/d
11	M	Computer Science	n/d
12	M	Computer Science	22
13	M	Computer Science	28
14	M	Computer Science	n/d
15	F	Art & Art History	n/d
16	M	Theatre Arts	31
17	F	Computer Science	22
18	F	Graphic Design	20
19	M	Mechanical Engineering	20
20	M	Computer Science	24
21	F	Computer Science	25
22	M	Graphic Design	20
23	M	Computer Science	27
25	F	Computer Science	23

**Table 5.2: Information regarding the 24 participants in our user study.**

### **5.2.3 Tasks**

The main user tasks were observation and interpretation. The user was led into the SenSpace environment, which was introduced as an art installation. They were told to move around and observe the environment, then to give their own interpretation of it in the subsequent questionnaire session. The viewing of the art installation lasted four-and-a-half minutes. Filling out the questionnaire took an average of twenty minutes for individuals and thirty minutes for pairs.

### **5.2.4 Procedure**

The procedure scripts for each group (1 to 4) are documented below.

***User group 1 (5 users): Naive visitors (These visitors are not told of the association between the environment and Narcissus myth).***

1. The user comes to my desk in Corporate Research Center (CRC) to fill the informed consent form.
2. **Introduction:**  
“This is an art installation that would last for 4 minutes.  
I would just like you to go in and note what you see and hear.  
Feel free to walk around.  
Try to put it all together and make sense of it.  
There is no correct answer.  
Afterwards, I would ask you a few questions, and that would be all.”
3. User is led into dark room with projected image; then I start up the sound.
4. I go into the observation room and take some notes of user behavior during the 4-minute duration.
5. After installation has ended, I turn the lights back on and give the user the questionnaire to fill.
6. Thanks, and departure.

***User group 2 (5 users): Knowing visitors (These visitors are told of the association between the environment and the Narcissus myth).***

1. The user comes to my desk to fill the informed consent form.

2. **Introduction:** “This is an art installation that references the myth of Narcissus. Are you familiar with this myth?”
3. **The Myth Summary:** Regardless of answer, say “Narcissus was a character in Greek mythology that fell in love with his own water reflection. He was so frustrated that he could not get the person he saw in the water to come out and meet him, that he withered away by the water, and turned into a flower. The installation you will be viewing attempts to convey the myth of Narcissus to you.”
4. “So this piece would last for 4 minutes.  
I would just like you to go in and note what you see and hear.  
Feel free to walk around.  
Try to put it all together and make sense of it.  
There is no correct answer.  
Afterwards, I would ask you a few questions, and that would be all.”
5. User is led into the dark room with projected image; then I start up the sound.
6. I go into the observation room and take notes take some notes of user behavior during the 4-minute duration.
7. After installation has ended, I turn the lights back on and give the user the questionnaire to fill.
8. Thanks, and departure.

***User group 3 (6 users; 3 pairs): Joint (These visitors experience the environment separately, fill the questionnaire jointly, and are NOT told of an association between the environment and Narcissus myth).***

1. The users come to my desk in CRC to fill the informed consent form.
2. **Introduction:**  
“This is an art installation that would last for 4 minutes.  
I would just like you to go in and note what you see and hear.  
Feel free to walk around.  
Try to put it all together and make sense of it.  
There is no correct answer.  
Afterwards, I would ask you a few questions, and that would be all.

3. User is led into dark room with projected image; then I start up the sound.
4. I go into the observation room and take some notes of users' behavior during the 4-minute duration.
5. After installation has ended, I turn the lights back on and give the users a questionnaire to fill between them.
6. **Questionnaire explanation:** "Please discuss each of these questions and try to come up with an answer that you both agree on, for each question. If there is any question you do not agree on, it is ok to write your answers separately in the space provided. Your discussion will be recorded to help with the study."
7. Thanks, and departure.

***User group 4 (8 users; 4 pairs): Joint (These visitors experience the environment separately, fill the questionnaire jointly, and ARE told of an association between the environment and Narcissus myth).***

1. The user comes to my desk to fill the informed consent form.
2. **Introduction:**  
 "This is an art installation that references the myth of Narcissus. Are you familiar with this myth?"
3. **The Myth Summary:** Regardless of answer, say "Narcissus was a character in Greek mythology that fell in love with his own water reflection. He was so frustrated that he could not get the person he saw in the water to come out and meet him, that he withered away by the water, and turned into a flower. The installation you will be viewing attempts to convey the myth of Narcissus to you."
4. "So this piece would last for 4 minutes.  
 I would just like you to go in and note what you see and hear.  
 Feel free to walk around.  
 Try to put it all together and make sense of it.  
 There is no correct answer.  
 Afterwards, I would ask you a few questions, and that would be all."
5. User is led into the dark room with projected image; then I start up the sound.

6. I go into the observation room and take notes take some notes of user behavior during the 4-minute duration.
7. After installation has ended, I turn the lights back on and give the users the questionnaire to fill between them.
8. **Questionnaire explanation:** “Please discuss each of these questions and try to come up with an answer that you both agree on, for each question. If there is any question you do not agree on, it is ok to write your answers separately in the space provided. Your discussion will be recorded to help with the study.”
9. Thanks, and departure.



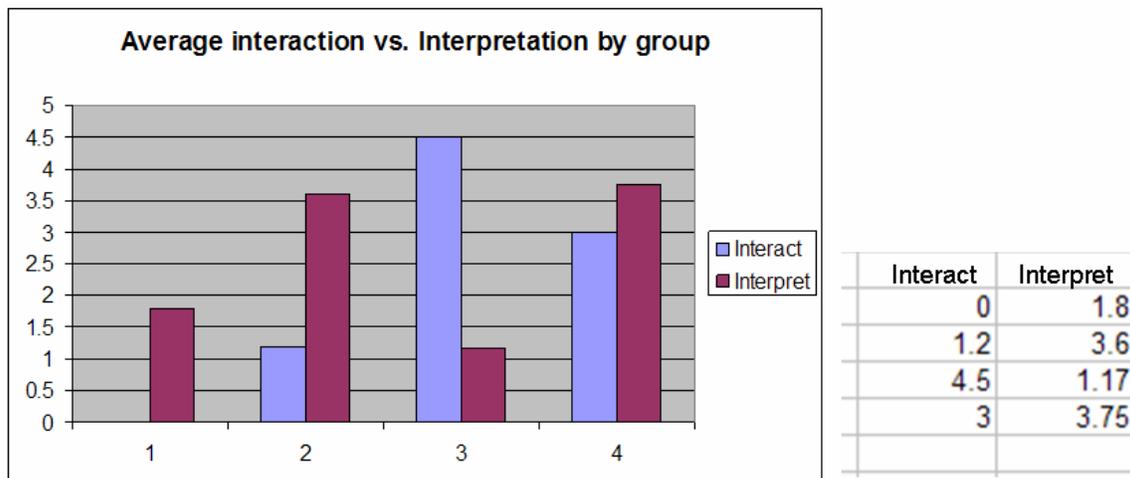
**Figure 5.3: SenSpace set-up showing rippled reflection of user on left wall and video playing on right wall.**

# Chapter 6

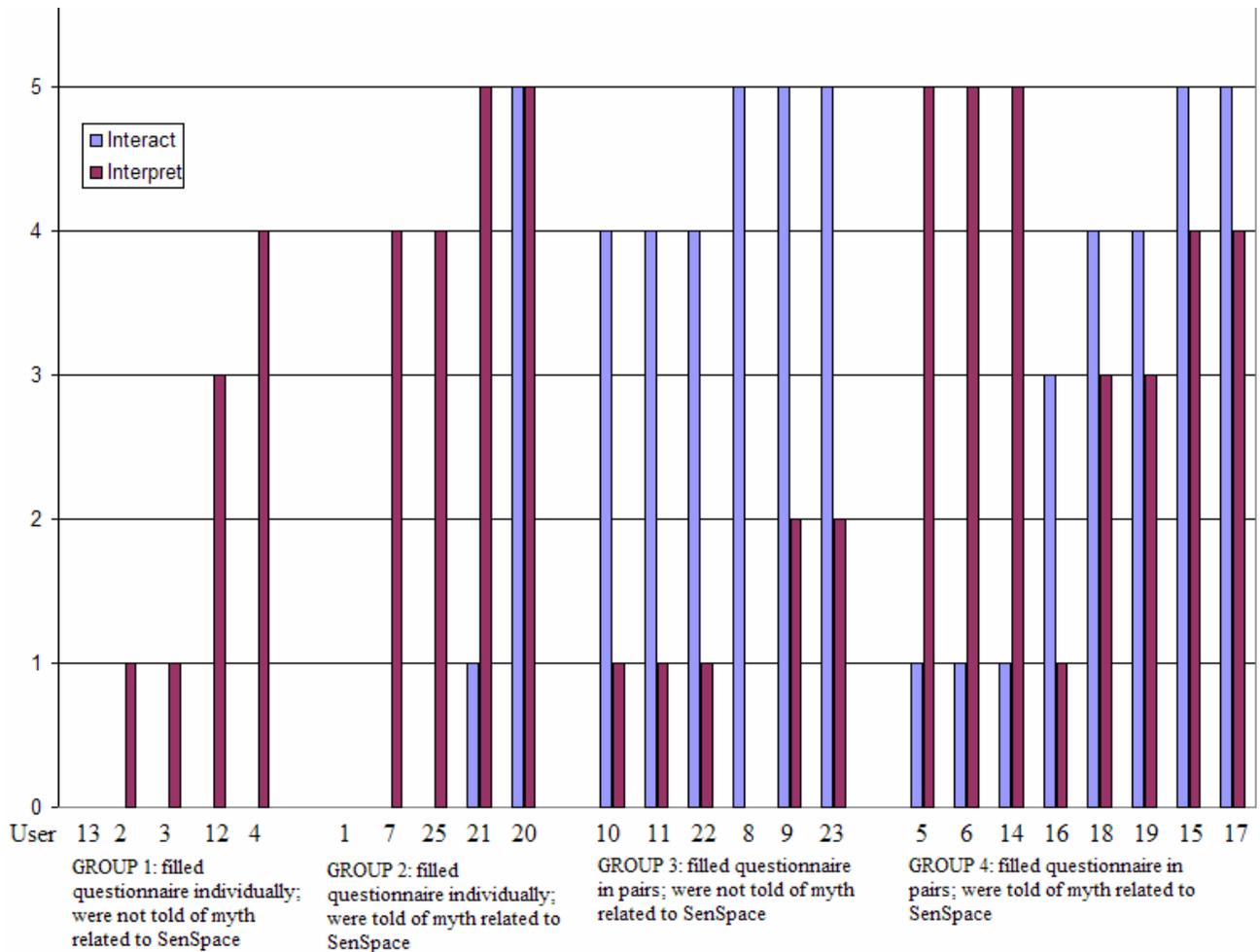
## Results and Observations

### 6.1 What did we learn about the relationship between users' level of interaction and their depth of interpretation of multimedia environments?

As shown in Graph 6.1 below, we observed an inverse relationship between users' level of interaction with elements in the environment, and the depth of the interpretations they gave of their experience in the environment.



**Graph 6.1: Cumulative interaction-interpretation performance of users by group. This graph shows the inverse relationship between interaction and interpretation by users in the multimedia environment. The inverse relationship seems reduced in Group 4, where the users were both prompted with a briefing of what they were about to see, and filled the questionnaire in pairs.**



**Graph 6.2: Levels of interaction and interpretation for each of the 24 users, by group.**

Many users spent most of their time making ripples in the water and watching the effects on the wall, or searching for new means of interactivity by punching the wall, waving at the projector, and so on (see Section 6.3). Such users were generally less able to arrive at an interpretation that was

- (a) satisfying to them and
- (b) encompassing of the various elements within the environment.

By (a), we mean that these users expressed confusion or frustration, or the feeling of having missed the point. By (b), we mean that they focused their description of the environment on the things that they touched, neglecting the *whole feel* of the environment that would require more attention to visual, tactile and audio stimuli, not just one of these.

**Exceptions:** The exceptions exist in Group 4. From Graph 6.2, 4 out of 8 users in this group seemed to exhibit high levels of interaction with the environment *and* depth of interpretation. Our explanation for this is that their discussion with another user, coupled with the prompting they received about the meaning of the piece, aided their ability to piece the bits together and carve their own meaning.

Lines of interpretation were higher on the average, for people who went in with the understanding that the environment was meant to convey to them, the myth of Narcissus.

Graph 6.1 shows that users who were told of the myth beforehand were, on the average, better able to come up with personal meanings of their experience [Group 2 (mean interpretation score = 3.60), and Group 4 (mean interpretation score = 3.75)].

### ***6.2 What did we learn about how users work together to understand a meaning?***

SenSpace was designed to be a single-user environment. However, after the experiment, fourteen of our 24 participants were paired together for the questionnaire part of the study. Four of the seven pairs formed had viewed the art installation with a prior knowledge of its relation to the Narcissus myth.

We found out that when asked what they noticed about themselves, Group 4 users (were in pairs *and* had a prior knowledge that SenSpace was based on the Narcissus myth) were the most forthcoming in revealing how they related the occurrences in the environment to themselves. As we can see from Table 6.1, responses given by all but one of the *other* participants were distant, and hardly revealed the participants' self-awareness. Even the participants in Group 2 (had a prior knowledge that SenSpace was based on the Narcissus myth but filled questionnaire *individually*) did not seem to go out of their way to relate their experience in SenSpace to Narcissus' personal experience of preoccupation with his appearance. The table below shows the responses given by the users.

Our explanation is that both prompting (leading the user along the path we *want* them to think) and collaboration are necessary for the users to reveal how they personalized the theme of the myth (and of the installation).

Question 14: During the time you spent in the room, tell us something you noticed about yourself

Group	User	Response
Group 1: not told about Narcissus AND filled questionnaire individually	2	“I slouch and do not move much unless told to do so.”
	3	“I saw my image with some noise or interference, projected on the wall. But it was very dark and I abstracted it during most of the time.”
	4	“I was just concentrating on watching. Sensuality with the movement of fluids.”
	12	“The color of the art projection decided whether I was able to see myself!”
	13	“I was more focused on watching the piece of art and its effects.”
Group 2: told about Narcissus BUT filled questionnaire individually	1	“I was standing with my arms crossed most of the time.”
	7	“I just noticed myself viewed on the wall. it seemed that I was reflected on the pond of water.”
		“I was curious as to what the artwork was trying to convey. I leaned and critiqued certain aspects of the artwork, such as the mirror reflection of the water.”
	21	“An image of myself was projected on another screen.”
	25	“I thought I looked good in my red sweater.”
Group 3: not told about	8	“[I was] constantly playing with water, kept touching it, felt comfortable in the room.”
	9	“I was concerned I wasn't playing with the right thing. I was

Narcissus AND filled questionnaire in pairs		holding back actions.”
	10	“I saw myself on the wall.”
	11	“I did not notice anything.”
	22 23	“I realized that I was foolish not to take off my coat” (due to heat). “Nothing.”
Group 4: told about Narcissus AND filled questionnaire in pairs	5	“I am fat and campy.”
	6	“I am tall, muscular arms - while thinking back on that, I realized it was kind of vain.”
	14	“I am wearing glasses.”
	15	“I was a representation of me (not real). I wish I was wearing something colorful.”
	16	“I felt a little guilty about spending time looking at my own image because it is the one piece of the installation I had already seen. I felt like I should have been strictly devoted to those unfamiliar things in the room.”
	17	“I felt awkward and stupid for not seeing instantly the way things fit together. But I felt playful. I was not comfortable looking at myself for long periods.”
	18 19	“I noticed that I was reflected.” “I realized that I spent most of the time trying to figure out what I could do to affect the experiment, rather than just watching it.”

**Table 6.1: User responses to the question “During the time you spent in the room, tell us something you noticed about yourself.”**

In the literature review (Chapter 2), Stahl had been quoted as noting that in collaborative processes, individual interpretations are aligned to a gradually shared meaning, which is itself co-constructed in the process. This was not always the case in SenSpace, however. Users were told that if they were unable to reach a consensus, they should write their separate answers in the space provided in the questionnaire, separated by a slash. Twelve out of 14 pairs of users had different answers for at least five of their questions. This might be because unlike a mathematical problem which often has a correct answer, the users' tasks of observation, recall and meaning-making are more subjective in nature.

### ***6.3 How did users think their actions were affecting the environment?***

In the SenSpace environment, we decreased our focus on interactivity so as to increase chances for users to observe and interpret occurrences. However, most users kept searching for some form of interactivity within the environment. From their questionnaire responses, it is clear that some users thought their actions were affecting the video that was playing out.

User 21 notes, "The color changes according to my motion." User 8 asks, "Did moving around make images move?" User 11 states, "I am not sure whether touching the wall changes the image...I saw a difference, but it might have been by chance." According to User 17, "I wanted to figure out how elements fit together, so I touched things to see how other things reacted." User 18 explains, "I thought about the way the water moved when I touched it, and tried to figure out if it somehow affected the movie displayed." And Users 14 and 15, who filled the questionnaire in pairs, and who were told of the installation's connection to the Narcissus myth, admitted, "We thought it was a test to find the interactive spots."

We try to understand why many users seemed to search for interactivity in the piece (Conclusions). More interestingly, we note the *ways* in which they sought to interact with the piece. Our observation of the things people did in an attempt to interact with SenSpace, serves two purposes:

- a) Reveals ambiguity as a design method that can be applied in making a piece more interactive.
- b) Shows us ways in which we can incorporate interactivity into SenSpace, if we decide to do so. Some ways in which our participants tried to find interaction within the space are listed below.
  - i) Punching the wall on which the video was being projected.
  - ii) Feeling the wall on which the video was being projected.
  - iii) Waving hand in front of the projector (perhaps for interaction triggered by motion-detection or temperature-change).
  - iv) Shifting weight from one foot to the other.
  - v) Talking. User 23 noted that he thought his voice might trigger off some changes in the environment.



**Figure 6.1: Some users felt the wall, searching for embedded physical interactivity.**

Some users convinced themselves that SenSpace afforded interactivity that went beyond creating ripples in the water. An example, as mentioned earlier, is User 21, who states, “The color [of the video display] changes according to my motion.” If our goal really were to create a highly interactive installation, then our users’ imaginations would have successfully satisfied this goal. This corroborates Gaver’s statement that ambiguity “provides the grounds for people’s interpretations to supplement technical limitations” (2003). It is however important to note that at least three users admitted to being bored after searching fruitlessly for interactive bits within the space.

## 6.4 Observations

Some observed behaviors were recurrent or interesting enough that they were worth noting.

### 6.4.1 Guilt

Gaver et al define ambiguity of relationship as ambiguity resulting from the personal relationship the user develops with the piece (2003). This form of ambiguity was particularly exemplified in the results of our study: some users, unprompted, found it necessary to express *guilt* for their actions in SenSpace. This is contrary to the Freudian perspective of the Narcissus myth, which emphasizes the “absence of guilt” (Tatar 2007) exhibited by Narcissus in his actions. We observe that SenSpace served as what Gaver described to be a “psychological mirror” for users, allowing them to assume the identity of Narcissus, and in some cases, leading them to question their values and activities. One outcome of this questioning may be the feelings of guilt reported.

Users expressed guilt over the following reasons:

a) *Playing with the pool of water instead of paying attention to changes in the environment.*

User 9: “Moving around and touching things distracted me, and made me feel like I should be constantly *looking* around.”

b) *“Vainness” for observing things about their physical appearance.*

User 6: “[I am] tall, [with] muscular arms – while thinking back on that, I realized it was kind of vain.”

User 16: “I felt a little guilty about spending time looking at my own image because it is the one piece of the installation I have already seen. I feel like I should have been strictly devoted to those unfamiliar things in the room.”

User 17: “I was not comfortable looking at myself for long periods.”

In trying to explain the phenomenon of guilt, we look at the writings of Joseph Campbell. In his book, *Myths to Live by*, Campbell contrasts the Christian West’s mythology of universal guilt, whereby “every act of nature is an act of sin, accompanied by knowledge of its guilt,” with the Orient, which lays more emphasis on the inherent innocence of nature, “even in what might appear in our human eyes and sentiments to be its cruelties” (p. 126).

#### ***6.4.2 Artists’ behavior vs. Engineers’ behavior***

For this experiment, we recruited 8 participants from the Department of Art and Art History, 10 from the Department of Computer Science, 1 from Mechanical Engineering, and 1 from Agricultural Economics department. We did not observe any significant differences in the interpretation or interaction of artists vs. engineers in the environment. Our understanding is that level of interaction and depth of interpretation are determined by other factors (social, cultural, personal curiosity, etc). We did not test for those factors, as they are not within the scope of our study.

# Chapter 7

## Conclusions and Future Work

### *7.1 Summary*

Overall, meaning-making in pairs, with the guidance of what to look out for, seems to be more effective than individual meaning-making with and without prompting, and than meaning-making in pairs without prompting. Working in pairs enables each participant to supplement the other's recollection and meaning-understanding. ***Our work shows that discussion is vital to the process of meaning-making.*** This applies even when both parties do not reach on consensus on the same meaning.

We also conclude that ambiguity is important as a design tool. By allowing users to play out their expected interactivity with the elements of the environment, we as designers can observe their actions and learn varied ways of providing that interactivity for them.

Finally, we observed that there might exist some inverse relation between level of interaction and depth of interpretation, in such multimedia environments. Our understanding of this finding is that searching for interactivity within the environment, and focusing on interactive elements in the environment, reduce the opportunity for the user to engage holistically with the environment. This holistic engagement is necessary for a consistent and guided interpretation of the environment.

### *7.2 Future Work*

Our future work will include further experiment and analysis to study the relationship between level of interaction and depth of interpretation. If interaction really does remove from the interpretative process as our results show, then we might need to question the role of physical interactivity in systems designed to support personal interpretation, and vice-versa. Physically interactive systems require or suggest that cognitive tasks be

carried out by the user. If the user has to focus on performing those tasks, she will miss out on the other occurrences within the environment (visual, tactile, sound), whose simultaneous effect is often important for guided meaning-making.

Future work would also involve further inquiry into the interesting element of guilt reported by about five participants in the study. Guilt presents an exciting irony to our work, because SenSpace is based on a myth that emphasizes the *absence of guilt* in the main character. What socio-cultural values may lead to one party feeling guilty about staring at their reflection, and another feeling comfortable with it? Within what contexts? If Narcissus had *known* that he was staring at himself, and not another being, would he have felt guilty, too? We tried to explain it as a socio-cultural quality of Christian-Western cultures. However, the ability to evoke such feelings through ambiguity is interesting, and worthy of further study.

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# **Appendix A: Man in the Mirror: A Myth-Driven Exploration of Multiple User-Interpretations in a Multimedia Space**

IRB # 07-105

## **A.1 Informed Consent**

### **VIRGINIA POLYTECHNIC INSTITUTE & STATE UNIVERSITY**

#### **Informed Consent for Participants in User Study**

**Title of Project:** Man in the Mirror: A Myth-Driven Exploration of Multiple User-Interpretations in a Multimedia Space

**Investigators:** Kunmi Otitoju, Steve Harrison

#### **I. Purpose of this Research/Project**

The purpose of this project is to explore how users may seek to understand the meaning behind a computer-based work. Thirty users are participating in this study.

#### **II. Procedures**

This study, taking place in the Corporate Research Center, requires you to observe a computer-based art piece that lasts for four and a half minutes, then to answer questions based on your observations and interpretations of the piece. Your interest in carving then expressing your own interpretation of the piece, are most important for this study.

#### **III. Risks**

There are only minimal risks involved in this study.

#### **IV. Benefits**

Thanks again for your potential participation in this study. You are helping us as researchers to understand how to accommodate multiple user interpretations in the creation of computer-based systems.

You understand that your participation in this study is voluntary and unpaid.

#### **V. Extent of Anonymity and Confidentiality**

Your session will be video and audio taped, to help us gather required information from the study. These tapes will be securely stored, and only accessible to the investigators. They will be destroyed after use.

#### **VI. Freedom to Withdraw**

Please understand that you are free to withdraw from the study at *any* time, with no consequences to you.

**VII. Subject's Permission**

I have read the Consent Form and conditions for this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

\_\_\_\_\_  
Subject Signature

\_\_\_\_\_  
Date

Should I have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research-related injury to the subject, I may contact:

Kunmi Otitoju  
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Dennis Kafura

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## A.2 Post-experiment questionnaire

### Man in the Mirror: An Exploration of Multiple User Interpretation in a Multimedia Space

#### Questionnaire

Please answer the following general questions first:

1. What is your age?

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2. If you are a student, what year are you?

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3. What is your major?

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The interactive environment that you just were in can be seen and understood from many points of view. We are interested in **your experience** of it.

4. What (if anything) was most striking or memorable about the experience?

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5. What are four things you remember seeing in the environment?

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

6. Was there a dominant color in the environment?

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7. How many trees did you see?

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8. How did moving around or touching things change what you were seeing?

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9. Did the experience of being in the environment remind you of any other experiences you have had? If so, what were they?

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10. Imagine you just went to a contemporary art museum in New York where you experienced this environment. You call up your good friend to describe what you have just seen. How would you describe the experience to your cousin?

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11. Were there any character(s) in the piece? Who were they?

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12. Was there a plot? What was it?

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13. Did the experience of moving around or touching things change what you thought about?

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14. During the time you spent in the room, tell us something you noticed about yourself.

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15. For this study, we asked you to stay in the room for 4 minutes. Given a choice, would you have wanted to stay longer or less time? Circle one:  
Stay less time                      same amount                      stay longer

16. What was the last time you went to an art museum, gallery, show or exhibit?

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17. When was the last time you made something that you thought of as art?

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18. How much do you like art that others have made? Circle one:  
Do not like looking    like looking at  
At art at all    works of art  
1      2      3      4      5      6      7

## Vita

Oluwabukunmi (Kunmi) Sharon Otitoju received her Bachelor of Science degree *summa cum laude*, from Howard University's Department of Systems & Computer Science, in 2005. She began her graduate studies in the Computer Science Department of the Virginia Polytechnic Institute & State University, in August 2005. She has interned in the technology division of Goldman Sachs New York, and more recently, with FAST, an enterprise search company in Oslo, Norway.

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