

Defining Conceptual Interactivity

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Abstract— This paper discusses the notion of conceptual interactivity and how it can be effectively used in the presentation of digital media content for artistic, educational, or technological purposes. *Conceptual interactivity* is a method of concept learning that results from a specific design strategy for controlling interactive media. Conceptual interactivity is defined as the attainment of a concept through an interactive experience that contains a psychological and physical correspondence between media content and the user interface for directing that content. The paper discusses the various components of conceptual interactivity and its relationship with user interface design, accompanied by examples of interactive video-sound installations created by the author.

Keywords—*interactive media; narrative media; concept learning*

I. INTRODUCTION

The user interface within most interactive media systems provides no conceptual relationship between the human gestures for controlling media and the media content being initiated through the gestures. The operation of the playback button on a video player typically has no conceptual relationship with the content that is presented when the button is pressed. The same button can be used to initiate playback of a video that presents a speeding car, a monkey climbing a tree, or a sailboat tumbling over a waterfall. Exceptions to designs that lack this correspondence are certain interactive environments, flight simulators, and computer game consoles that permit an illusion of navigating through space. The advantage of a user interface that provides a physical correspondence with the media content it controls is that a specific human gesture for controlling content can also contribute to media content. This approach is significantly different from user interfaces that employ human gesture only as a technical component of the control mechanism. Human-Computer Interaction (HCI) researcher Alistair Sutcliffe proposes that the lack of good interface design in media systems is due to developers being pressured to release designs to market as quickly as possible [1].

The notion of *conceptual interactivity* began to evolve in my work during the 1980s when my education and employment involved electronics engineering, visual art, psychology, and user interface design. Certain aspects of these disciplines became intermingled over the years, and in the early 1990s my work became focused on interactive video and sound

installations that were controlled by human gesture or live music. These installations were publically presented as digital artworks because they involved artistic ideas, computers, and technical features that involved human-computer interaction (HCI). My interest at that time was to create interactive media environments that contained the following HCI features: (1) unencumbered user interfaces, (2) user interfaces for the entire body, (3) multi-user interfaces, (4) multi-user interfaces as content, and (5) interactivity as content. The term "content" in these features refers to the perceptual and conceptual experiences that are conveyed through an interactive media system, including specific imagery and sound. The technical details of these early installations are discussed in articles from 1998 [2], 2000 [3], and 2001 [4].

The first of my installations that used interactivity as content was *TV Guides* (1995), an interactive video-sound installation. Viewers of this installation confront a living room environment containing couches and a television. The television plays live television broadcasts with typical afternoon programming of soap operas, talk shows, advertisements, and television game shows. The imagery on the television is overlaid by cross hairs within a circle, giving the impression that the programs and the viewer are separated by a viewing scope. See the top image of Fig 1. In response to any movement by viewers within the installation, the sound of the television fades out and its imagery recedes into black, followed by text on the screen that requests viewers to "Remain Perfectly Still." See the bottom image of Fig. 1. The live television imagery and sound resume only after the viewers in the installation have remained motionless for at least 5 seconds. A different text message is provided on the screen of the television each time a television program is switched off by the viewers' movements, including "Be Calm," "Just Relax," or "Please be Calm."

The intended concept of *TV Guides* is that 'people are being controlled by television', that people become passive "couch potatoes" by watching television. The motivation for creating this installation came from a statement by media theorist Marshal McLuhan, who wrote in 1964 that "TV has, some feel, introduced a kind of rigor mortis into the body politic" [5]. McLuhan presented this concept to his readers as text, but *TV Guides* presents the same concept as an interactive experience within a real environment of live television and sound.



Fig. 1. *TV Guides* installation, interactive video-sound installation.

TV Guides conveys its concept to an audience using a technological mechanism that allows an audience to directly participate with the content of the installation. I began using interactivity as content in 1995, and I first referred to this method as *conceptual interactivity* during a conference in 2001 at the Banff Centre for the Arts in Canada.

II. CONCEPTUAL INTERACTIVITY

The most common method for concepts to be communicated through traditional media is through symbolic representations using words, images, sounds, or music. The concept 'servility', for example, can be conveyed in a narrative film through dialogue and imagery that fictionally depict a group of people being enslaved by a tyrant. Viewers of this film would perceive 'servility' through a symbolic interpretation of the dialogue and imagery. In contrast to this common method, conceptual interactivity enables an audience to participate in the depiction of a concept rather than only observing its depiction. Conceptual interactivity is the attainment of a concept through an interactive experience with media content that results from an association between a user interface and media content. The design strategy that enables

conceptual interactivity is a physical and psychological correspondence between a person's manipulation of a user interface and the media content being presented through that manipulation, such as the upward manipulation of a physical lever being associated with the notion 'more', and a downward manipulation being associated with the notion 'less'.

The primary strategy of using conceptual interactivity in digital media is to identify a form of user interface that physically and psychologically corresponds with the concept being presented through the media. The lever example is considered to be a correlative user interface because most people correlate an upward motion with the concept 'more' and a downward motion with the concept 'less'. A similar strategy can be used when presenting concepts through media that are more complicated than 'less' or 'more', as used in the *TV Guides* installation. The intended concept being conveyed in this installation is 'people are being controlled by television'. Reading the words of this concept and understanding their meaning is significantly different from experiencing the concept. The *TV Guides* installation conveys McLuhan's concept to an audience not through words, but through the actual experience of being controlled by a television.

An understanding of the notion of conceptual interactivity requires a multidisciplinary perspective because its meaning incorporates aspects of media literacy, cognitive psychology, and user interface design. The remainder of this paper will discuss the components of conceptual interactivity in detail.

III. CONCEPTS AND NARRATIVE MEDIA

A. Concepts

Concepts provide people with orientation, the ability to recognize and distinguish objects in their world [6]. Research on understanding and defining concepts is popular in the fields of cognitive psychology and philosophy, though disagreements exist regarding a specific definition for 'concept'. Laurence and Margolis propose in *Concepts: Core Readings* that the difficulty in forming a conclusive definition arises from disagreements over whether concepts are objects, cognitive abilities, or behavioral abilities [7]. The notion of a concept is generally based on the perspective that we experience two separate worlds, one comprised of actual objects and the other comprised of corresponding mental objects. This article will use the convention of capitalizing words that represent concepts, such as the word BACHELOR representing a concept and 'bachelor' representing an actual person that is the *referent* of the concept.

The *Classical Theory of Concepts* proposes that concepts are complex mental representations that define all the necessary conditions for determining the identification of something [7]. These conditions are expressed as a specific hierarchy of sensory or perceptual criteria. The concept BACHELOR, for example, specifies that the conditions for something to be a bachelor include "NOT MARRIED, is MALE, and is an ADULT" [8]. The "principals of classification" contained within a concept permit us to understand what we encounter in our world by enabling us to recover a corresponding definition from our mind [9].

In the present article, a concept will be designated as a mental representation that enables a person to categorize objects, events or ideas, such as a concept that enables a person to distinguish objects that are lemons from objects that are not lemons. The *components* associated with a specific concept specify its classifications, such as FRUIT, YELLOW, and SOUR being components of the concept LEMON: a lemon is a fruit, a lemon is yellow, and a lemon is sour. The components of a concept can also be concepts, such as FRUIT being a component of LEMON and a concept. A concept that cannot be defined in terms of other concepts is known as a *primitive concept, feature, atomic concept, or unstructured concept* [7]. The concept LEMON is not a primitive concept because its structure includes FRUIT, YELLOW, and SOUR. The concept LEMON is also called a *lexical concept* because it corresponds directly with the single word 'lemon'. A *complex concept* is a concept that is not primitive; it is comprised of multiple concepts. LEMON is a lexical concept and a complex concept, but A SLICE OF LEMON TINGLING IN MY MOUTH is only a complex concept because it does not correspond with a single word. Current theories on concepts are significantly more refined and complex than what is being discussed here, but this information is sufficient for understanding the upcoming discussions pertaining to conceptual interactivity.

An important concern in the study of concepts is 'concept learning', which is the process of a person acquiring and retaining the concepts that enable categorical distinctions, such as a person acquiring a concept that enables distinguishing a lemon from what is not a lemon. This process is also known as 'concept formation' or 'concept attainment'. Bruner, Goodnow and Austin propose the primary questions for investigating conceptual attainment are the following [10]:

Achievement: how do people achieve the information for distinguishing and learning a particular concept?

Retention: how do people retain the information from relevant events so it can be used for concept attainment at a later time?

Transformation: how does a person transform information from the past into a form that is appropriate for concept attainment at a later time?

Bruner and his colleagues propose the major problem in understanding concept attainment is that the process consists of a series of events occurring over time, rather than attainment occurring at a specific moment in time. The complication created by the processes of concept attainment is that a person may not know which new information corresponds with a specific concept when that information is initially obtained.

B. Narrative Media

Within this article, the terms *media content* or *content* will refer to the perceptual information that is communicated through media technologies, such as words, images and sounds. The term *media* will refer to the specific technologies and distribution systems that deliver media content to audiences, including the Internet, digital audio, computer animation, and digital video.

An important social function of media is the propagation of concepts. We learn specific concepts through media by experiencing their symbolic representations. Lev Vygotsky (1896-1934) is considered the first psychologist to recognize the significance that cultural productions have in forming our thinking and conceptual development [11], a field of research known as *cultural-historical psychology*.

Some popular methods for learning concepts through media include reading written words in a book or on a computer screen, listening to audio recordings of person speaking, viewing static or moving imagery on a computer screen, and viewing films with moving imagery and sound. Any form of media content has a potential to contribute to concept attainment and consequently influence our thoughts.

Cognitive psychologist Jerome Bruner proposes that we possess two different modes of thought, each providing a different manner for constructing our reality [12]. He labels the first mode as the "paradigmatic mode", which provides us with empirical truths based on logic and observation. The other is the "narrative mode", which does not necessarily provide us with truth, but instead presents "good stories" that provide drama and "verisimilitude"--a lifelikeness that is absent in the first mode. Bruner states that the narrative mode provides us with a human experience that is grounded in a particular place and time, while the paradigmatic mode is an abstraction that transcends the particulars of the actual experience being presented.

Bruner's perspective is relevant to this article because conceptual interactivity attempts to propagate concepts through the narrative mode of thought. A *narrative*--also known as a story--is a series of connected events that is presented to an audience in the form of spoken word, text, static images, or moving images. The primary elements of a narrative are *plot, setting, characters, and narrator*. The *plot* of a narrative refers to a sequence of events that evolve over time and thereby convey an intended meaning to an audience. These events can occur in a simple chronological order, or they may include flashbacks or flash-forwards in time. The *characters* within a narrative refer to the roles and actions of the actors within the plot. A *protagonist* is the main character that an audience identifies with or admires. The characters in a narrative are considered to be allegorical if the human character is intended to be a symbolic representation of an intangible entity, such as a character representing truth, beauty, or goodness. The *setting* of a narrative refers to the location, time, and atmosphere of the narrative. The *narrator* is the person within a narrative work who tells the story and sets the point of view.

The specific characters, plot, and setting within a narrative film are its content, but a *film's concept* is the intended meaning of its narrative elements. Different narratives may contain different narrative elements, but they may still convey the same concept. Numerous films have conveyed the concept that PEOPLE ARE SELFISHLY CORRUPT by presenting various plots that depict evil and selfish characters who attempt to exploit each other. This concept is often presented in *film noir*, a genre of narrative that film historian David Cook describes as "characterized by downbeat atmosphere and graphic violence, and they [the films] carried postwar

American pessimism to the point of nihilism by assuming the absolute and irredeemable corruption of society and everyone in it” [13].

Audiences of narrative films are viewing emulations of reality that are closer to real life than a collection of facts, but these people are passive observers of the narrative elements. The strategy of conceptual interactivity is based on the presentation of a narrative through an interactive media system that enables a people to actively participate in a narrative. This strategy provides an audience with a method of concept attainment that is situated between traditional media and real life.

C. Interactive Media

The definition of interactive media being used in this article is the following: a media environment that enables a user to direct significant perceptual changes in media content. Fig. 2 diagrams the primary components of an interactive media system based on this definition. The *human input* component refers to the actions required by a user for directing the interactive media, such as a finger gesture, body motion, or voice. The *source media* component refers to media content that can potentially be output by the system, such as a specific collection of text, graphics, moving imagery, or sound. The *control mechanism* activates the correspondence rules that specify which source media will direct the output in accordance with the human input.

D. Correlative User Interface Design

A correlative user interface provides a physical and psychological correspondence between a user’s manipulation of the interface and the media content being presented through that manipulation. An example of this type of interface is the loudness of a sound being increased by an upward manipulation of a loudness control, and decreased through a downward manipulation of a loudness control. This approach reflects a cognitive correlation between INCREASE and UPWARD, and a correlation between DECREASE and DOWNWARD. This perspective assumes that the mental attention required to use the interface is reduced when cognitive stereotypes are used, such as MORE being associated with UP.

An important concern when designing a user interface for an interactive media system is the difference between the primary and secondary tasks. The *primary task* is the reason that a person is using an interactive media system, and the *secondary task* is the operation of a user interface that is required to complete the primary task. When the cognitive

attention of the secondary task is minimized, the maximum amount of a user’s attention is available for the primary task. For example, the primary reason I use a digital camera is to shoot photos, and the secondary task is the operation of the various controls on the camera.

A correlative user interface is an appropriate approach for conceptual interactivity because it involves a physical and psychological correspondence between the primary task and secondary task. The following are guidelines for creating a correlative user interface:

- *Minimal secondary task attention*: cognitive attention is devoted to the primary task with minimal attention required for the secondary task.

- *Obvious designation of a control*: the user can recognize without instruction what is a control and what is not.

- *Obvious function of a control*: the user can recognize without instruction the function of what is being manipulated by a specific control.

- *Language independent controls*: a specific language is not used to designate the function of a control.

- *Obvious operation of an input control*: the user can recognize without instruction how a specific control should be manipulated, if it should be pressed, turned, or operated using a particular gesture.

- *Obvious state of a control*: the user can recognize without instruction what is the current state of a control, if it is on, off, or in a state specified by a number or icon.

- *Correlative operation of a control*: the user can recognize without instruction a conceptual relationship between the manipulation of a control and the perceptual response created by that manipulation. A correlative operation is based on the following conventions:

- 1) *A gesture to the right* is correlated with the concept MOVE RIGHT or NEXT.

- 2) *A gesture to the left* is correlated with the concept MOVE LEFT or PREVIOUS.

- 3) *A gesture upward* is correlated with the concept MOVE UP or MORE.

- 4) *A gesture downward* is correlated with the concept MOVE DOWN or LESS.

- 5) *Discreet control decisions* are made using discreet controls, such as video channel 6 being selected by depressing a button labeled ‘6’.

- 6) *Continuous control decisions* are made using a continuous gesture, such as a sound volume being selected according to a position on a continuous slider control.

- 7) *Multiple controls are arranged in an order* that corresponds with the typical order for using the controls; controls are arranged in an order that requires them to be activated in the proper sequence from left to right or from top to bottom.

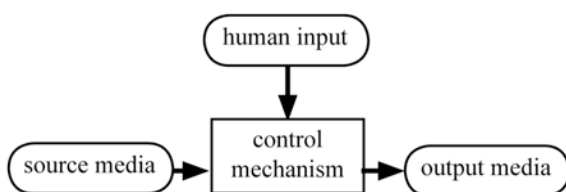


Fig. 2. Primary components of an interactive media system.

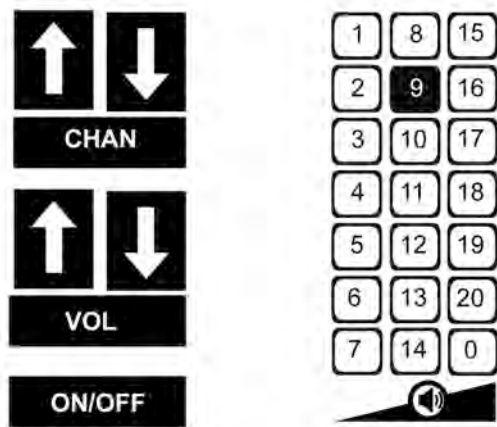


Fig. 3. Example of the redesign of a user interface using the guidelines for a correlative user interface.

E. Example of a Correlative User Interface

Fig. 3 provides an example of an actual user interface for interactive media that has been redesigned to contain elements of a correlative user interface. The left side of the diagram is the original user interface for an entertainment system that I encountered on an airplane a few years ago. The functions of the interface include the selection of a particular movie (CHAN), adjustment of the volume level (VOL), and activation of the system (ON/OFF). The redesigned version, located on the right, occupies the same amount of space as the original, but it includes indicators for the states of the control buttons. The new design has limited the number of channels to 20. The purpose of this simple redesign is to demonstrate how the guidelines for a correlative user interface can be incorporated into a user interface.

Some of the features of the original interface that conflict with the guidelines include the following: (1) the controls are language dependent--labeled in English; (2) the arrangement of the controls do not reflect the order of their operation, such as the on/off switch being located at the bottom of the controls, even though it would be the first control to be activated; (3) the user interface provides no indication of the currently selected channel or volume; (4) selection of a particular channel or a volume level is inefficient because multiple depressions of the control buttons (the up and down arrows) are required; (5) the positions of the up and down arrow buttons do not correspond with their meaning; they are oriented left and right rather than the up arrow being positioned on top of the down arrow; (6) the volume level is a continuous variable but the interface presents control buttons for a discreet variable.

The redesign of user interface includes the following features: (1) the control buttons use icons and numbers rather than a particular language; (2) the arrangement of the controls corresponds with the order of their operation, channel selected and then volume; selecting any channel number turns the system on and selecting the 0 button turns it off; (3) the user interface clearly indicates the current state of the selected

channel as 9, and volume setting as approximately 50%; (4) only one button press is required to select a particular channel or volume; (5) the channel numbers are contained in oval shaped rectangles that represent a video screen and the speaker icon represents volume; (6) controls for channel selection are discreet controls and the control for the volume level is a continuous control with position to the right representing more volume and a position to the left representing less volume.

The guidelines for a correlative user interface are intended to be a strategy for creating user interface controls that provide a physical and psychological correspondence between the operation of the control and what is being controlled. The actual appropriateness of these guidelines will vary depending on the specific application.

IV. CONCEPTUAL INTERACTIVITY WITHIN INSTALLATIONS

The incorporation of conceptual interactivity into an interactive installation involves a user interface that requires an audience to perform physical actions that correspond with an intended concept. The installation *Skies* requires that visitors cooperate with each other by walking onto certain locations within projected imagery; and the installation *Vox Populi* requires a visitor to speak confidently, like a political leader. Both installations, described in more detail below, enable visitors to become active participants in the content and intended concept of the installations.

A. *Skies* (1998)

online video: <http://aesthetic-machinery.com/skies.html>

Skies is a 17 by 17 meter interactive video-sound installation, shown in Fig. 4, that provides multiple visitors with an interactive experience with each other, nature imagery, and the sounds of nature. Visitors encounter a dark room containing two video projections of a night sky, one on the floor and one on the back wall. Visitors can walk around the 7 by 5 meter imagery on the floor or directly onto it. When visitors walk onto the projection, black paths appear under their feet at specific locations. As the audience discovers the five hidden paths, the projected imagery and sound transform into one of thirty-two different sequences of a night sky, day sky, water, land, or a sunny sky. The specific sequence presented is



Fig. 4. *Skies* installation, interactive video-sound installation at The Banff Centre, Canada.

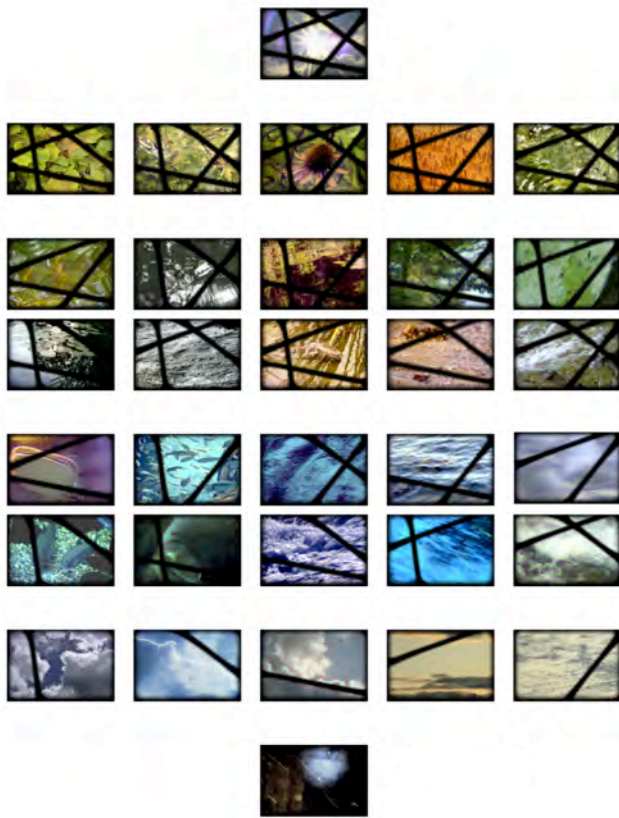


Fig. 5. Hierarchy of video sequences in *Skies* installation.

determined by which combination of the five paths has been discovered, as shown in Fig. 5. If the audience discovers all five hidden paths simultaneously, they will perceive the paths as a five-pointed star, one of civilization's most ubiquitous symbols. The list below describes the associations between the number of paths discovered and the type of imagery presented:

- no paths: 1 video sequence of a night sky
- 1 path: 5 different sequences of the sky and water
- 2 paths: 10 different sequences of water
- 3 paths: 10 different video sequences of water and land
- 4 paths: 5 different video sequences of land
- 5 paths: 1 video sequence of a daytime sky with the sun

Skies uses a collaborative user interface that can identify the locations of all persons within the installation and provide multiple users with simultaneous control over the installation. The design of this user interface permits visitors to navigate through the hierarchy of imagery and sound based on their mutual cooperation. A visitor cannot experience all the video and sound sequences in *Skies* without the cooperation of other visitors because one person can only discover one path. If visitors do not cooperate with each other or fail to disperse themselves on separate paths, their experience of the work is limited. Only through cooperation with each other are visitors able to experience all the images and sounds with the installation. The intended concept of *Skies* is COOPERATION

BETWEEN HUMANS AND NATURE. Visitors to the installation can experience this concept visually, audibly, and kinesthetically by interacting with the installation through the collaborative interface.

B. *Vox Populi* (2005)

online video: <http://aesthetic-machinery.com/voxpathuli.html>

Vox Populi is an 8 by 15 meter interactive video-sound installation that enables visitors to present a speech to an interactive video projection of a crowd. If no visitor is delivering a speech within the installation, the video projected crowd yells "speech, speech" and encourages visitors to speak from a lectern equipped with a microphone and a teleprompter that provides the text of historical speeches. See Fig. 6 for a photo of the lectern. When a visitor delivers a speech through the microphone, the text scrolls on the teleprompter and the crowd responds with varying degrees of hostility, support or ridicule, while the visitor's spoken words are mixed with the screaming of the crowd through a loud sound system. See Fig. 7 for a photo of the installation.

The components within the user interface of *Vox Populi* include the video-projected crowd, the lectern, teleprompter, and a microphone that is connected to machine listening software. A continuous analysis of the microphone's output identifies various vocal features that are combined to determine the level of confidence of the person delivering the speech. The different levels of confidence of the person speaking determine if the video-projected crowd responds with hostility, support or ridicule, and to what degree.

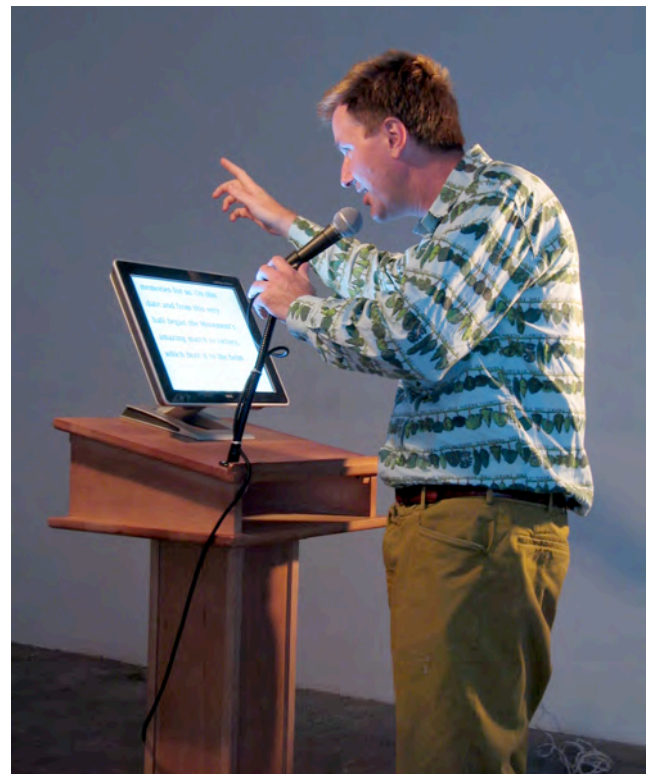


Fig. 6. Detail of the lectern in *Vox Populi* installation at Jack the Pelican Presents gallery, Brooklyn, USA.

Any visitor within the *Vox Populi* installation must decide to be either a passive audience member who simply observes the installation or to be an active participant who enacts the role of a leader by delivering a speech displayed on the teleprompter. The installation randomly provides various historical speeches, including Martin Luther King Jr.'s "I Have a Dream" and John F. Kennedy's "Ich bin ein Berliner" (I am a Berliner).

The two intended concepts being conveyed through *Vox Populi* are the following: BEING A LEADER IS DIFFICULT and MOST PEOPLE ARE SERVILE. The technical apparatus and user interface of *Vox Populi* create an interactive media environment that enables the person speaking through the microphone to participate in a depiction of the concept BEING A LEADER IS DIFFICULT, while visitors who do not deliver speeches will demonstrate the second concept, MOST PEOPLE ARE SERVILE. In addition, the audience members who act the leadership role may actually *feel* the difficulty of being a leader, and the persons who do not act the leadership role may *feel* that they are being servile.

In reality, most people are uncomfortable giving public speeches [14], but anyone who intends to be a leader within *Vox Populi* must overcome this fear. Philosopher David Hume writes, "Nothing appears more surprising to those, who consider human affairs with a philosophical eye, than the easiness with which the many are governed by the few; and the implicit submission, with which men resign their own sentiments and passions to those of their rulers." [15]

V. CONCLUSION

Various forms of media are being used today for propagating the concepts that enable us to understand and navigate our world. We can learn concepts through media by experiencing content that is associated with certain ideas, such as learning the notion of benevolence by observing a narrative film that contains a main character who is benevolent [16].

This article has discussed the attainment of concepts through interactive digital media, a form of media that provides users with an ability to control the presentation of content. The design features contained within the user interface of an interactive media system determine which aspects of its content are controllable. A *correlative user interface* is defined as an interface that provides physical and psychological correspondence with the media content being controlled by the interface. When this correspondence is provided, a user of interactive media is transformed from a passive observer into an active participant of media content, becoming like the main character of a narrative.

Conceptual interactivity is defined as the attainment of a concept through an interactive media experience by enabling an audience to participate in the depiction of that concept. An audience typically attains concepts through media by observing depictions of concepts rather than participating in the actual depictions. The mechanism that enables conceptual interactivity within media is a correlative user interface. A straightforward example of conceptual interactivity is the *TV Guides* installation discussed in the opening section of this article. Participants of this installation not only watch people being controlled by a television, they actually participate in being controlled by a television that switches off in response to their movements.

I have described three specific interactive art installations within this article because the notion of conceptual interactivity evolved in my work during the development of these installations. The discussion of concepts and the correlative user interface has been provided to demonstrate that conceptual interactivity can be used as a general design strategy that can also be applied to the design of interactive media for educational or technical applications.



Fig. 7. *Vox Populi*, interactive video-sound installation at SITE Sante Fe, USA.

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