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Towards a Phenomenological Theory of the Visceral in the Interactive Arts

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Towards a Phenomenological Theory of the Visceral in the Interactive Arts

by

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Towards a Phenomenological Theory of the Visceral in the Interactive Arts

Executive Summary
This thesis explores the ways in which certain forms of interactive art may and do elicit visceral responses. The term "visceral" refers to the cardiovascular, respiratory, uro-genital and especially excretory systems that affect mind and body on a continuum of awareness.

The "visceral" is mentioned in the field of interactive arts, but it remains systematically unexplored and undefined. Further, interactive artworks predominantly focus on the exteroceptive (stimuli from outside) rather than the interoceptive (stimuli arising within the body, especially the viscera) senses.

The existentialist phenomenology of Maurice Merleau-Ponty forms the basis for explorations of the visceral dimension of mind/body. New approaches to understanding interactive art, design and the mind/body include: attunements to the world; intertwinings of mind/body, technology and world; and of being in the world. Each artwork within utilizes a variation of the phenomenological methods derived from Merleau-Ponty's; these are discussed primarily in Chapters One and Three. Because subjective, first-person, experiences are a major aspect of a phenomenological approach, the academic writing is interspersed with subjective experiences of the author and others. This thesis balances facets of knowledge from diverse disciplines that account for visceral phenomena and subjective experience.

Along with the textual exegesis, one major work of design and two major works of art were created. These are documented on the compact disc (CDROM) bound within. As an essential component of each artwork, new technological systems were created or co-created by the author. User surveys comprise Appendices Two, Three and Four, and are also online at: www.sfu.ca/~dgromala/thesis. To access the URL: login as <feral>, and use the password <computing>. Numerous talks, exhibitions and publications that directly relate to the thesis work is in Appendix One.

This work begins with an introduction to Merleau-Ponty's ideas of flesh and reversibility. Chapter Two is the review of the literature, while Chapter Three is an explication of the hypothesis, an overview of the field, and a framing of the problem. Discussions of each artwork are in Chapter Four (The *Meditation Chamber*), Chapter Five (*BioMorphic Typography*) and Chapter Six (The *MeatBook*). Chapter Seven forms the conclusion. References to the documentation on the CD are found throughout the thesis, and italicized paragraphs provide an artistic context for each chapter.

Towards a Phenomenological Theory of the Visceral in the Interactive Arts

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To those supporters who went before me, I am indebted to Jill Scott and Victoria Vesna. This thesis has been enriched by the intensity and with the support of my worldly and itinerant colleagues from CAiiA-STAR to the Planetary Collegium, especially Gretchen Schiller, Margaret Dolinsky, Thecla Schiphorst and Yacov Sharir. Thanks are also due to my collaborators at The Georgia Institute of Technology: Dr. Larry Hodges, Dr. Irfan Essa, Dr. Thad Starner; and graduate students Fleming Seay, Mirtha Ferrer, Abhishek Kumar, Sunil Parihar, and Sumier Phalake. I am also grateful for support from Prof. John Bowes, Prof. Magy al Nasir and talented graduate students at Simon Fraser University: Dr. Steven Barnes, Jayme Cochrane, Aaron Levisohn, Jack Sam, Jinsil Seo, Meehae Song and Angela Tomizu. Sheila Levrant de Bretteville, Dr. Teal Triggs, Louise Sandhaus, Liz McQuiston, Franc Nunoo-Quarcoo, Maria Phillips, Jana Wilson Esser, Theodore Esser and Lily Shirvanee have been sources of longstanding encouragement. Finally, the blue flames lit in Dr. Eugene Thacker's and Prema Murthy's spoons proved to be especially enlightening.

I am privileged to have inculcated a lifetime of essential knowledge of the body from Dr. Theresa Gromala and Anton Valentine Krygoski. Sebastian, Roy, Zorah and Buddy Gromala provided necessary counterpoints and posed questions that would have escaped my focused attention. Finally, none of the work of the past twelve years would have be possible at all without the unstinting support of Dr. Chris Shaw. To have an intellectual partner of such calibre and humor is one of my life's greatest gifts.

Author's Declaration

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

This research has been financed by the Banff Centre for the Arts, the Wesley Center for New Media at the Georgia Institute of Technology and the School of Interactive Arts and Technology at Simon Fraser University. My registration with the Planetary Collegium began in late 1999 at the École Nationale Supérieure des Beaux-Arts, which was the beginning of my theoretical research for this dissertation. The *Meditation Chamber* was a collaboration with Dr. Larry Hodges, Dr. Chris Shaw, and graduate student Fleming Seay. *Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency* was co-authored with Jay David Bolter and published by the MIT Press. *BioMorphic Typography* was solely created by the author. The *MeatBook* was primarily created by the author with support by graduate students Jinsil Seo, Aaron Levisohn and Jack Sam.

The results of this research were exhibited, presented and performed at numerous and relevant venues. In addition, external institutions were visited for consultation purposes. In addition to the book *Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency*, several papers and book chapters were published. For a complete list, refer to Appendix 1.

Word Count in Thesis Document: 66,523
Word Count in Accompanying CDROM: 4,589

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Preface

Artistic Motivations and Vectors of Interest

In artistic practice, the artist discusses the motivations and influences that led her to create the artwork. This preface functions in the same way — to explicate those forces and influences that have led to the work at hand.

How does an interactive artist come to research the viscera? The answer is an extensive, multi-faceted one. For the purposes of this thesis, however, brevity is in order. Thus, this preface — along with the italicized, artistic contextualizations that serve as introductions to each chapter — comprise the artistic interests, motivations, and influences in phenomenologically appropriate, first-person, form.

The Visceral

Most of these influences and motivations have evolved over decades. My fascination with taking pictures of road kill, for example ranged from grammar school and high school biology to university studies. The mysterious phenomenon that these photographs elicited – a physical, visceral, "gut" reaction – became an obsession that evolved into formal, artistic works during my undergraduate studies in photography, film studies and design. Creating photographs and film always paralleled readings in cultural studies and philosophy; I was looking for any knowledge that could explain these physical reactions to images. In graduate school, I explored this further through the lens of cultural studies, particularly in Walter Benjamin's idea of mimetic "resonances," that is, our proclivities as human primates to "copy" or mimic the actions of other humans or things in the world. This was his explanation of how we test the world to determine what is me (subjectivity) and what is not me (alterity), and the extent to which we can "become" like someone or something else, including technologies.

Chronic Pain

My interest in how inert images can incite a visceral response also collided with my health. Images of my viscera were created by physicians in order to "objectively confirm" my subjective experience of pain. Curiously, these images did not provoke a visceral response. At least, not until I saw surgery upon my viscera in real-time video, as the surgery itself progressed while I was awake (described in the italicized introduction to Chapter 3). There, I experienced the cause-and-effect of the video images during the surgery with the dull, unfamiliar sensations I felt deep within my body.

Though viscerally provocative images were not part and parcel of my work as a professional designer at Apple Computer in the mid- to late 1980s, my work on HyperCard focused not on the ability it provided for animations, text, and audio to function together (e.g., "multimedia"), but on the bodily senses that we could reach through the program. Ultimately, I wondered, what would it be like to *walk into* a multimedia experience? When considering the extreme of what multimedia could be, I had the good fortune, through the beneficence of the Banff Centre for the Arts, to become one of the very first artists who explored immersive virtual reality (VR). This was an artwork I created with Yacov Sharir, of indeed walking into (or being immersed in) a virtual environment.

My artistic work in immersive VR with choreographer Yacov Sharir began late in 1990. Working with a dancer whose knowledge of the body was immense (though difficult to articulate outside of firsthand experience), and with the new technologies of VR, turned my interests into an intense, lifelong commitment to exploring bodies, including my own, and their relationship to technologies of any sort — medical, chemical, or digital. Though always interested in the body and biology, I never worked with so much zeal as when I began to experience chronic pain in 1984.

My work with a dancer and choreographer added to the medical knowledge I had been accruing in pursuit of pain relief. Most unexpectedly, some characteristics of VR provoked corporeal responses that felt quite similar to my Buddhist meditation practices (along with acupuncture, these provided the only temporary relief I could find after a 20 year odyssey in centers for pain management). The methods of "pain distraction" that were practiced in pain centers in the U.S., more often than not, served to distract a patient's attention by having him imagine some far off, "happy place" — implicitly, the body was left behind. In my opinion, this only served as a temporary *disconnection* between the patients' corporeal experience and their imaginings.

Buddhist meditation practice, in contrast, focuses on an inward sense, one that could extend to an experience of inner vastness, and with practice, to a "remapping" of the experience of pain. Because our virtual environment was also an organic space (created from the data of an MRI of my body), it produced a new and sustained awareness of proprioception, or "where we feel we are in our bodies." This new awareness of proprioception and an oddly experienced kinesis felt akin to the senses of the corporeal I had while meditating.

After the first project in VR (*Dancing with the Virtual Dervish: Virtual Bodies*), I tested my own aversion to the idea of "pain distraction" by working on a VR application (at the Human Interface Technology Lab in Seattle) for patients who experienced 3rd degree burns and for ten year-olds who were suffering from acute pain during chemotherapy (at Georgia Tech). What I found was that pain distraction *does* work for acute pain. Our findings at the HITLab, for instance, suggested that VR was more effective than opiates during burn abradement (Hoffman 2004, pp.58-65). But the approach of distraction did not work for long term, chronic pain. Therefore, I returned to the site of inner senses and co-created the *Meditation Chamber* with Larry Hodges, another long term meditator, and Chris Shaw. We worked specifically on how biofeedback technologies, combined with VR, could bring perceptions of our inner workings into conscious awareness, and hoped that VR would help those who had never mediated with some form of feedback. As I learned from my classes in meditation, beginners often have little to no idea if they are actually effecting bodily change or not. Biofeedback provides some indication of this, and the Meditation Chamber seemed to fulfill our hopes for a functional aid that could be used in therapeutic ways at Virtually Better.[1]

What I gained from talking to many patients who experience chronic pain over the past 20 years is what Elaine Scarry articulated: that pain tends to be inexpressible, and tends to rob us of our language (Scarry 1985, p.5). My work in VR and with physicians on other projects were all conducted in order to give patients tools for expressing what seems inexpressible — both to help the physician with diagnoses and to enable personal expressions (Gromala & Shaw 2004, pp.253-256). The latter has been found to help with other conditions, such as depression (Segal, Williams & Teasdale 2001, pp.282-283).

My own attempts to deal with chronic pain led me to other courses of study, most of which are learned orally, in the presence of someone more knowledgeable: acupuncture, meditation (in its numerous forms), Tai Chi, Qi Gong, Yoga (in many of its forms) and "Body Talk," to name the more significant. I also studied anatomy and the history of medicine at Yale University, and took classes in Pain Management at the University of Washington in Seattle. Individual tutorials were sometimes provided by my physicians, whose interest was garnered after I presented my VR work. After my first artwork in VR, I worked in the design of virtual environments for use in pain management, always under the purview of a psychiatrist or physician. It is common, when presenting my work to audiences who have physicians in it, to later meet with them. Some led to collaborations, others to provocative experiments, like the psychiatrists at Wayne State

[1] Virtually Better is a spin off company from Georgia Tech. It is a center that treats psychophysiological conditions, from phobias to post-truamatic stress disorder. With a psychiatrist at his or her side, the patient uses VR in a variety of ways to treat their condition. Virtually Better has 20 clinical partners across the world that share VR applications and knowledge. The *Meditation Chamber* is currently in use there. See www.VirtuallyBetter.com

University's School of Medicine, who wanted to expose half of the first year surgical interns to the *MeatBook* and compare them to the control group, measuring the responses of both groups with an fMRI. (First year surgical interns usually have issues with cutting into living human flesh, according to one of the Psychiatrists there. They thought the MeatBook could provide a form of habituation, which could in turn reduce anxiety. We did not, however, gain Human Subjects approval.)

Beyond VR

At the time (1996), VR was at an impasse — its technical configurations were at their limit, and it was still very expensive, both in terms of programming hours and the cost of high-speed computers. In addition, the discourses surrounding VR were dominated by those who focused on VR's purported "disembodying" qualities. My position was that VR instead enabled a sense of re-embodiment. For these reasons, I decided not to follow a technology, but to follow experiences of the body that were enabled by any technology. In addition, each of my VR works that were designed for pain management took several years to complete, with an overwhelming amount of work devoted to Human Subjects approval. The creative aspects were tightly constrained by this process.

Thus, the artworks described in this thesis are but a few examples of how and why I explore technologies and materials ranging from biofeedback and typography to the creation of a quasi-animated book made of meat. From pragmatic design to interactive artwork, in their own ways, hopefully, these works can elicit and make experientially available felt experiences that usually are barely recognized because they are obscured by habit, cultural proclivities or because they are generally meant to be the background of our existence. This barely conscious awareness, or "registering" of the visceral, with practice, can become consciously controlled. At that point, they can potentially become transformative and become a visceral sense (refer to figure 3.1).

Text and Embodied Knowledge

One of the major precursors to these explorations was the context of my teaching job in Georgia Tech's School of Literature, Communication and Culture. The School was comprised of critical theorists of technology, a media scholar, literary experts and several other humanists. I was deeply familiar with these practices through numerous courses I took as an undergrad at the University of Michigan and a graduate student at Yale, and in collaborations with cultural theorists at the University of Texas and the University of Washington. Nonetheless, I found the daily assumptions under which these scholars worked surprising: they articulated an aversion to the flesh of the body, whether it was an idea or whether it related to the "craft" (production) of creating art- or mediaworks. This has deep historical roots, extending as far back as the ancient

Greeks (Shiner 2001, pp.19-27, 38-46). As Vivian Sobchack says of the tendencies of her colleagues in the Humanities, ". . . too often our central concern is to create an impossibly extroverted body whose investments have become completely exteriorized and performative, a body that we paradoxically have trouble seeing 'as it is' because we are no longer in touch with it" (Sobchack 1991, p.186). This experience reinstated my own values for the body, learned through art, design and feminist studies, along with a respect for the depth of our bodies that I learned from physicians, healers, and the collaboration with a choreographer in VR. Trying to articulate embodied cognition or "bodily knowledge," such as that of a skilled artisan, led me to a re-examination of Merleau-Ponty's work. In order to understand how and why this aversion was still at play, I co-authored a book with the historian Jay Bolter, entitled *Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency* (hereafter referred to as *Windows and Mirrors*), under MIT Press' *Leonardo* imprint in 2003.

What was most valuable in this collaboration is that although Bolter and I shared a deep love of design, I spent much of my time (as a trained artist and designer), trying to articulate the idea that, from my perspective, art and design has to do with the more ancient definition of aesthetics that referred to the sensorial, and not the culturally determined notion of the beautiful. Most importantly, however, was that I was interested in Martin Heidegger's and Merleau-Ponty's work since it seemed to offer the most productive work we could employ for our argument. In *Windows and Mirrors,* we tried to disabuse computer scientists of their assumption that the interface is nothing more than a "window" onto textual or numeric "information" that one was supposed to read through. Although this book was the first of my thesis works, it inadvertently took a slightly different direction than my original intention. The reader of *Windows and Mirrors* may be able to discern this, especially in the chapters that explored the works I curated for the SIGGRAPH 2000 Art Gallery (Bolter and Gromala 2003, pp.58-141, 144-149). It was necessary to stick more to discussions of the interface and less on the phenomenological contexts I intended to explore in much more depth. Finally, the book was written for both computer scientists and designers, in a style intended for a general audience. Readers will be able to recognize Heidegger's notion of present-at-hand and ready-to-hand, and that our notion of "oscillation" nears Merleau-Ponty's idea of reversibility. Nonetheless, the most important aspect about writing that book was that our fundamental disagreements — about the ability of humans to have pre-cognitive (or prenoetic) knowledge, bodily forms of tacit knowledge and immediacy (or any experience outside of language) — enabled me to later explore these issues to a depth that I would not have otherwise. For those daily but congenial disagreements, I am most grateful indeed.

An Intertwining of a Visible Artist, Invisible Inner Bodies and Worlds

Throughout the course of my artistic career, careful and sustained observation about the potential meanings of felt experience, focusing on the body, has been a way of life, a way of being in the world that has fed my artistic practice and scholarly writing. Many methodologies provide for ways to account for meaning and sustained observation of the body. However, none but Merleau-Ponty's approach allow for the close examination of felt, lived experience — from a first-person perspective that is verifiable, if necessary, by second-person perspectives and scientific methods — one that assumes that the body is the basis for all perception and meaning. Thus, I view the body as the ground and basis not only for experience, but also for creating and experiencing technologies, whether they are objects or procedures. For as much as they seem to be able to extend our bodies or become autonomous from us, no technology could be created without us, from the ground of our existence — our bodies. As Merleau-Ponty reminded us, technologies are in the realm of the world, and our bodies — felt or imagined (i.e., virtual bodies) — are continuously intertwining with the world, natural or simulated.

The deepest, innermost aspect of ourselves — our viscera — is usually and necessarily the silent background to our conscious experiences. This work seeks to bring that ground into awareness, to form part of the figure in a figure/ground relation, and to be potentially transformative.

Chapter One: Maurice Merleau-Ponty

1.1 Introduction

Since Maurice Merleau-Ponty's ideas are central to the creation and explication of this thesis, it is necessary to first examine his work in detail in this chapter. Though it is not common to begin with a chapter on methodology, the centrality of Merleau-Ponty's ideas and his phenomenological methods provide a framework for subsequent chapters. The methodology employed in this thesis is derived from the principles of existential phenomenology, particularly from the works of Merleau-Ponty (1908-1961). It includes subjective, first-person accounts of "lived experience." But these first-person accounts are not purely private accounts, as they are often assumed to be. Rather, they must be open to intersubjective validation (Varela and Shear 1999, p.1). Thus, second-person and the empirical, "objective," third-person accounts that are standard scientific practices in Human-Computer Interaction (HCI) are also included, especially in the examination of the *Meditation Chamber.* These accounts are triangulated, or cross-referenced, according to the types of accounting-for that were deemed to be most appropriate for each artwork. Triangulation involves comparing first-person, subjective accounts with observations of others, and with contextually relevant, scientific knowledge and/or methods. A discussion of the ways in which this methodology was engaged to respond to the contexts of each artwork is included in the methodology sections of Chapters 4, 5 and 6. For demonstrations and documentation of each artwork, please refer to the CDROM bound within. Where possible, the computer code for each artwork may be found online; the URLs are listed within Chapters 4, 5 and 6.

Each artwork created for this thesis is an experiment and enactment of some of Merleau-Ponty's major ideas. The *Meditation Chamber* enables users to more fully experience their own inner lifeworld, and to bring into conscious awareness some aspects of what usually operates invisibly, in the background of awareness: their autonomic system. The way in which the *Meditation Chamber* works is an example of Merleau-Ponty's concept of reversibility (refer to Chapter 4 and the CDROM: *Meditation Chamber*). *BioMorphic Typography* is also an example of reversibility (refer to Chapter 5 and the CDROM: *BioMorphic Typography*). In addition, it explores the "brute" and expressive aspects of language that Merleau-Ponty was developing at the time of his death at the age of 53. Finally, Merleau-Ponty's idea of reversibility and flesh are explored in the *MeatBook* (refer to Chapter 6 and the CDROM: the *MeatBook*). The second chapter is the review of pertinent literature, and the third chapter is an introduction to my work; subsequent chapters explore each artwork individually.

1.2 The Phenomenology of Maurice Merleau-Ponty

Maurice Merleau-Ponty was a French philosopher whose work focused on the body. Taylor Carman and Mark Hansen state, "... Merleau-Ponty's account of the bodily nature of perception, of the perceptual bedrock of human existence, remains his most profound and original contribution to philosophy" (Carman and Hansen 2005, p.10). His form of phenomenology is generally referred to as existential phenomenology. Although the work of his contemporaries and fellow existentialists, Jean-Paul Sartre and Simone de Beauvoir, were more popular in his time, Merleau-Ponty's work has enjoyed a significant re-emergence in numerous disciplines. Herbert Dreyfus explains that "While in the 1950s practically no one in the United States was thinking along these lines, now there is a converging interest in embodiment not only in philosophy but also in psychology, linguistics, cognitive science, anthropology, artificial intelligence, and neuroscience. In the 1950s, the one exception to the tradition of disembodied philosophy was the work of Merleau-Ponty" (Todes 2001, p.1). Scholars and artists in other disciplines who have exhibited a renewed interest in Merleau-Ponty's work are from the Humanities, the Arts, HCI and Medicine (Carman and Hansen 2005, pp. 1-3; Evans and Lawlor 2000, pp.1-3; Weiss and Haber 1999, pp. x-xvii; Gallagher 2005, p.1; Dreyfus and Dreyfus 1999, pp.103; Leder 1990, p.2-7).

1.3 Undoing Representationalism

Before we delve into Merleau-Ponty's work, a discussion of why Merleau-Ponty's phenomenology, and that of his predecessors is an important break from much of philosophical thinking is in order.

Proponents of representationalism sought to analyze and explain the "directedness of consciousness" by positing inner mental tokens. The function of these inner mental tokens was to:

> "depict or describe things out in the world. Ideas, or in Kantian jargon 'representations' (Vorstellungen), thus formed a kind of bridge, both causal and experiential, between the inner and the outer and were thus made to serve both a rational and a mechanical function simultaneously: ideas were at once supposed to be *effects* produced in us by the external world and to contain or *express* our knowledge of that world" (Carman and Hansen 2005, p.6).

These inner mental tokens would enable us to "understand the relation between the mind and the world" *if* we could grasp the peculiar nature and operation of those representational intermediaries. But this theory of ideas was "incoherent from the outset, because that theory took the notion of our awareness of our own ideas for granted as self-evident" (ibid.). Because our own ideas were self-evident, it was believed that they were not worthy of consideration.

The very notion of an *indirect,*

> "representationist theory of perception thus presupposes intentionality in the way it conceives of our epistemic relation to our own ideas, and yet disallows itself any recognition of that relation as an essential aspect of thought or perception" (Carman and Hansen, 2005, p.6).

Husserl's phenomenology was innovative because it rejected this epistemological picture by "distinguishing between the *objects* and the *contents* of consciousness. There is a difference, that is, between the things we are aware of and the contents of our awareness of them" (ibid.). Husserl makes a distinction between the abstract or "ideal" and the concrete or "real" aspects of mental phenomena. Husserl then inspired a generation of phenomenologists, including Heidegger and Merleau-Ponty.

Heidegger, however, disagreed with Husserl's methods. Thus, Heiddeger created his own account "not of some preconceived domain of 'pure' consciousness, or transcendental subjectivity, but of what he called our everyday "being-in-the-world" (Carman and Hansen 2005, p.9). For Heidegger, our everyday "being-in-the-world" included a consideration of intentionality — or that which representationalists assume or ignore.

What Merleau-Ponty learned from Husserl was "the need for faithful description of phenomena, as opposed to metaphysical speculation" (Carman and Hansen 2005, p.9) and complex, abstract philosophical systems. Where Merleau-Ponty differed from both of his predecessors was that he made the body central to his philosophy. While Husserl and Heiddeger mention the body, they both argued that consideration of it was beyond the scope of their ideas. Merleau-Ponty though argued that "perception and the body together constitute *the* phenomenon" (ibid.) that was crucial to our "being in the world" (ibid.). Merleau-Ponty described "embodied agents immersed in worldly situations in virtue of perceptual and affective attitudes whose contents are themselves often conceptually indeterminate" (Carman and Hansen 2005, p.10). His account of the bodily nature of perception and his notion of intentionality, along with the foundational ideas of Husserl and Heiddeger, all served to problematize those philosophical directions of representationalism. For these phenomenologists, there were no mental tokens that functioned as if by magic, no abstract, complex philosophical structures to rely on. Rather, they developed ways of directly experiencing the world, although *how* this was achieved differed among Husserl, Heidegger, and Merleau-Ponty. Merleau-Ponty's phenomenology, which posited the body and mostly prereflective perceptions of the world presented a radical contrast to representationalism.

1.4 Mearleau-Ponty and the Body

Merleau-Ponty examined common, everyday phenomena because he felt that science and philosophy had become too abstract and had lost sight of the very ground of our being — our bodies. As Carman and Hansen explain,

> "To understand Merleau-Ponty's work at all, one must appreciate his abiding commitment to . . . phenomenological description as an antidote to abstract theorizing, conceptual system building, and reductive philosophical explanation" (Carman and Hansen 2005, p.12).

Further, "Merleau-Ponty thus sought to rescue our understanding of perception from the conceptual oblivion to which traditional psychology and epistemology had consigned it" (ibid.).

Merleau-Ponty's work focused on phenomenological explorations of the body, especially its pre-reflective aspects, and its inextricability with the world. In his first major book, the *Primacy of Perception* (Merleau-Ponty 1964a), Merleau-Ponty explored what he called "inter-individual" perception, motility and habit. His later work progressed into the ontological realm, culminating in his last major and unfinished work, *The Visible and the Invisible* (Merleau-Ponty 1968). Though this book was unfinished at the time of his death, his colleagues published the completed chapters, along with his notes for subsequent chapters. This chapter of the thesis is an overview of several of Merleau-Ponty's ideas from both his earlier and his later works. This and subsequent chapters also include the work of Drew Leder, a physician and phenomenologist who extended Merleau-Ponty's work. Leder's contribution is crucial because it explores the innermost organs and viscera that Merleau-Ponty barely touched upon. Indeed, the criticism levied against Merleau-Ponty's work is that the body to which he referred was assumed to be healthy, athletic, and youthful to middle-aged (Ihde 2001, p.15). That is, he did not explore the vast differences in bodies that result from age or gender, although he did account for medical conditions in some cases. Further, Merleau-Ponty's work is also criticized because it primarily explored the body on its "surface level" (Leder 1990, p.62).

This criticism is somewhat unfounded, because Merleau-Ponty did explore the inner (or interoceptive) "senses" of proprioception and kinesthetics. Further, his work with neurologist Kurt Goldstein suggests that he was interested in atypical states of the body and the role of internal organs on perception. "Goldstein insisted that medicine and physiology be attentive to the essential unity of organisms and the global and subtle intermingling of seemingly discrete organs and functions" (Carman and Hansen 2005, p.12). Though this work was compelling, Merleau-Ponty did not have an opportunity to delve into these explorations because of his early death. Nonetheless, following Merleau-Ponty, Leder and Frank Buytendijk did explore the inner organs, their effects on the states of our minds/bodies, and their influences on perception. Leder focused on how the inner workings of the body are usually the imperceptible ground of our conscious perception in a figure/ground relation (Leder 1990), while Buytendijk explored the ways in which each organ played a role in perception and affect (Buytendijk 1974).

Merleau-Ponty's most productive ideas for the work of this thesis are the related ideas of *flesh* and the *reversibility chiasm* (Merleau-Ponty 1968, pp.127, 133, 138-149, 152-153, 248-251, 273-274).

Before I describe those terms, I will provide a simple explanation of how these ideas are utilized in practical, pedagogical ways that inform my teaching and research. To explain in the most jargon-free manner, I will discuss an assignment I give to my students, which was strongly inspired by phenomenologist Don Ihde (Ihde 2001, pp.4-5). I ask my students to close their eyes and imagine that they are parachuting from a plane. I slowly and verbally articulate each aspect, until at the end of five or six minutes, I describe landing. Afterward, I ask these students whether they saw themselves from a first-person perspective or from the third-person or omniscient point of view. Over seven years of giving this assignment in 4 different academic institutions and departments, I found what Ihde suggested: half of the students "experienced" the jump from a first-person perspective (body as subject), while the other half experienced it from a third-person perspective (body as object). In the last few years, students have reported that their "experience" is an alternation of these two points of view.

The goal of the assignment is to enact one of Merleau-Ponty's points: that we experience the world as both a subject *and* an object. According to Merleau-Ponty, Simon Todes (Todes 2001) and other phenomenologists, this ability is what lies at root of Descartes' mind and body distinction. They argue that Descartes associated the first-person view with a knowing subject, and that he confused our inherent ability to ALSO experience ourselves as objects. Leder makes the claim: that this is what led to Descartes' separation of mind from body (Leder 1990, p.128-134). Extending Merleau-Ponty's work, Leder demonstrated that our bodies have inner dimensions that are usually and necessarily inaccessible to the conscious awareness; and that these dimensions are in a reversible figure/ground relation (Leder 1990, pp.24-27, 31-35). When this usually inaccessible dimension can or does become conscious, it reverses and becomes the figure in the figure/ground relation. This inner dimension and its reversibility from figure to ground (or vice versa) is what is at work in the *Meditation Chamber* (refer to Chapter 4 and the CDROM: *Meditation Chamber*). Leder's extension of Merleau-Ponty's work is an important concept, because much of Merleau-Ponty's work focused on an intentionality towards an object or other human, and not within the visceral depths of one's own body.

1.5 Flesh

In Merleau-Ponty's earlier work, he referred to the body as the *lived body* to emphasize its always active, experiential dimensions, either potential or realized (Merleau-Ponty 1964a, pp.2, 5, 12-43, 162). In Merleau-Ponty's later work, *flesh* is the term he used to describe the more ontological and complex relations that arose from his claim that all arises from the perceptual, and is oriented toward-the-world. *Flesh* was also used to refer to the "corporeal consciousness" that is the basis of Merleau-Ponty's work (Merleau-Ponty 1968, pp.136, 151). For him, knowledge and experience are gained in and through the body, usually at the pre-reflective level of everyday interactions.

Flesh also implies, for Merleau-Ponty, that our bodies have intentionalities, an orientation toward the world, that in turn, offer possibilities for intertwining with the world in numerous ways that rely on context (Merleau-Ponty 1968, pp.130-155); also refer to Buytendijk and Gibson in Chapter 6). And so when mind, body and world are inevitably intertwined in countless ways, the world draws on these corporeal intentionalities, just as they arise from within. "Thus, flesh belongs neither to the subject nor world exclusively. It is a primal 'element'" (Merleau-Ponty 1968, p.139) out of which both are born in mutual relation. It cannot be conceived as mind or material substance. Rather, flesh is a kind of "coiling over of the visible upon the invisible" (Merleau-Ponty 1968, p.140), "which traverses me but of which I am not the origin" (Leder, 1990, p.62). In *The Spell of the Sensuous,* David Abram defines Merleau-Ponty's conception of *flesh* as "the mysterious tissue or matrix that underlies and gives rise to both the perceiver and the perceived as interdependent aspects of its spontaneous activity" (Abram 1996, p.66). This is the way Merleau-Ponty discusses meaning. For him, meaning cannot be purely or solely attributed to ideas, but usually precedes them in pre-reflective, bodily experiences — a kind of corporeal know-how. Further, Merleau-Ponty also claims that meaning bears an inherent materiality, from our bodies to objects. To take a contemporary example, as Mark Hansen suggests in *Bodies in Code: Interfaces with Digital Media,* there is always a body involved in any aspect of technology, and that cyberspace is anchored in the body (Hansen 2006, pp.3-5,14-15).

1.6 Reversibility

Merleau-Ponty continually sought to overcome strict dualistic thinking. A prime example of this effort lies in his concept of the *chiasmic* (a "crossing") *reversibility* (Merleau-Ponty 1968, pp.130-155, 199, 265-266). He uses the example of our hands touching each other to explicate this idea. We can never simultaneously perceive touching our right hand while it is also touching an object of the world, according to Merleau-Ponty and his predecessors. He suggests that "either my right hand really passes over into the rank of the touched, but then its hold on the world is interrupted, or it retains its hold on the world, but then I do not really touch it" (Merleau-Ponty 1968, p.148). As a result, there is a gap (or écart in French) between ourselves as touching and ourselves as touched, a divergence. However, this gap is important and fundamentally different from yet another dualism. (Carman and Hansen 2005, p.196-197). This is because touching and being touched are not just separate orders of being in the world, *but are a kind of fission that stops the body as subject from merging with the body as object.* The two categories are not ontologically separate, but are more akin to *two sides of the same process.* Further, the two sides also form "bridges," because of prior experience and because reversibility is always an imminent possibility. As Leder explains, " . . . the world leaps out of a chiasm between subject and object, my vision and that of others, perception and language" (Leder 1990, p.63). Further, touching and being touched are more than the body's capacity to be both a perceiving object and a subject of perception in a constant oscillation,[2] though never exactly in the same ontological category. Merleau-Ponty stated:

> "I can identify the hand touched in the same one which will in a moment be touching . . . In this bundle of bones and muscles which my right hand presents to my left, I can anticipate for an instant the incarnation of that other right hand, alive and mobile, which I thrust towards things in order to explore them. The body tries . . . to touch itself while being touched and initiates a kind of reversible reflection" (Merleau-Ponty 1964a, p.93).

[2] Oscillation is used to suggest that Merleau-Ponty's reversibility can be an extremely fast experience.

Figure 1.1 In touching one's own hands, we perceive our subjective sense of one hand that is doing the touching, while the other hand is perceived to be an object. This can become quickly "reversible" when we reverse the perception of which hand is doing the touching. Illus: Angela Tomizu, 2007.

Given that we cannot touch (or tickle) ourselves, or anybody else, without this tacit recognition — it seems that the awareness of what it feels like to be touched encroaches, or even supervenes upon the experience of touching (Merleau-Ponty 1968 p.47). This encroachment is an example of a "bridge." Thus, any absolute, dualistic distinction between touching and being touched, according to Merleau-Ponty, deprives the phenomena of their complexity (Merleau-Ponty 1986, p.137, 141). Our embodied experience is located in the *intertwinement* of the two aspects of touching and being touched, and not in one or the other. Merleau-Ponty posits here a chiasm, a crossing that has something like one crossing line "reaching" for or encroaching upon the other and vice versa. Merleau-Ponty uses the metaphor of a chiasm to describe how this overlapping and encroachment can occur between a pair (such as touching and being touched) that nonetheless retains a divergence (or, in his words, a dehiscence), as touching and being touched are never exactly the same thing.

According to Merleau-Ponty, this concept also bears an applicability that extends well beyond the relationship between touching and being touched. He contends that many dualisms, such as body and mind (Merleau-Ponty 1968, pp.247, 259), subject and object, self and world (Merleau-Ponty 1968, p.123), are all associated in this immanently reversible chiasm.

1.7 Intertwinements and Reversibility of Body and World

According to Merleau-Ponty, this chiasmic reversibility, this non-dualistic divergence between touching and being touched—which necessitates some form of crossing or encroachment between the two,—also means that the world is capable of encroaching upon and altering us, just as we are capable of altering it. This ontology then rejects or blurs any absolute distinction between self and world, along with any notion of subjectivity that valorizes a rational, autonomous individual. Merleau-Ponty explicitly asserts this when he states that what is rarely considered is the paradoxical fact that though we are *of* the world, we are nevertheless *not* the world (Merleau-Ponty 1968, p.127). In affirming the interdependence of humanity and the "things," objects or phenomena of the world in a way that allows neither fusion nor absolute distance, he advocates an embodied inherence of a different, non-dualistic type. Merleau-Ponty asserted:

> "(This) does not mean that there was a fusion or coinciding of me with it: on the contrary, this occurs because a sort of dehiscence opens my body in two, and because between my body looked at and my body looking, my body touched and my body

> touching, there is overlapping or encroachment, so that we may say that the things pass into us, as well as we into the things" (Merleau-Ponty 1968, p.123).

Merleau-Ponty's notion of a chiasmic reversibility is an important idea for interactive art generally, and the work within this thesis specifically, in that it foregrounds and stresses the importance of the world's "affordances" (as understood in HCI). That is, our mind/body both has experiences according to its intention as well as a calling forth from the world, according to specific contexts of the world. In Gibson's terms,

> "Technically, an affordance is a property of the environment that affords action to appropriately equipped organisms . . . In other words, an affordance is a three-way relationship between the environment, the organism, and an activity" (Gibson 1983, p.118).

1.8 Merleau-Ponty's Consideration of Art

Art, whether painting or interactive art, engenders an ability of our bodies to be able to transform perception, to imagine, to become Other and to experience, say, flying. He termed this the imaginative or virtual body. As Steeves relates, "The painter plays on habitual ways in which we perceive different situations with our bodies so that we are able to see the world in new ways" (Steeves, 2004, p.4). Steeves uses the example of painting because it was the art form that Merleau-Ponty explored in the most depth.

Discussing Merleau-Ponty's ideas further, Steeves continues,

> "The meditation of Being in the form of flesh precedes any real/virtual distinction, as well as any actuality/possibility distinction. The reversibility of the real and the virtual can be seen in the fact that the flesh, while being immersed in the real experience of the sensible, contains the possibility of the sentient as the sensible's inner lining. *Flesh, in other words, is the medium for the possible without which possibilities could never be taken up by the sensing body"* (emphasis mine) (Steeves 2001, p.150).

So, for example, although we may never fly without technological prostheses, we can feel a sense of what that may feel like by "flying" in immersive VR, or in our dreams. But the body is the bedrock from which these sensations arise.

Steeves further interprets Merleau-Ponty's consideration of art as he argues that, "The artist, like the mime, is aware of the creative role that the body plays in perception and attempts to return to the viewer's attention to the creative power of the body" (Steeves 2004, pp.7-8). An artwork may present a quality to the imagining body "an entire perceptual structure that the body understands as a world of virtual and possible modes of embodiment" (Steeves 2001, p.7).

For artists, according to Merleau-Ponty, art is a battle "more than a struggle to represent objects, it is a fight to reinvent the very way we perceive the world" (Steeves 2004, p.51). What distinguishes Merleau-Ponty from others who write about art and literature is that he demonstrates an "appreciation that he shows for the expressive body and the role it plays in every form of art . . . what is common in every artwork is the way it uses the imagining body to extend the experience of perception to a heightened sense" (Steeves 2001, p.53). Further, as Merleau-Ponty stated, "I would be at great pains to say where is the painting I am looking at. For I do not look at it as I do a thing; I do not fix it in its place. My gaze wanders in it as in the halos of Being. It is more accurate to say that I see according to it, or with it, than I see it" (Merleau-Ponty 1964a, p.164). The work of art offers not another visible object but a visible presentation of the "genesis of things" (Merleau-Ponty 1964a, p.183). Like Merleau-Ponty's pre-reflective perception, "art . . . is in contact with the world which precedes thought about the world" (Merleau-Ponty, 1964b, p.28).

Style

For Merleau-Ponty, the body of the artist

> "forms a background for the artistic vision. . . These styles, unique to each artist, are essentially ways of being embodied in the world that are universalized in the visible work of art, available for all to see and to virtually explore with their own imagining bodies. The artwork is an expression of the artist's style of embodiment" (Merleau-Ponty, 1964b, p.52).

"The work of art," Merleau-Ponty continues, "provides us with 'new organs' (ibid.) with which to see the world.

The philosophical significance and effects of art, for Merleau-Ponty, extends to "its mode of production in the work of the artists" (Carman and Hansen 2005, p.15). For "paintings are not just finished products, but echoes of human effort, human perceptions of the world, human lives" (ibid.). He continues:

> ". . . works of art are living extensions of flesh-and-blood persons, and they manifest the human condition in much the same way our bodies do: by realizing in gesture a particular coherent *style,* an understanding, a sensitivity, a way of being in the world. Style characterizes great art, but it is also an essential aspect of ordinary perception and action. Over and above the objective movements of a person's body, what we see when we see the person – in particular, when we *really* see him, by *recognizing* him – is his *character,* the *style* of his comportment. What is enigmatic about style, apart from its sheer conceptual elusiveness, is its ubiquity; it is not an isolated property, but manifests itself globally in handwriting, in typical behaviors, in voice and speech. Only by drawing direct connections between what we learn from the exemplary expressive power of artists and what we already know of ourselves and each other by knowing our characters, Merleau-Ponty believed, will we come to appreciate the philosophical significance of perception and the body" (Carmen and Hansen 2005, p.15).

1.9 The Absent Body

Leder seeks to account for our innermost selves — including the visceral systems I have outlined — in *The Absent Body.* According to Leder, Merleau-Ponty focused more on the exteroceptive and surface aspects of our bodies, on perception and motility, and less on the interoceptive and depth of our physical interiority (Leder 1990, pp.36-37). Examining our interoception is important since, according to Heinz von Forester, "we are 100 thousand times more receptive to changes in our internal than in our external environment" (von Foerster 2002, p.221). That is, we have significantly more ways of registering or sensing our internal states — even though they usually operate in the background of our conscious awareness — than our exteroception. Most of the time, the information or sensation associated with our internal states must necessarily remain quiescent or they would overwhelm our conscious states. However, in ways similar to F.J.J. Buytendijk's *Prolegomena to an Anthropology and Physiology* (Buytendijk 1974) and Gibson's *The Senses Considered as Perceptual System* (Gibson 1983), Leder explicates some of the ways in which interoception is usually the background of our mind/body experiences, as well as how it can be brought into our conscious foreground. He terms this the "ecstatic/recessive structure of embodiment" (Leder 1990, pp.47, 53-54). This can change according to certain events, as each system can be *both* passive and not passive (or "seeking," according to Gibson), depending on the state of the individual. Hunger provides an example: when sated, we usually are unaware of our visceral goings-on (unless we have gas), but after a while, small twinges of hunger tweak our awareness until, when extremely hungry, we direct most or all of our conscious efforts to finding food.

What we do know about the enteric system (which is from mouth to anus),[3] for example, is that it can enormously impact our mood and disposition, partly because many of our mood-changing neurotransmitters and like-substances are created and work there (Gershon 1999, p.18) and partly because of the workings of our "protopathic sensibility" (Àdàm 1998, pp.141-142). Àdàm uses Henry Head's term of the protopathic sensibility to describe "the function of the more ancient, less differentiated system of carrying thermal and pain messages from the periphery" (ibid.) to the brain. Àdàm found that parts of the system which accounts for protopathic sensibility are visceral and function there, while other parts reach the brain. By not taking these constant affective shifts into account, Leder reminds us, our understanding of being-in-the-world is simply inadequate. Further, he suggests that viscerality "adds further dimension to Merleau-Ponty's chiasmic analysis" (Leder 1990, p.65). Accordingly, our body is not just an

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[3] Note that North American physicians do not generally consider that what we ingest through the enteric system is "in" our bodies until or unless it is absorbed. Rather, they consider the enteric system to be something like a tunnel (of the external world) through our bodies. (Gershon 1990, p.18).

intertwining of perceptual possibilities. Rather, Leder adds what he terms a "vertical synergy:" that our bodily surface powers are dependent upon deeper processes, a chiasm of conscious and nonconscious levels, "a viscero-estheiological"[4] being. The artwork created in this aspect of the investigation, the *MeatBook* (refer to Chapter 6 and the CDROM: *MeatBook*), is an exemplar of how these processes can be brought into conscious awareness and experienced.

1.10 Summary

Merleau-Ponty's phenomenological work on the bodily nature of perception, and of the body as the perceptual basis of being has been an important set of ideas that has recently been re-emerging in numerous disciplines as enumerated in section 1.2. The body intermingles in numerous ways, usually at a pre-reflective level. To illustrate this, Merleau-Ponty offers an example of the everyday: "To be sure, if a woman of good faith who closes her coat (or the contrary), were questioned, she would not *know* what she has just done" (Merleau-Ponty 2004, p.190). The intermingling of body and world is a dual process: the body is generally focused outward, toward the world, through its own intentions; the world also calls the body forth, according to its affordances. These intertwinings are transformative. In Merleau-Ponty's words, "The body unites us directly with the things through its own ontogenesis" (Merleau-Ponty 2004, p.253).

The characteristic most pertinent to this thesis is Merleau-Ponty's related ideas of *flesh* and a *chiasmic reversibility.* According to Evans and Lawlor, "*flesh* is two-sided; and its two sides — the sensitive and the sensed—are not thought entirely apart from each other. The sides of perceptibility are reversible—as a jacket or the windings of a Mobius strip" (Evans and Lawlor 2000, p. 190). Merleau-Ponty uses the example of one of our hands touching the other: one hand does the touching, while the other hand is sensed as being touched. While one can reverse this sensation, it is not possible to equally sense both hands as touching each other, simultaneously.

Merleau-Ponty developed an understanding of art that includes both the body of the artist, available through her style or particular way of being in the world, one that enables the viewer to experience something of it as well. Merleau-Ponty explains in provocative terms that ". . . the artist appeals to others only because 'there is a little of him in every man'' (Merleau-Ponty p.64). What works as a common bond between the observer and the artist "is the creative potential of the imagining body," (Steeves 2004, p.66) along with the "gaps and fissures that the viewer is left to imagine" (Steeves 2004, p.7-8).

[4] Estheiology refers to study of the skin's surface layers.

Drew Leder, a contemporary physician, extended Merleau-Ponty's phenomenology into the realm of the visceral, as did, to lesser degrees, Buytendijk and Gibson. Merleau-Ponty's ideas of reversibility, along with Leder's extension of Merleau-Ponty's ideas into our innermost realms of the viscera are explored in more detail in the subsequent chapters. Chapter 2 is the review of the literature; Chapter 3, the hypothesis and examination of the field of interactive art; and Chapters 4-6 illustrate these ideas through the explications of the artworks.

Chapter Two: Literature Review

2.1 Introduction: Phenomenology

Few methodologies account for the subjective, first-person experience of the lived body. Phenomenology is one of a few that focus on subjective experience. However, phenomenology is not a hegemonic philosophical tradition, but is rather comprised of differing and often conflicting ideas. Merleau-Ponty's particular form of existential phenomenology is best suited for the questions about the visceral because it focuses on the body and its intertwinement with mind and world, from subjective, first-person accounts, accounts which can be compared to second- and third-person accounts. The resurgence and extension of Merleau-Ponty's work over the last two decades has been observed across numerous disciplines: Medicine, Physiology, Neuroscience, Psychology, Cognitive Science, Artificial Intelligence, Mathematical Modeling, Philosophy, Ecology, the Humanities and the Arts (refer to Chapter 1, section 1.1). This is not an exhaustive list, but it does make evident the usefulness of Merleau-Ponty's work.

Merleau-Ponty's phenomenology will primarily guide this analysis. The major precepts of Merleau-Ponty work are first, that not everything is amenable to critical reflection (especially that which involves intense corporeal involvement, from craft to intense visceral sensations). Second, he rejected the abstract structures of representationalism (or intellectualism), because he believed they privileged mind over body and kept us at a length from lived experience (refer to section 2.2). Thus, he strived to create a theoretical wholism that would enable a return to the phenomena of everyday life; in doing so, to some degree, he rejected detachment and many forms of objectivity. Finally, he believed that an active social context is the ultimate foundation of intelligibility.

2.2 The Body

Because the visceral sense is a subset of the larger question of the body and experience, the literature review begins with a review of publications that most closely examine foundational issues of the "felt" body in two primary areas: first, traditions of Art History, Philosophy and Cultural Studies in the Humanities, and second, aspects of cognitive science most closely aligned with HCI. Both present limitations. While intellectual traditions in the Humanities, particularly Cultural Studies, deal with the social, political and economic meanings of the body in broader cultural contexts, it most ignores the material, scientific facts of the body. Many of these theorists do not include first-person, subjective experience unless they come from a feminist (Grosz 1994; Carmen and Hansen 2004, p.193) or a phenomenological tradition. This remains despite the veritable explosion of publications in humanistic studies on the body (For an overview, refer to Frank 1990, pp.131-62.). Cultural theory is limited in that critique, analysis and critical awareness are its primary end goals; less often, productive enactment or embodiment outside of textual forms are examined unless performativity (Butler 1993) is a focus. Likewise, Neuro- and Cognitive Science can tell us how the body works — for example, what proprioception is and the contesting accounts of how scientists currently believe it works — but rarely does it offer tools to examine the meaning that proprioception can assume in subjective terms or in broader cultural contexts. In addition, scientists tend to view the body as ahistorical (Clark 1998, pp.1-2; Romanyshyn 1989, pp.110,174). Nevertheless, such traditions provide useful concepts and observations that can inform an artistic practice.

Important exceptions in both the Humanities (Min-ha 1991; Arendt 1998; Vattimo 1992; Hayles 1999; Massumi 2002; and Shaviro 1993) and Cognitive Science, Computer Science, and Neuroscience (Clark 1998; Dourish 2001; Dreyfus 1992; Evans 2000; Varela, Thompson and Rosch 1993) remain. Most notably, the intellectual tradition of Merleau-Ponty's existential phenomenology is employed by or has significantly influenced these scholars, because it directly grapples with the body as object AND subject; because it insists on everyday, pragmatic analysis over disconnected, abstract reasoning; and because it pervades areas of Art, HCI and the Humanities. Its recent and growing reemergence signals its usefulness (refer to Chapter 1, section 1.2). The following summary briefly outlines differing traditions of phenomenology. These major directions of continuing phenomenological study are useful to distinguish between, since Merleau-Ponty's existential phenomenology does differ in significant ways from other phenomenological traditions.

2.3 Phenomenological History

Phenomenology is defined as the study of structures of experience from a subjective or first-person point of view (CARP 1997, p.1). As such, it has been practiced for centuries in differing forms; for example, when Hindu and Buddhist philosophers examined numerous states of consciousness achieved in practices of meditation. As a field or movement in the Western history of philosophy, however, contemporary phenomenology is just over a hundred years old. As Merleau-Ponty realized, "phenomenology can be practiced and identified as a manner or style of thinking, that it existed as a movement before arriving at complete awareness of itself as a philosophy" (Merleau-Ponty 2004, p.64). Preceded by the work of Immanuel Kant (Cerbone 2006, p.36), G.W.F. Hegel (Woodruff-Smith 1997, p.3), and Franz Bretano (Cerbone 2006, pp.11-12), Edmund Husserl (Cerbone 2006, pp.5, 11-37), is generally acknowledged as the progenitor of the Western, historical movement of phenomenology, which he termed the "science of consciousness" (Woodruff-Smith, D 1997, p.3).

Since Husserl's work, differing traditions of phenomenology have been developed. The *Center for Advanced Research in Phenomenology* (CARP 1997, p.4) offers a useful if condensed schema, using the metaphor of the trunk of a tree (represented by Husserl) and four branches. The first branch, *realistic phenomenology,* is the search for universal essences; Adolph Reinarch, Max Scheler, Edith Stein and Roman Ingarden are a few of its major contributors. The second, *constitutive phenomenology,* is deemed the philosophy of natural sciences, including Husserl's method of epochê. Husserl's epochê can be understood as a kind of "bracketing" off of the object one is studying from one's prior knowledge or preconceptions of it, in order that the object can be allowed to reveal its essential features. In the some academic arenas, this has been rejected as an "essentialist" attitude, that is, an attitude that ignores or significantly limits the role of culture (Collins 2003, pp.69-73). Oskar Becker, Aron Gurwitsch and Elisabeth Stroker are its major proponents. The third branch, *existential phenomenology,* includes Hannah Arendt, Miki Kyoshi and Kuki Shuzou, Emmanuel Levinas, Simone de Beauvior, Maurice Merleau-Ponty, Jean-Paul Sartre and Alfred Schütz. "These phenomenologists, rejected Husserl's position of a detached observer and insisted instead that the observer cannot separate himself from the world," (Stewart and Mickunas 1990, pp.64-65), they termed this being-in-the-world. In addition, "the modalities of conscious experience are also the ways one is in the world," (ibid.). While Sartre and Merleau-Ponty were concerned with the individual, Levinas and Schütz were interested in the intersubjective, collective or the social body. Finally, the practitioners of *hermeneutical phenomenology* strive to understand human existence as interpretive; Hans Gadamer, Paul Ricoeur, Don Ihde, Gianni Vattimo and Carlo Sini are among its major proponents.

In most cases, phenomenologists study structures of conscious experience from a subjective, first-person position, along with conditions of that experience. Intentionality is usually understood to be the central structure of experience — that is, the way experience is directed is through its meaning or content toward a certain object in the world (Cerbone 1999, pp.4-5, 11, 14-17, 124). Despite the differences among the four major branches, phenomenologists tend to share certain features. First, for the most part, they reject grand and abstract theorizing, preferring to focus on the "lived world." Second, they generally oppose objectivism, positivism and intellectualism, terms for a dualistic worldview that privileges mind over body, dominant since the Renaissance. Third, phenomenologists tend to believe that objects in the natural and cultural worlds, and ideal objects, such as numbers, can be known. Fourth, they "tend to recognize the role of description in universal, a priori, or 'eidetic' terms" to precede "explanation by means of causes, purposes, or grounds." And finally, phenomenologists debate whether or not Husserl's "epochê" (or bracketing) "is useful or even possible" (CARP 1997, p.2).

Although conscious experience is an experience we live through or perform with awareness, phenomenologists also study experiences that we are also less overtly aware of. Martin Heidegger, for example, examined actions such as hammering a nail, walking, and speaking in our native language. These are actions we are not generally or explicitly conscious of, unless we are made conscious of these habitual actions, such as when we break a hammer, leg or suffer from aphasia (Dourish 2001, p.139). Michael Polanyi, in a related vein, examined the "tacit" aspects of knowing and being (Polanyi 1975, 1983). Similarly, in *Windows and Mirrors,* Bolter and I suggest that the context of the work should determine the varying levels of transparency (windows) and reflexivity (mirrors), and that many works of art and design oscillate between the two (Bolter and Gromala 2003). Our argument of oscillation comes very close to Merleau-Ponty's notion of reversibility, where "conscious experience" may continually range and "reverse" from full awareness to semi-conscious states, to habits or nonconscious experiences.

2.4 Maurice Merleau-Ponty

Existential phenomenology, as defined by Don Ihde, "is a philosophical style that emphasizes a certain interpretation of human *experience* and that, in particular, concerns *perception* and *bodily activity"* (Ihde 1990, p.21). One of Merleau-Ponty's main contributions was his analysis of the primacy of the body and perception, as explored in *Naturalizing Phenomenology.* The authors state:

> "Merleau-Ponty's interest in perception is not about the act of perception but about the way the perceived world appears . . . It emphasizes the importance of grounding phenomenological analysis in the dimension of embodiment that entails an openness to the world, where perception is not understood just as a mediator between world and consciousness" (Petitot, Varela, Pachoud and Roy 1999, p.53).

That is, Merleau-Ponty considered the body as the locus or the very ground of existence. The tradition of existential phenomenology, particularly as developed by Maurice Merleau-Ponty and those who have extended his ideas, is directly relevant to the investigation of the visceral sense. This is because Merleau-Ponty's main concern was the *lived body*, especially its pre-reflective perception. At least since the time of Descartes, the Western intellectual tradition has assumed a separation between mind and body, and has privileged mind over body. Maintaining the privileged position of the mind versus the body does not disrupt the Humanist tradition of considering humans as rational, as "higher forms of life" and central to most concerns. Privileging the mind also retains the agency humans are assumed to have in the nature versus nurture debate. Thus, few philosophers have given serious consideration to the primary role of the material body. In Merleau-Ponty's phenomenology, however, *one needs to be in order to think*, and the basis of being for Merleau-Ponty is the body.

To put it more clearly, according to Merleau-Ponty, the body is the ground and condition for the mind. This is an inversion of traditional philosophy, where one proceeds from perception to meaning to action. Merleau-Ponty and other phenomenologists thus reorient the question from, "How can we know about the world?" to "How does the world reveal itself to us through our (embodied) encounters with it?" From this perspective, meaning lies not in the mind as distinct from the body, but in everyday, embodied interactions with the world.

The work of Merleau-Ponty in particular is directly concerned with embodiment. He drew together the work of his predecessors — Husserl's concern with perception and Heidegger's orientation of being situated in the world — by focusing on the role of the body in perception (Carman and Hansen, p.340), a body situated in and inextricable from the contexts of the world. For Merleau-Ponty, the body is neither object nor subject, but continually circulates between them, and is a lived, experiential structure and the context or milieu of cognitive mechanisms. Attributing all consciousness to pre-reflective awareness of the corporeal, Merleau-Ponty tried to overcome the traditional dichotomy between subject and object through his concept of an interworld (ibid.) — an inextricable intertwining among mind, body and world. He emphasizes the critical role of the body in mediating between internal and external experience.

Merleau-Ponty also argued that that the innate structure of the human body limits experience, materially and culturally. For him, culture and language impose limits on perception. For instance, language is enacted rather than any kind of pre-given crucible out of which meaning and interpretation flow. Wary about fully attributing intentionality to consciousness, Merleau-Ponty focused on "intentionality within being." This is an intentionality that *precedes* consciousness. Accordingly, for Merleau-Ponty, the body is not separate from the world but is always situated within it, and attunes itself with it, intermingles with it. The way in which the world occurs, prior to our focused attention, as an unconscious but accessible background to our activity, is essential to our mode of being. Merleau-Ponty states that, if left to itself, perception "forgets itself and is ignorant of its own accomplishments" (Merleau-Ponty, 1964a, p.89). According to Merleau-Ponty, the very intertwining of the perceiving organism with its surroundings is what lies at the basis of perception. This means that there is no separate mind, as Descartes argued, and no abstract universal; there is only perception as it is lived in the world. For Merleau-Ponty, consciousness is perceptual, an ontological intertwinement of mind, body and the world.

Merleau-Ponty availed himself of scientific work, especially with the neurologist Kurt Goldstein. Goldstein collaborated with Gestalt theorists, as had Merleau-Ponty, and studied patients who had aphasia. "Goldtsein insisted that medicine and physiology be attentive to the essential unity of organisms and the global and subtle intermingling of seemingly discrete organs and functions" (Carman and Hansen 2005, p.12). Further, Merleau-Ponty believed that every organism continually worked toward a normative equilibrium (ibid.). He sought to "rescue our understanding of perception from the conceptual oblivion to which traditional psychology and epistemology and consigned it" (ibid.). Finally, Sean Kelly, drawing on Merleau-Ponty, argued that the nonconceptual content of perception is due to two interrelated aspects: one the one hand, it is due to the context dependence of the *sensory appearance of objects,* while on the other hand, it is due to the *object-dependence of the sensory appearance of qualities.* To put it a different way, the same thing looks different according to different contexts or situations. Both Sartre and Merleau-Ponty pointed toward the context-dependence of color to illustrate this point. By referring to paintings of Matisse, they contend that *color is not an abstract property, but is a concrete feature* of the genuinely tactile object: in Sartre's case, he spoke of the "woolly red" of a Matisse's painting of a carpet, while Merleau-Ponty spoke of a "woolly blue."
Finally, Mearleu-Ponty concerned himself with art throughout his career.

2.5 Contemporary Phenomenology following Merleau-Ponty

Phenomenology has enjoyed a resurgence in the past decade in the Humanities, — from Philosophy (Ihde 2001; Weiss 1999a; Welton 1999) to Film Studies (Sobchack 1991; Marks 2000) — as well as in the Sciences, from Cognitive Science and AI (Dreyfus, 2005) to HCI (Dourish 2001). An articulation of its relevance in disciplines that directly bear on the visceral sense follows.

Phenomenology

Merleau-Ponty, as stated earlier, has had an effect on numerous disciplines. It is beyond the scope of this thesis to go into his contributions in detail for each discipline, so this discussion is limited only to the way Merleau-Ponty has affected contemporary phenomenology according to the issues at hand. It should be noted first that the work of Todes (Todes 2001) builds both on that of Merleau-Ponty's and Gestalt Psychology. According to Hubert Dreyfus, author of the introduction to Todes' book (Todes 2001, p.xviii), Todes' work extends Merleau-Ponty's in ways that account for the orientation of the body and motility, and offers a strategy to overcoming what was found to be problematic in Merleau-Ponty's work. That problem is that Merleau-Ponty's work tends toward idealism. Todes' preserves the authority of experience while avoiding this tendency toward idealism (ibid.) in his description of how independent physical nature and experience are united in our bodily action. Merleau-Ponty was aware of his tendency, and tried to overcome it with his notion of intertwinement of body and world, so it is more a matter of degree — Todes takes on the issue of idealism directly, and to a greater degree. In addition, according to Dreyfus, "In offering an original account of the role of the body in making knowledge possible, Todes opens new ways of thinking about such problems as the relationship to thought and the possibility of knowing an independent reality" (Todes 2001, pp.xiii-xiv). Further, Todes extends Merleau-Ponty's work by emphasizing the complex structure of the human body: "its front to back asymmetry, its need to balance in the earth's gravitational field, the role that bodily structures play in creating the spatiotemporal field of experience, and in making possible objective knowledge of the objects in it (Todes 2001, p.xiii). He shows that perception involves nonconceptual, but nonetheless objective forms of judgment. In this last argument, the work of Todes closely relates to Michael Polyani's idea of "tacit knowing" (Polyani 1993). According to Jerry Gill,

> "The pivot point of Polyani's reconstruction of the concept of objectivity is, of course, his notion of tacit knowing. By extending the cognitivity (sic) dimension of human experience to include the tacit pole as well as the explicit pole, he has made it possible to understand the matrix out of which knowledge is actually generated, namely, the interaction between subsidiary awareness and somatic and/or imaginative participation. This not only allows us to see the crucial role played by personal commitment and aspiration in all knowing, but it acknowledges the cognitive significance of bodily activity as well" (Gill 2000, p.178).

Taylor Carman and Mark Wrathall make clear in their essays that Merleau-Ponty's perception is "neither brute sensation nor rational thought, but an aspect of the body's intentional grip on its world," physical or social (Carman and Hansen 2005, p.12). Gail Weiss and Don Welton discuss diverse meanings of body images, returning to Merleau-Ponty's original description as the authoritative definition and description of how it works (Weiss 1999), while Don Welton explores further Merleau-Ponty's notion of *flesh* (Welton, 1998, 1999).

Film Studies and Art

Although Film Studies has been dominated in recent decades by analyses derived from psychoanalysis and ideology, phenomenologist Vivian Sobchack (Sobchack 1991, 2004), and theorists Laura Marks (Marks 2000), and Steven Shaviro (Shaviro 1993) account for the somatic, felt experience of film. In Art History, James Elkins (Elkins 1996, 1999) focuses on the corporeal reception of art, emphasizing bodies as both primary objects of seeing and as the principle conditions for seeing. Although Rosalind Krauss is not predominantly considered to be a phenomenologist, she conducts a corporeal reading of important moments in modernity and art (Krauss 1993). Though none of these theorists but Shaviro have take interactive art into consideration in their books, Sobchack and Marks have dealt with interactive arts in conferences and class lectures.[5] Whatever their commitment to examining interactive arts, these theorists provide useful examples of contemporary phenomenological methods of analyses that deal with the corporeal in relation to art.

Cognitive Science

In cognitive science, Varela, Thompson and Rosch directly extend Merleau-Ponty's work by arguing that in order to obtain a more complete understanding of cognition, a sense of common ground between mind in science and mind in experience must be developed (Varela, Thompson and Evans 1993, p.39). Consequently, they developed a "dialogue" between cognitive science and Buddhist meditative psychology. This provided a basis for my research in the development of the *Meditation Chamber* (refer to Chapter 4). Their approach combined a first-person methodology with scientific methods. In subsequent work, Varela also illustrated the way the body is the condition for being as well as an object, through his examination of his felt experience of his own transplanted liver (Varela 2001, pp.259-271). This strongly resonates with this author's work with VR and pain (Gromala 1996, pp.222-237).

Andy Clark (Clark 1998) interweaves ideas and techniques from artificial intelligence (AI), robotics, psychology and neuroscience to argue that mind/brain, body and world are intertwined in a complex "dance" of computation and causation. Clark states:

> "This simple shift in perspective has spawned some of the most exciting and groundbreaking work in the contemporary study of mind. Research in "neural network" styles of computational modeling has begun to develop a radically different vision of the computational structure of mind. Research in cognitive neuroscience has begun to unearth the often-surprising ways in which real brain use their resources of neurons and synapses to solve problems. And a growing wave of work on simple, real-world robotics is teaching us how biological creatures might achieve the kinds of fast, fluent real-world action that are necessary to survival. Where these researches converge we glimpse a new vision of the nature of biological cognition: a vision that puts explicit data storage and logical manipulation in its place as, at most, a secondary adjunct to

[5] Marks is a regular speaker at my department's colloquia, where she talks about the relation of Middle Eastern artistic traditions and contemporary interactive art in her upcoming book. Vivian Sobchack provided a lecture and participated in CAiiA-STAR's and UCLA's DART conference in 2002.

> the kind of dynamics and complex response loops that couple real brains, bodies, and environment" (Clark 1998, p.1).

Although cognitive science is not the primary knowledge base for this investigation, it does inform HCI, which is a community that regularly informs the technical depth of my work; it regularly includes my publications and adjudications.

HCI

The perceptual psychologist Gibson (Gibson 1983) provides a foundational reference for HCI. Rather than understanding the senses as simple channels of stimulus, Gibson makes a distinction between that passive view, and the active, "ecological" view he articulated. He does not treat different senses as mere producers of visual, auditory, tactual, or other sensation. Rather, he also regards them as *active* seeking mechanisms. Gibson's position in this regard, along with his ideas of "affordance" and "disposition" strongly parallel Merleau-Ponty's "intentionality within being." This is clear in the way Gibson defines the term affordance as "a three-way relationship" (Gibson 1983, p.118) among the environment (or world, in Merleau-Ponty's terminology), the organism (human) and an activity. In other words, Gibson's idea of affordance in many ways parallels Merleau-Ponty's intertwinement of mind, body and world, or *flesh,* the primal 'element' from which all are born in mutual relations.

In HCI, phenomenology is a contentious theoretical position, particularly in the analyses of computational theories of cognition and artificial intelligence (Dreyfus, 1992; [6] Winograd and Flores, 1986). The works of Hubert Dreyfus in particular were initially strongly rejected by the AI community. More recently, his work has led to the quickly growing field of "embodied AI research." More closely related to the research at hand, Paul Dourish has outlined both a phenomenological method for analysis as well as a foundation for design that refocuses the assumptions upon which design is based in computer science, from procedural to interactional. This brings HCI design much closer to artistic practices. He argues that:

> " ... phenomenology turns our attention to how we encounter the world as meaningful through our active and engaged participation in it . . . The design concern is not simply what kinds of physical skills, say, we might be able to capitalize upon in a tangible interface, or what sorts of contextual factors we can detect and encode into a ubiquitous computing model. Instead, we need to be able to consider how those skills or factors contribute to the meaningfulness of actions" (Dourish 2001, p.12).

[6] Dreyfus' basic position is a rejection of representationalism. That proposition is that the fundamental relation of a person to the world consists in the relation of the content of an individual *mind* to the world of objects, events, and states of affairs as represented by that content. Instead, he argued that the most fundamental variety of human action consists of the apparently unthinking, skilled action that makes up much of our everyday activities— ones that do not require mental guidance for its successful accomplishment (Dreyfus 1991, p.52). According to Dreyfus, our experience of action is of a "steady flow of skillful activity" in which we are "simply solicited by the situation to get into equilibrium with it" (Dreyfus and Dreyfus 2005, p.111).

Meaning is a primary concern of artists, as Dourish asserts. Further, Dourish stresses that the work of artists is an important way to refocus design, and thereby opens a methodological door for the legitimate inclusion of their work in HCI research. In addition to Dourish, Toni Robertson uses Merleau-Ponty's work as the basis for a taxonomy of embodied actions for the analysis of group activity (Robertson 1997, pp.207-208). Lars Hallnas and Johan Redstrom employ phenomenological methods to account for expressiveness in the design of presence, aesthetics and a "logics of expressions" (Hallnas and Redstrom 2002, p.115). Finally, two related practices in computer science have a deep resonance with phenomenology: theories of Situated Action (Suchman, 1987) and Activity Theory (Nardi, 1997). In situated action, for example, an object is partially determinative of activity, and every activity is, by definition, uniquely constituted by the confluence of the particular factors that come together to form one "situation." In Activity Theory, research is generally conducted in the field, in order to get a better sense of what users really do — this includes their minds and bodies, and stresses the importance of the context. Activity Theory is a framework and perspective for describing *activity*. Although it assumes a deep respect for action and the body, it is a psychological theory, rather than a phenomenological one. The HCI research described above closely relates to interactive art and in some cases references it, but none directly addresses interactive art in any depth, and none addresses the visceral sense.

The Visceral

It should be noted that while the term "visceral" or "gut reaction" is in common usage, Donald Norman uses the term "visceral" as one of the precepts of his recent book *Emotional Design: Why We Love (or Hate) Everyday Things* (Norman 2005). According to Norman, any successful design is an interplay among behavioral, reflective and the visceral, each of which he associates with a major but "simplest" and the most "primitive" part of the *brain*. However, Norman poorly defines the visceral as that which is "primitive," "genetic," "hard wired" (Norman 2005, p.65) and the "simplest" part of the brain (Norman 2005, p.29). Norman contends,

> "Although the visceral level is the simplest and most primitive part of the brain, it is sensitive to a very wide range of conditions. These are genetically determined, with the conditions evolving slowly over the time course of evolution . . . The visceral level is incapable of reasoning, of comparing a situation with past history" (ibid.).

Further, "The advantage human beings have over other animals is our powerful reflective level that enables us to overcome the dictates of the visceral, pure biological level. We can overcome our biological heritage" (Norman 2005, p.30). Obviously, Norman does not believe we can learn to control the visceral, even through, say, operant conditioning. As we shall see in other chapters, the visceral is open, for the most part, to both learning (certainly in the form of operant conditioning) and in many cases, conscious control.

The Ahistorical and Historical Body

In the sciences, the body is usually treated as being ahistorical — that is, that we all have the same general and unchangeable features of a species. The assumption at work here is that we are discussing the body within a relatively short period of time, because longitudinally, the discourse of human evolution and physical change is also assumed. What is unanswered is to what degree of time and when do environmental influences precipitate significant changes? And how does one experience one's body during historically different times and culturally distinct contexts? For the most part, the scientific assumption is that the human body remains the same (Clark 1998, pp.1-2).

However, from a Humanities perspective, there are historical differences in the way we understand and experience our bodies (Foucault 1990, 1995). Further, in the Humanities, the body is often considered to be "text" that is to be read, the changing product of differing cultures. For example, the Hellenist views that became the European views of the body are compared with the Chinese view in Shigehisa Kuriyama's work (Kuriyama 1999). Kuriyama argues that since the body in the European view was influenced by autopsies of cadavers, physicians understood it to be relatively inert and mechanistic. Meanwhile, the Chinese developed the notion of Chi or *Qi,* defined as active energy force that pervades the body and the world. These distinct world views are not simply ideas, but are enacted on the level of the everyday and influence how one experiences one's body. Kuriyama states,

> "We can read Confucius's warnings anachronistically as a sort of crude psychophysiology, as primitive insights into the terrifying influence of hormones — if we bear in mind that blood and qi were known otherwise than by chemical analysis, that the heart of their reality lay in personal experience...It was the intimate everyday familiarity of such sensations that made the traditional discourse of vital flux so compelling. The deepest certainties about qi were rooted in knowledge that people had of the body because they were, themselves, bodies" (Kuriyama 1999, p.103).

2.6 Historical Precedents: Art & Technology

Artists at the turn of the 20th century, most notably Tristan Tzara, Dziga Vertov, Sergei Eisenstein, Jean Epstein, the Russian Constructivists and the Futurists were concerned with the then relatively new technologies of photography and film and its effect on the body, and argued that these technologies enabled us to perceive the world in ways that were not previously possible. For Eisenstein, cinema "could reactivate the sensuous, primitive chains of meaning now lost" (Moore 1999, p.8). However, it was German scholar Walter Benjamin who more than others systematically concerned himself with the ways in which technologies affected the corporeal. Benjamin was not a phenomenologist per se. However, he was educated by the main predecessor of phenomenological tradition (Franz Bretano), and shared this university class with Edmund Husserl. Moreover, Benjamin's work strongly parallels phenomenology in its concern for the role of sensation in perception, in studying concrete and everyday phenomena, and in situating that study in larger cultural contexts. He contributed three ideas that are important to visceral sense: the optical unconscious, habit and the mimetic faculty.

2.7 Walter Benjamin

In the essay *A Small History of Photography,* Walter Benjamin (Benjamin 1979, p.243) proposed what he termed the "optical unconscious," that is, that the then relatively new technologies of film and photography, operating in the context of Modernity, enabled us to perceive the world in ways that were not previously possible. An example is that which is revealed in the filmic effect of slow motion. In Benjamin's words,

> "Whereas it is commonplace that, for example, we have some idea what is involved in the act of walking, if only in general terms, we have no idea at all what happens during the fraction of a second when a person steps out. Photography, with its devices of slow motion and enlargement, reveals the secret" (Benjamin, 1931, p.243).

Benjamin's optical unconscious can be understood as a phenomenon capable of evoking and holding (with regard to film at least) the disparate, inarticulable associations around a meaning while "reshaping, in a bodily mode, the habits of perception" (Taussig 1993, p.25). Benjamin later developed this idea of "reshaping, in a bodily mode" an attunement to the "shocks" of film as "habit" in *The Work of Art in the Age of Mechanical Reproduction* (Benjamin 1985, p.250). According to Benjamin, the habits of perception that are transformed in response to new forms of technology may remain below our conscious awareness, but they are transformative, not only perceptually, but culturally as well. In photography, for instance, he examined the ways in which in which it changed our notions of death and memory (Benjamin 1979, pp.160-163), while he also examined the potential democratization of art that would otherwise remain in a museum (Benjamin 1985, p.273). In addition, Benjamin does insist that it is possible to carefully formulate and articulate this phenomenon. Benjamin's consideration of habit and shock is important to this exploration of the visceral because it accounts for a continuum of conscious/not-conscious awareness, and for levels of intensity and *kind* of interactive art experience. Benjamin's oeuvre reveals a lifelong concern for the corporeal, from explorations of "physiognomic aspects," and the "haptic qualities," in connection to the optical unconscious and a concern for kinesthetics and the physiology of color perception (Caygill 1997, p.3) in other work.

Finally, Benjamin's notion of the human "mimetic faculty" in many ways parallels the phenomenological position of the inextricable intertwinement of mind/body with environment. His definition of the mimetic faculty does NOT follow the Aristotelian notion of mimesis as the ability of art to imitate, albeit not as well, nature or reality. Rather, Benjamin employs a more anthropological meaning that concerns corporeal proclivities. He writes:

> "Nature creates similarities. One need only think of mimicry. The highest capacity for producing similarities, however, is man's. His gift of seeing resemblances is nothing other than a rudiment of the powerful compulsion in former times to become and behave like something else. Perhaps there is none of his higher functions in which is mimetic faculty does not play a decisive role" (Benjamin, 1979, p.160).

To simplify, Benjamin's mimetic faculty is more akin to mimicry. The way human primates come to know their worlds, to learn, in part, is through mimicry, with an emphasis on the body (Gebauer and Wulf 1992, pp.107). Benjamin's definition of the mimetic faculty is this: we establish a sense of the difference between the individual and the world, as well as the similarities to the world through *sensuous correspondence.* The mimetic faculty is the "faculty to copy, imitate, make models, explore difference, yield into and become Other" (Taussig 1993, p.3). Contemporary anthropologists like Michael Taussig have adopted Benjamin's notion and refer to a kind of economy of mimesis and alterity, or a continual human testing of what is me and not me. As Gunter Gebauer and Cristoph Wulf write in regard to Benjamin's particular take on mimesis:

> "External and internal worlds are continually approximating each other and are comprehensible only in terms of this reciprocal movement, in which similarities and correspondences between inner and outer are formed. And here we arrive again at a mimetic relation: individuals make themselves similar to the outer world, changing themselves in the process; in this transformation, their perception of both outer world and self change. The result is a mimetic developmental spiral" (Gebauer and Wulf, 1992, p.275).

The relevance of Benjamin's idea is important for the research at hand, in its focus on corporeal transformation precipitated by new forms of technology, as they evolve in specific cultural contexts. Specifically, Benjamin's idea of mimesis as described by Gebauer and Wulf — the "reciprocal movement" of external and internal worlds — is in effect a parallel and an approximation of Merleau-Ponty's reversibility. In certain forms of martial arts, for example, one strives to "become" a tiger or snake in order to think, act, move, and "be" in a similar way. There are limits, however. One can find *sensuous correspondences*, or "be like" a tiger to the extent that one lacks four legs, fur and an acute sense of smell.

It was Benjamin's contention that Modernity, and especially the technologies aligned with it, inaugurated a resurgence of the mimetic faculty. An imitation in terms of a palpable, sensuous, *connection* between the very body of the perceiver and the perceived would explain how, for example, it is possible to "feel" a sense of proprioception when watching *Crouching Tiger, Hidden Dragon* (Lee 2000), or the tentative testing that occurs when users first encounter animistic robots. It is a similar observation made by others in diverse discplines. In the realm of Dance, for instance, John Martin (Martin 1933) describes a kind of corporeal empathy, or what he refers to as "kinesthetic sympathy." Charles Sherrington (Sherrington 1947) referred to "moments of resonance," while Gilbert Simondon (Simondon 1995) and Varela (Varela 2001, pp.262-263) referred to as "internal resonance." Recent, scientific findings refer to mirror neurons (Gallagher 2005, p.220), which seem to be another way to understand this phenomenon.

Comparisons of Like, Intersubjective Experiences, from "Resonance" to Mirror Neurons

Charles Sherrington	**1906**	**moments of resonance**	**Physiology**
Water Benjamin	**1933**	**mimetic faculty**	**Cultural Studies**
Maurice Merleau-Ponty	**1964**	**attunement**	**Philosophy**
John Martin	**1988**	**kinesthetic sympathy**	**Dance**
Gibert Simondon	**1995**	**internal resonance**	**Philosophy**
Francisco Varela	**2001**	**internal resonance**	**Philosophy, Cognitive Science**
Nathalie Depraz	**2003**	**empathy, bodily**	**Philosophy, Cognitive Science**
V. Ramachandran	**2003**	**mirror neurons**	**Neuroscience**

Notable researchers who have made significant strides in understanding mirror neurons are G. Di Pellegrino, L. Fogassi, V. Gallese, M. Iacoboni, G. Riizzolatti, and B. Wicker.

Table 2.1 Comparisons of Like, Intersubjective Experiences, from "Resonance" to Mirror Neurons.

Finally, pursuing the question of subjectivity (the permeable and continually tested boundaries of what is me and not me), the literature review includes investigations in the most problematic, "boundary areas" of a sense of self in relation to the visceral sense: Julia Kristeva's notion of the *abject* (Kristeva 1982), which is sometimes at play, but which is a limiting idea for a visceral sense; Avital Ronell's notion of *narcotics* (Ronell 1993, pp.50-73), an important reminder of the effect of external substances taken internally; and the ultimate limit of self in relation to dissolving the mind/body split: pain. Scholars in the field of Pain Studies deal with the most problematic area of the mind/body question, as well as with levels of perceptual intensity, the mutability of the corporeal and the remapping of sensation (Delvecchio-Good, Brodwin, Good and Kleinman 1994; Scarry 1985; Vertosick 2000).

2.8 The Visceral

Merleau-Ponty himself availed himself of scientific work, especially with the neurologist Kurt Goldstein. Goldstein collaborated with Gestalt theorists, as had Merleau-Ponty, and studied patients who had aphasia. "Goldstein insisted that medicine and physiology be attentive to the essential unity of organisms and the global and subtle intermingling of seemingly discrete organs and functions" (Carman and Hansen 2005, p.12). After an extensive search in numerous libraries in English-speaking countries, and in online bibliographic services, little was found on recent work concerning the visceral. The primary work hails from the fields of Medicine, The Philosophy of Medicine and Neuroscience. Physician and philosopher Drew Leder extends Merleau-Ponty's work by examining the innermost realms of our being — our viscera (Leder 1990). Leder argues that by examining of our usually absent visceral goings on, it "will serve to reveal the essential structures of embodiment" (Leder 199, p.2).

Buytendijk's *Prolegomena to an Anthropological Physiology* offers insight into the ways in which each of the organs associated with the viscera have their own "intentionalities," needs, and ways of being. Although a highly respectable beginning, describing the nature of function, ways of revealing itself, and cultural understandings of each, if continued, would be more than a lifetime's work. Contemporary scientists who have resuscitated research about the visceral have found that such research has lagged significantly since the 1930s, include Cameron (Cameron 2002), Michael Gershon (Gershon 1998) and the following neuroscientists: Paintal; Procacci, Zoppi and Maresca; Iggo; Malliani, Lombardi and Pagani; Andrews; Janig and Morrison; Dockray and Sharkey; Higashi; De Groat; Cervero and Tattersall; Willis; and Lumb (Cervero and Morrison 1986, pp.3-279). Though this list may appear to be long, these are the primary researchers from around the world. Compared to say, neuroscience, this is a short list indeed. Reviews of their articles clearly reveal that almost all of them understand the brain to be the primary aspect of their research, which is another example of the brain-centric focus of that and related fields, especially the Consciousness Studies conference that began several years ago in Tucson.[7] The list of scientists working in the visceral area listed above do not hold Cameron's and Gershon's position that the visceral can be understood to be independent of the brain, and thus termed "the second brain."

Nevertheless, this research is difficult because of the diffuse nature of the visceral systems themselves. Because of how we develop in embryonic stages, a twinge or felt pressure in one organ may commonly originate from a neighboring organ. Further, referred pain can make

[7] A review of all of their publications confirm the brain-centric views of most of its authors.

diagnoses by physicians difficult — a cardiac infarction, to take a more common example, can present as pressure in the chest, a diffuse or sharp pain in the chest, the arms, or the neck. Or it may not present itself to the physician at all, except for blue fingernails and clubbed fingers (Leder 1990, p.51). No singular CT scan or combination of imaging devices exist primarily for the purposes of investigating the visceral. Rather, a complex combination of imaging devices, and tools that measure motility, real-time blood chemistry and numerous other substances, among other aspects, are necessary (Cameron 2002, pp202, 311). Further, thought the visceral systems are diffuse in nature, they usually remain in the background of our experience, and so we have few words to describe this experience. Visceral goings-on, not easily apprehended or discussed, are also difficult to bring into conscious awareness, to exert some kind of volitional control over them even though they color our world and are not outward-going. This usually absent field is "an organized field in which certain organs and abilities come into prominence while others recede" (Leder 1990, p.24).

2.9 Summary

Although Merleau-Ponty's effect on contemporary phenomenology has been widespread, he did not explore the visceral or inner workings of our body to any significant degree. In addition, no one discipline explores the visceral from the position of the existentialist phenomenologist, Merleau-Ponty, with two exceptions, Francisco Varela and Drew Leder. Nonetheless, a diversity of disciplines have been examined and used in order to provide a more global picture of how the visceral works in medical terms, and in first-person, subjective terms. A thread of what numerous theorists have called, variously, physical "resonances," "empathy," "a mimetic faculty" and internal simulations arising from mirror neurons has been developed to account for intersubjective sharing of perception.

The methodologies of existential phenomenology vary to some degree according to its primary theorist. However, many share an approach that combines first-person accounts with third-person or scientific accounts (Varela and Shear 1999, p.1-3). Merleau-Ponty was not anti-science as is commonly understood, but was careful to carve out a space where scientific findings had limited, and not overriding, purchase. Carman and Hansen affirm this: "Merleau-Ponty availed himself of empirical data and theoretical insights drawn from the biological and social sciences, although he was not a psychologist, a linguist or an anthropologist" (Carman and Hansen 2005, p.1). Because the following thesis work is an exploration of facets of the visceral sense implementing Merleau-Ponty's approach, the methods similarly vary slightly according to the requirements of the contextual variables and intent of each piece.

Chapter Three: The Visceral

In the early 70s, I was lying in a surgical suite in a teaching hospital, more or less aware but ignored — except, from time to time, when a gloved hand touched my arm, and a disembodied voice asked if I was all right. I was more and less than all right. The opiates, I recognized, were a very good thing, and I attributed to them the lack of irritation I felt when my body was jiggled, pushed and manipulated. Keenly, I was aware of some feeling, some deep feeling — a pressure I was told "shouldn't hurt." But it was a bizarre pressure, not so much painful as unrecognizable. I did *recognize with all certainty that this pressure was deeply primal, primordial, a pressure that was assuredly connected with death.*

Someone else's death.

Death didn't bother me then; I was after all in my teens. Death was inconceivable for me, although I was well acquainted with the hard, waxy, translucent stiffness of several dead relatives. What bothered me was that the wheels of a table I saw beyond the drape were not as clean as they should have been. What were they thinking? Did no one check? I desperately wanted to gag.

But that is when I caught sight, between the tent of blue drapery that cut me off from all but my world, of IT. Me. My viscera. It was me up there, projected, I surmised, for interns to watch. And it was. . . gorgeous. Red and white viscera, loops here, taut stringiness there, long expanses of smoothness. A thousand, million reds.

I was draped so I could not see my internal world. It belonged to someone else, medical science I supposed, the same anonymous someone who ordained that it would upset me. As I connected the internal pressure I felt to the shiny metal instruments poking around, making that pressure, I felt relieved. It was me. I was inside out, simultaneously lying on the table and contained up there, like some flesh-bound mobius strip.

Thus began my consciousness of immediacy. Glorious, pre-reflective, immediacy of perception. Beyond language, miles past what anyone else seemed to know.

— Diane Gromala: Artist's Contextualization from a First-Person Perspective

3.1 Introduction

This chapter defines and examines the visceral, especially in relation to interactive art, phenomenology, and physiology. It includes my hypothesis, problem statement, methodology and goals, interactive art and its history in relation to the visceral, and what we know about the field in relation to the visceral.

This work is a phenomenological study of the visceral in relation to contemporary interactive art and design. Interactive artists sometimes collaborate with scientists and theorists from the Humanities. In addition, some theorists focus on interactive art. This forms a loose kind of cross-pollination. Among these groups, I have found that although there exists interest in the body, two aspects are found to be rare: an accounting for the body in first-person, highly subjective terms, and an accounting for the visceral. Exceptions are from phenomenologists who practice in many of these disciplines. Nonetheless, while they account for the subjective, lived body, very few examine the visceral as a central concern, with the exception of Leder and György Àdàm (refer to chapter 2, section 2.5 and chapter 3, section 3.2).

A subset of interactive artists and designers are interested in "the body," as new, interactive forms of technology are created, from wearables and ubiquitous computing to biotechnologies and nanotechnology, to name a few (see Wilson [Wilson 2001] for an extensive survey). Subjective experience is part of artistic practice; however, a systematic exploration of the visceral has been found to be rare in interactive arts. Theorists in the Humanities over at least the last two decades have also explored the body, as evinced by the amount of publications on "the body." However, these publications have been found to rarely account for the first-person, subjective aspects of the body, or what Merleau-Ponty calls the *lived body.* As phenomenologist and sociologist Jack Katz states:

> "Anyone who briefly glances at the last decade's literature of social theory and interactionist sociology will see volumes of works on 'the body.' But like the writings of both depth and academic psychology, this sociological work is overwhelmingly two-dimensional and rationalistic. The focus is either on the body as represented and read in culture (in ads, in movies and novels, in the content of talk about the body, or more generally in 'discourse'), or the body as manipulated to give off indications about the self or one's place in an emerging sequence of collaborative action. The body so regarded is either a mannequin, a billboard, a neon sign, a puppet, or some kind of symbolic text. The person is not seen as embodying a moving comprehension of various depths and regions of self" (Katz 1999, p.334).

Further, Humanist Vivian Sobchack argues that,

> ". . . it seems imperative that we move from merely *thinking* about 'the' body (that is, about bodies always posited in their objective mode, always seen from the position of another) to also *feeling* what it is to be 'my' body (lived by me uniquely from my side of

> it, even as it is always also simultaneously available to and lived by others on their side of it" (Sobchack 1991, p.187).

Exceptions accounted for in the literature review include Steven Shaviro and Brian Massumi. While their work does deal with subjective experience and new technologies, the visceral assumes only a very small aspect of their work (Shaviro 1993, p.130; Massumi 2002 pp.112-113).

Finally, scientific fields who do concern themselves with subjective aspects use methods of case studies, questionnaires, surveys, structured interviews, and other methods (Creswell 2003, p.153-175). While these methods do account for subjective impressions, the scientific framework through which these are abstracted are in effect, "objective" interpretations.

HCI is something of an exception, in that some of its practitioners went from concern with the technology (creating technologies and then finding applications) to concern for the user as a primary starting point for inventing technologies (Dourish 2001, pp.7-18). Thus, these practitioners account for the subjective accounts of users, going so far as to include them in long, iterative processes of technology design, called participatory design (for a survey on this method, refer to Bodker, Kensing and Simonsen 2004), activity theory (for its originary source, refer to Nardi 1997), situated actions (see Suchman 1987, for its initial incarnation) or one of several action research methods (Denzin and Lincoln 2005, pp.560-600). Nonetheless, the way scientists deal with subjective aspects of the lived body, like the visceral, is by asking people what they *think*. As Dourish would have it, what remains unaccounted for in such approaches is *felt experience* — especially of the pre-reflective kind that Merleau-Ponty focused on — and *meaning* (Dourish 2001, pp.22, 87). Thus, Dourish argues for phenomenological approaches in HCI, and demonstrates that some of the concerns of phenomenologists are already (and perhaps unwittingly) at work in the assumptions that underlie Tangible Computing and Computer-Supported Collaborative Work (CSCW) (Dourish 2001, p.155). Nevertheless, accounting for the visceral is still a difficult proposition. Àdàm makes it clear that there are hardly any technological methods for measuring real-time, internal visceral sensations and relating these to subjective experience. (Àdàm 1998, p.94; also refer to section 3.2).

Through this thesis – phenomenological, textual and artistic explorations of what is arguably our most innermost, subjective, felt sense, our visceral sense – I hope to offer artistic examples of what Merleau-Ponty termed *flesh*. That is, I hope to extend his work — a phenomenological perspective that is concerned with the body not as a textual metaphor, but as a continuous intertwinement of mind, body and world — by examining the visceral and technological aspects of interactive art, and by offering the artworks that accomplish this work as well. In doing so, more far-ranging implications of the inextricability of our minds and bodies may be more carefully studied and considered to be as legitimate as our minds and worlds. "Only then can we hope to develop technologies that are made for humans" (Dourish 2001, p.190), for our volatile,[8] imperfect bodies to be appreciated for what they are and what they can tell us, and for artists to continue to gain footholds in trying to influence the very creation of technologies themselves.

3.2 Definition of Terms: The Visceral

This phenomenological study of the visceral in relation to interactive art and design focuses on the taken-for-granted aspects of our usually unnoticed viscera. Although the term is commonly used to refer to deep, primordial, intuitive, and/or "hard-wired" aspects of the mind and body, it is used in this thesis more precisely. In keeping with the scientific definition, the visceral will refer throughout this thesis to our respiratory, cardiovascular, uro-genital and especially enteric (or excretory) systems. Also in keeping with observations from a diverse but relatively small group of scientists who study the visceral, its physiological functioning will also be addressed, because it is an exemplary nexus of the inextricability of mind and body. For instance, the viscera produces the majority of the hormones that profoundly influence or make possible emotions (Gershon 1999, p.18). More importantly, however, is that the viscera generally and the enteric system specifically, is like the brain, a control center for what we ingest and excrete, and for many aspects of the functioning of mind/body states (Cameron 2002, p.41). Because of these and other major roles, and because it can be completely disconnected from the brain and still function, it is often referred to as "the second brain" (Gershon 1999, p.16). Existentialist phenomenologists are concerned with the common, everyday aspects of experience. Those who focus on physiology, such as Leder, have much to offer about the role of the viscera in felt experience. Finally, Humanists who study the visceral, namely Massumi and Shaviro, also offer what the sciences do not: theories of the role the viscera has in experience and meaning in cultural contexts.

It is currently a bit of a quixotic quest to account for the visceral *in vivo.* This is evident in the ways that scholars who study the visceral articulate it, because there are no concrete ways to

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[8] This includes a feminist approach that takes into account, in the words of Elizabeth Grosz, our "volatile" bodies. That is, a consideration of bodies that unlike Merleau-Ponty's normative, "athletic" bodies, assumes that our bodies change: they age, menstruate, become pregnant, excrete, and so on. Refer to Grosz, E 1994, *Volatile Bodies: Toward a Corporeal Feminism*, Indiana University Press, Bloomington. For an example of how gender differences are embodied, see Young I, 2005, *On Female Body Experience: "Throwing like a Girl" and Other Essays.* Oxford University Press, Oxford.

measure peristaltic contractions, blood chemistry, and finer, more detailed movements and chemical interactions, especially not in real-time. Nonetheless, while some of these methods are being developed (Cameron 2002, pp.306-311). Àdàm admits that *"In vivo* neurophysiology had and still has no reliable and precise methods" (Àdàm 1998, p.97). Difficulties abound, mostly because of the structure of the visceral and especially its component enteric system, and because of the complex ways in which they work. Different kinds of visceroreceptors, for instance, "are mostly diffuse structures" that are "not easily distinguished by histological examination," because their differences are "obviously submicroscopic or chemical" (Àdàm 1998, p.94). In asking "what renders peculiar features and specificity to visceral sensation and perception" (Àdàm 1998, p.6), Àdàm has developed five basic methods of analysis that include objective and subjective aspects (Table 3.1):

Table 3.1: Functions of Afferent Visceral Signals According to G. Àdàm, 1998

Levels of representation & analysis	**Biological & psychological functions**
Physiological	1. Homeostatic
	2. Reflex
Psychophysiological	3. Modulation of general central activation
	4. Modulation of sensory input
	5. Orienting/alarming
Behavioral: nonverbal	6. Motivating (energizing)
	7. Directing/discriminative[a]
Subjective: nonverbal & verbal	8. Regulation of mood, affect, & emotion
	9. Informative/perceptive
Social: verbal	10. Instrumental/appellative

[a] sensation versus discrimination (detection)

While a treatise on neurophysiology is beyond the scope of this thesis, examining Àdàm's five basic methods of analysis makes it evident that these methods take into account physical, objective, affective and subjective aspects of the visceral. Further, examples in Àdàm's text are of how the visceral can be brought into conscious awareness, and how differing aspects of the visceral affect conscious awareness. What Àdàm has found is that the visceral appears to be independent of and different from the traditional five senses, although the visceral can affect the traditional five senses. The visceral is also different from the five senses in the structure of the receptors, in their function and their sometime independence from the brain. Variously called viscerosensory perception, internal perception or internal cognition, Àdàm and others cited in this thesis believe that it largely operates outside of conscious awareness, but that internal signals from the visceral system influence our emotional states. Though still debated, what Àdàm calls "the ubiquitous unconscious" is considered to be a kind of sensory system.

The term "unconscious" will be avoided for its Freudian overtones; Freud's unconscious is not the same as Merleau-Ponty's unconscious. In Merleau-Ponty's ontology, lived experience is prior to abstract reflection; its is pre-thematic" (Robbins 1997). We don't explicitly think about it and what we are living. When one is engaged in a typical task, for example, one does not reflect on the task. Rather, this mode of engagement is "the primordial, experiential ground which makes reflection possible" (Robbins 1997). When one reflects intellectually on experience, one returns to the lived world of our experience prior to reflection. "This is a way to think about the unconscious without necessarily buying into a Freudian meta-psychology" (Robbins 1997). From Melreau-Ponty's perspective, the unconscious is *not* a repression of aspects of our world that we choose not to deal with. Rather, his unconscious is the "pre-thematic, pre-objective, lived, concrete latent experience of our engagement with the world before we reflect on it. "It is what we live out but do not speak or think. When we bring it into reflection, we make it 'conscious'" (Robbins 1997).[9]

Our visceral goings-on are usually quiescent, non-conscious, mind/bodily experiences, like the frothy little gurgle of incipient hunger, or the flutter that seems to be at once in our throat or stomach or heart when we see one with whom we are infatuated. We can fruitfully understand the visceral as being on a continuum, from sensations we are not fully conscious of or that we barely register. This end of the continuum is thus what I term the *Visceral Register*. These visceral sensations are fleeting but perceived, if ever so briefly.

[9] Freud's unconscious refers to that part of the mind (or mental functioning) of which people make themselves unaware. It does not include all that is not conscious, only what is actively repressed from conscious thought or what the person is "averse to knowing consciously. It is a force that can only be recognized by its effects, expressed in a symptom" (Geraskov 1994, p.17). This "struggle" between Freud's biological instincts and a self relies on a mind/body duality that is antithetical to Merleau-Ponty's view of a unity of mind, body and world, in Being. According to Merleau-Ponty, "The whole architecture of the notions of the psychology (. . . pleasure, desire, love, Eros) all that, all this bric-a-brac, is suddenly clarified when one" considers it "as *differentiations* of one sole and *massive* adhesion to Being which is the flesh. . ." (Merleau-Ponty 1968, p.270). Finally, Freud reinforces the distinction between mind and body, especially by privileging the mind and by positing mind and body in conflict, at least where repression and many psychological disorders are concerned. For further discussion of the limits of Freudian psychology, refer to Merleau-Ponty's Introduction and Chapter 1 of *The Structure of Behavior* (Merleau-Ponty 1963).

continuum

Visceral Register ⟷ ***Visceral Sense***

Senses of visceral that are barely, consciously registered — *Conscious sense, experience, or control of the visceral*

Figure 3.1: Gromala's Continuum from the Visceral Register to the Visceral Sense

On the other end of the continuum are those visceral sensations that we learn to alter, for instance, through biofeedback or from years of meditating. I term this end of the continuum the *Visceral Sense.* This increased intimacy and ability to consciously manipulate the visceral through meditation is a sense that is ongoing and can be transformative, for example, in evolving states of "mindful awareness." As explained by Francisco Varela, Evan Thompson and Eleanor Rosch, "Mindfulness means that the mind is present in embodied everyday experience; mindfulness techniques are designed to lead the mind back from its theories and preoccupations, back from the abstract attitude, to the situation of one's experience itself" (Varela, Thompson and Rosch 1993, p.22). Further,

> "...mindfulness/awareness is considered part of the basic nature of the mind; it is the natural state of mind that has been temporarily obscured by habitual patterns of grasping and delusion. The untamed mind constantly tries to grasp some stable point in its unending movement, and to clink to thoughts, feelings, and concepts as if they were a solid ground" (Varela, Thompson and Rosch 1993, p.26).

In other words, if users practice techniques of mindful awareness through meditative practices, they may be able to transform their experience of the present into one that they can become aware of — experience that was otherwise hidden by habit. In addition, this enhanced awareness, attained through rigorous practice, involves very little effort, less effort than it takes to remain in a state of concentrated focus, for instance.

Other visceral sensations are sometimes intense enough to bring us to our knees. Think of the dreaded stabbing sense that results from food poisoning and its explosive aftermath. Or the incessant, aching burn of esophagitis reflux. This other end of the continuum, the *Visceral Sense,* includes those aspects of the viscera that enter into one's consciousness in deeper, more insistent ways. They include those we learn to exert some control over as a form of bodily knowledge, from sports, dance and performance art training[10] to meditation, surgery or

[10] In theatre, for example, Jerzy Grotowski offered visceral training; by tightly closing one's mouth and sphincter for as long as one can, and then letting them go, the body produces uncontrollable but aesthetically interesting movements. From an interview with Kjell Petersen, Montreal, 20 April 2007. According to Petersen, most of the knowledge of "Physical Theatre" is not in textual form, but is passed down from practioner to practioner. An investigation of 19 books on theatrical training that included Grotowski's work did not mention this particular

marksmanship. The very extreme terminus of this part of the continuum includes acute visceral pain, the kind that robs us of our ability to communicate to others, threatens our sense of self and threatens our very being (Scarry 1985, pp.3-11). Covered in sweat, the acute, chest-grabbing reflex solicited by a cardiac infarction in progress is an example.

The systems that comprise the visceral most often work together, holistically. The enteric system, which works like a "second brain," is a notable exception. "The enteric nervous system differs from the sympathetic and parasympathetic in its anatomical and functional independence from the brain and spinal cord. It is this separate-but-equal classification of the enteric nervous system that still surprises audiences of doctors and even neuroscientists" (Gershon 1999, p.16).

Not all of the experiences of the workings of these systems are negative, or in the words of Kristeva (Kristeva 1982), *abject.* According to her, the abject is an experience that threatens our sense of self or body image, such as slowly driving past a bloody car accident. While we are compelled to look, we are also compelled to look away, then to look back, and eventually to shut down this short-lived moment because of the threat it implies to the fragility of our body image, and because it is a vivid reminder of our mortality.[11] According to Kristeva, a state of abjection is one that lies between an object and subject, as something that is or was alive but simultaneously is not. Our bodily fluids, for example, are substances that once outside of our body, we recognize as having once been part of ourselves, but no longer so. Although Kristeva did not express abjection on a continuum of responses per se, she did offer examples that elicit varying intensity of responses, such as seeing the dismemberment of a limb, a corpse, or rotting flesh. These experiences, according to her, disrupt or threaten our body image as whole, with a clearly demarcated exterior and interior. Further, the abject lies outside of the symbolic order and is inherently a traumatic, repulsive experience.

The visceral is clearly implicated in the abject, say, when one vomits because one has seen blood, mutilated bodies, or rotting flesh, or when one faints when viewing a video of Orlan's

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practice. Discussion with performance scholar Phil Auslander, editor of Routledge's multi-volume encyclopedia of performance, was also familiar with Grotowski's "enteric" practice, as well as professors of Theatre and Dance at the University of Georgia, Yale University, UCLA and the University of Texas. Accordingly, it was found that Butoh dancers also practice the mouth-to-anus technique, but are hesitant to discuss it.

[11] A tangential but interesting finding of this research is that the visceral, especially the enteric system, is also implicated in death and mummification. When all matter is removed from the enteric system, the body decays at a much slower rate. Further, when the stomach and intestines themselves are removed, mummification is significantly more successful. The ancient Egyptians and Peruvians observed this phenomenon. Ancient Tibetan monks (based on mummies c. 1200-1400 AD) also seemed to have observed this, as some had "self-mummified" by slowly starving themselves (or emptying their enteric system) over the course of a month or so as they continuously meditate until death. (Mair 2004).

face being peeled away from her skull.[12] The only other aspect that some forms of the visceral sense share with the sense of abjection is that some of the more intense visceral sensations also lie outside of the symbolic realm (Massumi 2002, pp.112-113). However, the abject is but a small component of the visceral. An ambient, background register of the visceral can also be a joyous or euphoric affair, as when one feels infatuation, for instance, or when opiates quiet visceral goings-on in the enteric system and enhance the release of those hormones which induce euphoria. As previously stated, the majority of mood-altering, internal chemistry[13] is produced in the visceral system (Gershon pp.37-80). These range from serotonin and hormones that serve a more depressive function to those that influence affect in diverse ways. Further, one can learn how to affect or control some of these functions, as is made clear through meditation, the practices of certain monks (Austin 1999, pp.74-104) and performance artists (refer to footnote 9), to name a few. In conclusion, it must be clear that a wide range of potential experiences can be elicited by the visceral system, not merely one of a threatening sense of abjection.

3.3 Hypothesis

As interactive artists pursue issues of corporeality (refer to [Wilson 2001] for 95 pages of this work), they more closely question and examine interrelationships of its differing aspects of the body. The hypothesis of this thesis is that what was once considered beyond our conscious control, the visceral, is a nexus of the mind/body problem, and can indeed be elicited by specific forms of interactive art. Further, a continuum of conscious awareness must be accounted for, from what I term the *Visceral Register* to the *Visceral Sense.* The *Visceral Sense,* whereby one is conscious of one's viscera and where one can learn to control it consciously, may offer possibilities for transformative experiences. For example, the "Mindful Awareness" that results from sustained meditative practices, can easily be seen to be transformative, as could the study of a botanist when looking at a forest after training. Further, qualities of interactive art, characteristics of the technologies used by interactive artists, and the cultural contexts enable or a return back to interest in and a revaluation of mind/body experiences. Finally, although experience is comprised holistically, of enormous and constantly changing variables of mind/ body and world, a specific sense, like the visceral, can be brought into awareness and studied. This enhanced awareness, or ontological "lens" can be brought to bear on the experience of interactive art, possibly enabling a user to experience or "attune" themselves to the particular artworks with a greater sense of being.

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[12] As observed at the *Virtual Futures* conference at the University of Warwick, May 24-26, 1995.
[13] Narcotics and other drugs that are not produced in the body can and do affect the viscera in a diversity of ways.

3.4 Problem Statement

I propose that some forms of interactive art can provoke, elicit or enable a register or awareness of the visceral, and taken over time and in multiple contexts, a sensibility. The continuum from visceral register to the visceral sense can be transformative in creating new possibilities for mind/body/world modes of being in that they may create barely or fully conscious awareness, attunements to various contemporary contexts that may require a new way of being, or at least a greater awareness of our inner selves and of being itself. The continuum (Figure 3.1) is used to take into account mind and body as well as varying levels of awareness and intensity. This is neither a Romantic turn to some fabled, feral past, nor is it a study of Kristeva's theory of the *abject*.

Rather, this work is intended to point toward and hold open the doors to possibilities and multiple transformations of the mind/body and technologically-suffused worlds we find ourselves in. By provoking or eliciting the visceral through interactive art, an ability to more fully experience inner and outer realms may be enhanced; and might make possible experiences that are unmediated. Merleau-Ponty's phenomenological approach allows for a more expansive way of investigating subjective, bodily ways of being in the world. Further, his embodied concept of *reversibility* is a robust idea that is directly explored in the three artworks produced for this thesis (refer to Chapters 4, 5 and 6, as well as the CDROM: *Meditation Chamber, BioMorphic Typography* and the *MeatBook)*.

3.5 The Field: Interactive Art and Design

Perhaps more than prior forms of fine art, many forms of interactive art, as the term "interactive" implies, engage a user's body. According to telematic artist, theorist, and pioneer Roy Ascott (2003), interactive art is defined as:

> " . . . that art in which the behaviour of the viewer effects transformations of image, structure or environment, and in turn may cause transformations of the viewer's perception, consciousness or physical state."

This is a clear definition that distinguishes itself from others in its brevity. Interactive art and the new, numerous forms of technology that are constantly being adopted seem to make defining it a moving target. The terms themselves have changed, for instance, from "Electronic Art" to "New Media Art" and "Digital Art," to name a few of the more influential terms. Popper uses the term "technological art" instead and asserts that

> "The nature of technological art can . . . be illustrated through the examination of attempts made by artists to implicate the spectator in the creative process and, in particular, through analysis of the transformation that was effected when they

> passed from a simple invitation to participate to an appeal for a more elaborate interactive involvement" (Popper 1993, p.8).

Popper tries to come to terms with how to categorize differing forms of technological art by describing their characteristics:

> "It seems clear, however, that on a creative level there are many characteristics which allow the grouping together of a number of diverse art works. Notable among these are interaction and interactivity, multisensoriality (sic), the creative process itself; and in addition a concern with the temporal and spatial dimensions as well as emotional and mental states . . . The principle aim is an interactivity instigated by the artist that allows creative communication, one which employs constructive, critical and innovative attitudes. In enabling new types of social interactions, technological art can also claim to represent most effectively the changes that are occurring in our social fabric with all their contradictions" (Popper 1993, pp.179-180).

Five years later after Popper wrote this, the term "interactive art," seemed to hold sway. As Leopoldseder and Schöpf write in also trying to come to terms with the evolving forms of digital art, "Artworks have become complex 'machines' where the user does not so much individually control the work, but cooperates, obstructs and directs. This results in dynamic patterns of interaction within which the work evolves." They continue by stating that numerous forms of technologies:

> "are applied to create works of art, in which the actions of users and machines become almost indistinguishable . . . Interaction here means to participate in a process . . . the artwork manifests itself as a dynamic process, as an experience instead of as an aesthetic object" (Leopoldseder and Schöpf 1997, p.107).

Although they successfully blur the distinction between users and machines, their effort seems to function more as a description than a definition.

These definitions are notable for also focusing on an artifact, rather than the give-and-take or cause-and-effect interchanges that typify interactivity. Rush focuses on interactivity I his definition, but limits it to narrative. He says that "Interactive artists aim to positively encourage viewers to create their own narratives or associations with their interactive works (Rush 1999, p.201).

Similarly, historian Oliver Grau, whose work was concerned with "virtual art" describes its characteristics, but misses its short term and longer term effects and reinscribes a mind/body split, despite his few references to the body (Grau 2003). Grau's teleological imposition also calls into question the relationships he proffers. Further, Grau offers an overarching definition of an artwork, any artwork: "An artwork symbolizes and focuses a particular artistic view of the world. Aside from all genre-specific differences, it *fixes* (italics mine) concept, ideology and hypothesis, aesthetic preferences and norms, and consciously or unconsciously, follows social constellations" (Grau 2003, p.204). Grau's attempt of inclusion, however, invites pause. For how can an artwork "fix" a concept, ideology, hypothesis, aesthetic preference, or norms, if one takes a long, historical view of an artwork, one in which the original historical context is for the most part lost, and one in which the actual artists or their intentions may never be known? After the publication of his book on virtual art, however, he tends to offer a more positive definition, though again he does not draw clear distinctions among its different forms, mixing characteristics with distinctive forms of interactive art:

> "Digital art is open, transient, interdisciplinary, multimedia, processual, discursive, concept- and context-dependent, and, in addition, is increasingly oriented toward interaction with the recipient. Within the evolving art genres, virtual art has begun to further dismantle the traditional tableau; this time, in favor of a processual model of art. Interaction, telematics and genetic image processes not only encourage the crossing of boundaries; they also drive the trend toward fusing the perception of the users with interfaces that increasingly assail the entire suite of human senses" (Grau 2007).

The artists who represent the "historical tableau" which he refers to would probably take issue with this definition, as many of these concerns were explored by artists before the advent of interactive art. One need only consider the performance artists following Artonini Artaud, "process-oriented" art, and conceptual art, to name a few. Also of interest is the "drive" to "fuse" the perception of the users with interfaces that increasing *assail* the *entire suite* of human senses. This seems not to be a give-and-take implied by term interactivity. Again, while his definition might seem to relate to a phenomenological intertwining of perception and interface, the teleological drive that underlies his work seems to undermine what may have been a less conflictual, more open-ended prognostication.

Likewise, although Stephen Wilson perceptively lists the numerous characteristics of what he terms "Information Arts" — arts that may not be electronic or digital, but that occurs in collaboration with scientists of many types. He does not offer a concise definition, but states that "This experimentation has left the philosophy of art in turmoil. It has become difficult to achieve consensus of art, that nature of aesthetic experience, the relative place of communication and expression, or criteria of evaluation. However, there is some agreement on these features: art is intentionally made or assembled by humans, and usually consists of intellectual, symbolic, and sensuous components" (Wilson 2005, p.17). Further, Wilson also references the Getty Museum Program in Art Education (ibid.). Together, these definitions give us a good sense of information arts that seem to require open-ended considerations, and not set one definition in stone. Further, Wilson offer first a list of characteristics of information art that are incisive: he is obviously a practitioner who has attended decades of electronic, digital information, or interactive art. The range of artists he includes is vast and inclusive, while Grau's are questionable. Where, for instance, art the Banff Centre's VR Art Environments — the first in the world to focus on the art and not collaborations among artists, industry and scientists. Second, he continues the practice of attributing one VR artwork with singular people, while such work requires months of work among many artists and computer scientists?[14] Comparing his with Grau's underscores the difference between a practitioner's attempts at defining and characterizing information art and a critic's attempts at defining VR art. What's more, Wilson leaves open the multiple meanings that each artwork can engender, and isn't weighed down in his assessments by the teleological imperative.

These and other definitions are not concise, and do not reflect the position of a phenomenologist. Ascott's definition makes clear that the "viewer" and the artwork are engaged in a mutually effecting relationship. Further, Ascott does not simply refer to the viewer, but to aspects of the viewer's mind and body. Thus, his definition is very close to one that would serve the purposes of a phenomenologist. However, I would alter it to reflect my position more precisely:

> "Interactive art works in a mutual relation. The behavior of the enactor effects transformations of elements that appeal to exteroceptive senses, such as image, sound, or tactility, as well as structure or environment. This in turn may cause transformations of the enactor's conscious or pre-reflective perception, from which all arise."

It is precisely the "transformations" of the user's "perception, consciousness" *and* "physical state" that are the focus of this research. The specific aspect under examination concerns the visceral — our innermost, most difficult to reach aspects that are usually and necessarily quiescent, but that are always moving into and out of varying states of mind/body. Most often, one experiences or registers the visceral; it touches our consciousness reflection, and vanishes. In the most extreme cases, such as acute visceral pain, it can render us beyond language (Scarry 1985, p.5) or the ability to act in the world. Although termed the "autonomic" (or occurring involuntarily), one can learn to exert some control over some of the systems that comprise the visceral, such as breath, heart rate, and some aspects of the enteric system.

[14] This was discussed at the meeting of the College Art Association held in Atlanta Georgia, February 17, 2005. Hosted by *Leonardo* chief editor Roger Malina and numerous interactive artists, the outcome of the meeting strongly suggested that like a film, the numerous workers involved in an immersive VR work should be always attributed. This was deemed one way to overcome the notion of the singular genius model of art, as it should be because contemporary art practices are often conducted in collaborative groups. Further, the lack of attribution of collaborating scientists serve only to reinforce their felt exclusion from artworks. It should be recognized that while artists who collaborate with computer scientists are valued by the art community, the obverse is not true in the sciences; rather, it is usually considered to be :"dabbling" unless an important scientific outcome resutls. Thus, scientists have little professional rewards for collaborating with artists, and instead collaborate for personal reasons which usually end when the majority of these graduate students find professorial jobs. Prominent, tenured professors seem to not be as affected.

The corporeal, experiential aspects of interactive art are issues that are explored by some artists in the field. For example, their work is represented on 95 pages in Wilson's book *Information Arts* (Wilson 2001). However, I have found that few theorists or artists have explored this subcomponent of the corporeal — the visceral dimension — specifically or systematically. The visceral is the focus of this research because unlike the five senses, and the proprioceptive sense and kinesthetic sense, the visceral system, and especially the enteric system, is partially autonomous from brain function (Cameron 2002, p.106) and continuously enters into and out of many levels of conscious awareness. Thus, it is an exemplary nexus of the mind/body problem.

Further, the senses that are being explored by interactive artists, such as the haptic, visual, or smell are all exteroceptive senses. Artists such as Orlan (Orlan 1990), Stelarc (Stelarc 1998), Mona Hatoum (Hatoum 1997), and Eduardo Kac (Kac 2003) are notable exceptions, as they explore interoception through swallowing cameras, or inserting them into their bodily orifices, and implanting chips into their own bodies. With the exceptions of Hatoum and Stelarc, while these artists do experience pain, they do not intentionally explore their interoception or a visceral sense per se. I would suggest that the effects of their artwork and performances may elicit a visceral sense, however, through the "empathy" or "resonance" of the viewers of their work.

Finally, the visceral serves as a more specific and focused extension of how the visual arts in the last century were understood to provoke or influence other senses, which were at that time primarily lumped into what was termed the optical tacility, haptic visuality, or the haptic sense (Taussig 1993, pp.25-26, 35: Marks 2000, pp.xi-xii,127-162). Film theorists Sobchack (Sobchack 1991), Marks (Marks 2000, 2002), Rachel O. Moore (Moore, 1999) and Hansen (Hansen 2006) have continued this exploration of the "haptic" sense, along with anthropologist Michael Taussig (Taussig 1993, p.270n9). Marks in particular has explored the haptic and has begun to explore other senses, such as smell, by focusing primarily on video art in her book *Touch: Sensuous Theory and Multisensory Media* (Marks 2002). However, these phenomenologically-influenced theorists focus on film and video, and only tangentially on interactive art. Margaret Morse (Morse 1998), Hansen and Shaviro are a few theorists whose work primarily focuses on interactive art and the body

3.6 Historical Contiguity

Artists who work with interactive technologies are the direct descendents of artists whose work in the four prior decades focused on then-new technologies and scientific ideas, from Nam June Paik's work with video cameras to kinetic, light, laser, holographic, telematics, satellite and early electronic art, to name the most evident (Popper 1993, p.6). These artists were ignored by the mainstream art world until very recently. To quote Jon Ippollito:

> "A number of pioneering artists began experimenting with the computer as a visual arts medium in the late 60s and early 70s when most fine-arts circles refused to recognize art made by computers as a viable product of human creativity. This was the era of computer punch cards, when the visual results of algorithmic input were nothing more than line drawings. Many of the forward-looking artists who were experimenting with this technology were not taken seriously by the established art venues, and were, in fact, often ostracized by their peers. More recently, the work of computer artists has begun to appear in general textbooks on the history of art, but each book features one or two completely different artists. The books are inconsistent in their documentation of this fairly new medium. There are a number of journals that have had special issues devoted to this topic, including the *Art Journal,* and there are also whole journals dedicated to the field, such as *Leonardo.* There are, however, very few books that do justice to the movement, and few that include artists of Japan. In other words, there is a great deal of activity in the field, but the documentation is neither thorough nor consistent" (Ippollito 2005, pp.177-180).

Interactive artists have formed their own loosely knit community of publications and exhibition venues. Aware of not leaving the interpretation of their work to art critics, art historians and cultural theorists — many of whom have little understanding of or experience with the technologies they discuss, or do not examine the art of living artists — some interactive artists have actively tried to take on some of those interpretive or framing roles. Artists of course have written about their own work for centuries (Smith 2004, p.94), but less in academic terms than in documentary terms. In contemporary times, interactive artists do produce scholarly papers within their own realm. In addition, some interactive artists are engaged in interdisciplinary, collaborative work with scientists. This has resulted in the inclusion of artistic work in conferences such as CHI, SIGGRAPH, Tangible and Embedded Interfaces (TEI), and Ubiquitous Computing Conference (UbiComp) and the Conference on Wearable Computing, to name a few.

There are two noteworthy but unexplored paradoxes at work. First, the critics of interactive art often write about it without having experienced it,[15] and thus rely on the artist's writings. Most of the time, pragmatic reasons are cited for the lack of experiencing the interactive artworks that critics write about. Similarly, it would be difficult for each reader of this thesis to experience each artwork firsthand. Nonetheless, if interactive art demands anything, it surely must demand firsthand experience, as the term interactivity suggests. Second, over the last thirty years or so, a core intellectual idea in the Humanities has been "the death of the author," or by extension, of

[15] Numerous discussions with Jay Bolter, Richard Grusin, Laura Marks, Edward Shanken, Steven Shaviro, Eugene Thacker and others from 2000 to the present have verified this practice.

the artist. This refers to the ways in which the meaning of a piece of literature – and by extension, art – are no longer solely determined by the author's intention, but by both the author *and* the reader, or the interactive artist and the user. Interactivity and forms of interactive art such as art that proffers emergence or AI, by their very nature, reposition the role of the creator to one who does not solely determine the meaning (or in this case too, experience all of the possibilities) of a work of art. The same issues are at work in other forms of art that require presence: Music, Dance, Theatre, and Performance Art. Thus, I believe it is important to experience the works of art, as much as possible, in order to write about them more knowingly. Therefore, the artworks I discuss in more detail are those artworks that I have personally experienced. Finally, although it is beyond the purview of the thesis to enable every reader to experience my artworks, I have provided documentation on the enclosed CDROM. While it cannot replace first-hand experience, it is an important aspect of the thesis, since it provides aspects of the artworks in media forms that extend beyond purely textual accounts.

Many interactive artists are and were concerned with issues of the body, notably feminist artists at work in the 1970s: Carolee Schneeman (Schneeman 1964), Kiki Smith (Smith 1994), Lynn Hershman (-Leeson) (Hershman 1993), Annie Sprinkle (Sprinkle 1993), Linda Montano (Montano 1983), and Bob Flanagan (Dick 1997), among many others. The field has also been open to inter- and trans-disciplinary collaborations, so the fields of Dance, Electronic Music, Performance Art, and Architecture have enriched the core of interactive artists whose training was primarily in the Fine Arts. A survey of the most inclusive databases of electronic and interactive art[16] list categories that range from issues of DIY (do-it-yourself) biotechnology, nanotechnology, and eco-systems to consciousness, immersion, presence and synesthesia, to name a few. Those works that enable the most motor, physical involvement range from artworks that are explorations of touch, haptic and gestural interfaces; movement and gesture (from Dance and Performance Art), to responsive environments. As Popper makes clear, the invention of new forms of technology often give rise to new forms of art (Popper 1993, pp.180-181).

While contemporary artists explore the corporeal, experiential aspects of interactive art, I have discovered that very few theorists or artists have explored a component of the corporeal — the visceral dimension — specifically. The visceral is the focus of this research because unlike

[16] Databases of Interactive Art, Electronic Art, and Art and Science work include: Ars Electronica [http://www.aec.at/en/archives/prix_einstieg.asp?nocache=125010]; the Internet Art Database [http://dart.fine-art.com/]; The Langois Foundation's Database of Virtual Art [http://www.fondation-langlois.org/]; rhizome's Artbase [http://rhizome.org/art]; SIGGRAPH's [http://arts.siggraph.org/]; UNESCO's *DigiArts* [http://portal.unesco.org/culture/en/ev.php-URL_ID=28566&URL_DO=DO_TOPIC&URL_SECTION=201.html]; and Stephen Wilson's [http://userwww.sfsu.edu/%7Einfoarts/links/wilson.artlinks2.html] among others. All retrieved 24 February 2007.

the five senses, kinesthetics, proprioception or other senses, the visceral (or enteric) system is partially autonomous from brain function. As described by the gastroenterologist Gershon, "The enteric nervous system is . . . an independent site of neural integration and processing. This is what makes it the second brain." (Gershon 1999, p.17). In addition, the enteric system continually shifts into and out of many levels of conscious awareness, but usually functions as an insensible background. (Leder 1990, pp.36-69). It also produces the majority of mood-altering substances that are responsible for emotional states, the ability to focus, and so forth. Thus, the visceral is an exemplary nexus of the mind/body problem. Further, it serves as a more specific and focused extension of how the visual arts in the last century were understood to provoke senses other than or through the visual. Oddly, the "haptic" sense (or optical tactility) was most often explored and referred to during the last century, whether the sense might actually be haptic or tactile or not (Benjamin 1985, p.174; Taussig 1993, pp.35-36). More recently, film theorists Sobchack (Sobchack 1991), Marks (Marks 2000, 2002), Rachel O. Moore (Moore 1999) and Hansen (Hansen 2006) have continued this exploration of the "haptic" sense, along with anthropologist Michael Taussig (Taussig 1993, p.270n9). Marks in particular has explored the haptic and has begun to explore other senses, such as smell, by focusing primarily on video art in her book *Touch: Sensuous Theory and Multisensory Media* (Marks 2002). However, these theorists focus on film and video, and only tangentially on interactive art. Margaret Morse (Morse 1998) is one of the few theorists who extends her research emphases from video and television to interactive art.

As interactive artists pursue issues of corporeality, they more closely question and examine the interrelationships of its differing aspects. Experience is comprised holistically, and is not split off entirely into the realm of, say, the haptic sense. Nonetheless, it is important to know the workings of the human body and how some senses achieve temporary emphasis in experience. Thus, aspects of the visceral, from the subsystems that comprise it to its barely conscious register or fully conscious sense, are explored throughout the thesis in relation, primarily, to interactive art.

3.7 Characteristics of Interactive Art that May Create Conditions for the Visceral

The viscera are always at work, even though we are usually and necessarily not conscious of their existence (Leder 1990). At certain times, however, we do become conscious of our own viscera, whether it be from a disorder with the viscera, such as irritable bowel syndrome (IBS), from something the mind/body does, or from some "stimulus" in the world. Interactive art is implicated in the latter two. What is it about interactive art in particular that can give rise to a barely conscious register of the visceral or a heightened or transformative visceral sense? It is my contention that at least four characteristics that create conditions which may enable or provoke a visceral response are at play.

The first characteristic is *interactivity,* but the kind of interactivity that focuses on forms beyond mere mouse clicking: from installations that demand a user's gestural, bodily movement, to those that explore the so-called five senses. Interactivity in immersive virtual reality (VR) works that create a sensory feedback loop engages a user's sensorium in direct, volitional, motor and grossly physical ways (Gromala 1996, pp.224-225).

The artistic aspects of complex or novel interactivity in contemporary times often enable users to become self-aware of their engagement with the art and/or the interface, such as the physical movements required by Camille Utterbach's *Text Rain* (Bolter and Gromala 2003, p.12; Utterbach and Achituv 2000). Other artworks that enable or demand users to become aware of their sensorium range from Orlan's video of her face being peeled back (Orlan 1990) and Wim Delvoye's *Cloaca* (Delvoye 2004) to Thecla Schiphorst's wearable *Whisper[s]* (Schiphorst, Baker, Burgoyne et al. 2005), Sissel Tolaas' work with smell (Tolaas 2005), and Janet Cardiff's work with sound (Cardiff 2005), to name a few. These forms of interactivity, either intentionally or not, elicit a conscious sense of one's mind/body, and further address one's mind/body in ways that evoke a visceral response: seeing excrement being made, wearing and "sharing" another's heartbeat, smelling perspiration from men who experienced fear, and hearing binaural "voices in your head" that invite paranoia or uncertainty.

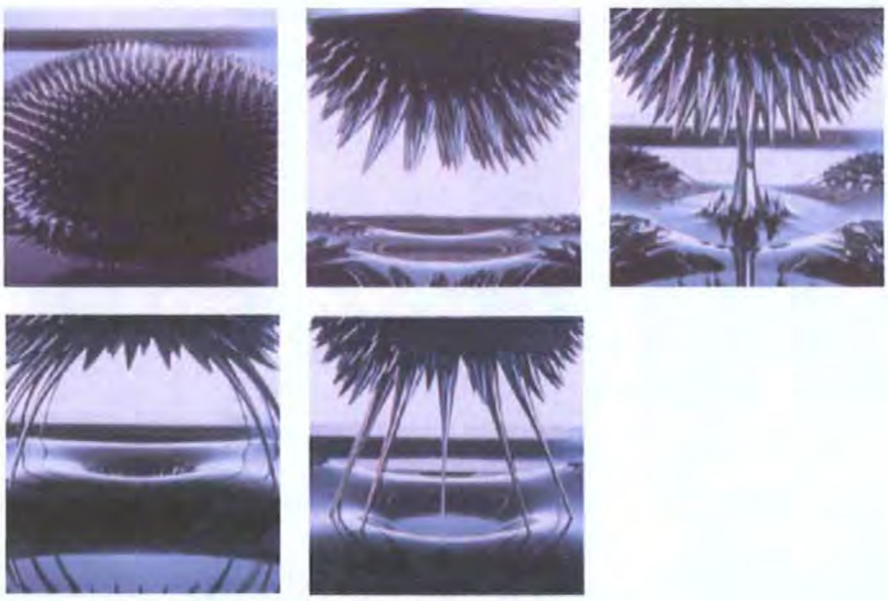

Figure 3.2 *Protrude, Flow* by Kodama and Takeno, 2001.
Art Installation, Medium: Magnetic fluid, microphone, digital camera, video projector, computer. Dimensions: 4m x 4m x 7m. Exhibited, SIGGRAPH 2001: n-space art gallery, Los Angeles, CA, August 14 – August 16.

The second characteristic of interactive art at play is the *responsiveness or purported agency of the artwork itself.* The artwork *Protrude, Flow* (Kodama and Takeno 2001), for example, because of its morphological, computer graphic spikes-cum-porcupine movements, seemed to incite a novel form of animism — being neither creature or inorganic form. In trying to provoke this blob to turn into responsive spikes, human users themselves barked, hissed, growled, vocalized piercing sounds, shrank back when the responses were unexpected, and generally behaved more like feral animals.[17] Other interactive work, such as an interactive guillotine (Knipp 2001) and a thousand pound cube that users lay under at SIGGRAPH 2001, seemed to both provoke a very strong "fight or flight" reflex, a reflex known to strongly involve the visceral (Cameron 2002, pp.10, 36, 84).

AI and robotic work, such as Simon Penny's robot bicycle wheel — which follows users around and appears to bow and "sniff" at crotch level — unarguably elicited visceral trepidation.[18] Not all of these forms of art and technology elicit a visceral response of course. Sony's AIBO dog, for instance, seems a docile toy, even in the hands of Natalie Jeremijenko (Jeremijenko 2002-2006). The agency of some interactive works of art is compelling enough so that even critics and writers cannot stop themselves from writing about such artwork as if it really did have agency that was autonomous from human creation. It is difficult to say if the novelty of such work will become an everyday event or expectation, and what role novelty bears in users' responses.

The third characteristic is *the very nature of some forms of the technologies*, ranging from VR and telematics to Tissue Culture or biotechnologies. Some VR Art, such as *Dancing with the Virtual Dervish: Virtual Bodies* (Gromala and Sharir 1991-2004), my collaboration with Yacov Sharir, falls squarely in the visceral domain. Since ours was among the first group of 6 artworks in VR, the hardware and software was still in its early or beta stages. The obvious simsickness felt by some users in immersive VR definitely elicited a visceral response, one resulting from the well-known lag of the visual/vestibular and geometric distortions of the 3D graphics, which affects proprioception (Kennedy et al. 1992, pp.295-301). Neither the visual or vestibular responses to VR are *directly* visceral, but they certainly provoke, in some users, an *indirect* but strong sense of being nauseated, which is visceral. Further, in immersive VR, one can feel as though one is flying. At the same time, however, the tug of real gravity asserts itself (Gromala 1996, pp. 224-230). Merleau-Ponty's idea of a "body image" seemed to be quite disrupted as these conflicting stimuli were worked out by the mind/body (Merleau-Ponty 2004, p.104). This

[17] As observed over the course of four days at the SIGGRAPH 2001 Art Gallery and in Kodama and Takeno's online videos of its exhibition at other venues. For a video, refer to youtube: www.youtube.com/watch?v=W2IO2wNNOy4 [accessed 1 July 2007].
[18] As observed at the University of Connecticut's Art Gallery in 1994.

short period of time (about 5-7 minutes or so) felt odd, as if one's bodily limits were fluctuating. In addition, it was also felt, as one dancer put it "in the body's center," that is, inside, near the navel. Other users said they felt this in the "gut."

Later VR artwork, such as Char Davies' *Osmose* demanded, in the first case, a sustained control of a user's breath. Since the respiratory system is part of the visceral, Davies' piece is in the visceral domain, although a visceral response is not her expressed intention (Davies and Harrison 1996, pp.25-28). Most of Margaret Dolinsky's networked VR art (Pape, Anstey and Dolinsky et al. 2003, pp.1041-1049) is concerned with perceptual shifts. While initially confusing, her work enables users to understand some aspects of the kinds of spatial perception they take for granted. I would argue that in her work, the physical involvement had to do more with the aspects of the visual, sonic, and to a very small degree, the proprioceptive. These aspects are not in the realm of the visceral. Further, the systems Dolinsky employs — the CAVE — had been improved and stabilized, so that the feeling of simsickness was for the most part nonexistent.

However, the form and characteristics of the specific technology extends beyond artistic uses of them. The author's own collaborative work in VR as a therapeutic modality, for instance, suggested that immersive VR is more effective than opiates during the acutely painful wound abradement of burn patients (Hoffman 2004, pp.58-65), though the number of patients was very small. Similarly suggestive findings were discovered about the *Meditation Chamber*, discussed in Chapter 4.[19]

[19] For the bulk of papers published in North America on the use of VR for disorders of many kinds, refer to the University of Washington's Human Interface Technology Laboratory (HITLab): http://www.hitl.washington.edu/projects/common/papers.php?idx=61 and papers authored by Larry Hodges et al. at www.virtuallybetter.com.

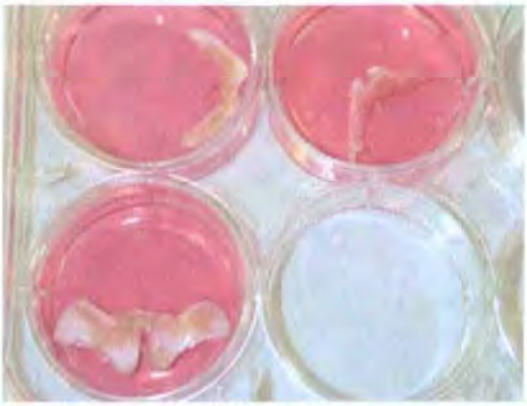

Figure 3.4 and 3.5: Ionat Zurr and Oron Catts, 2002, *Pig Wings.*

Art Installation, Medium: Pig mesenchymal cells (bone marrow and stem cells), biodegradable/ bioabsorbable polymers (PGA, P4HB), hybridization oven, stuffed animal. Dimensions: 4cm x 2cm x 0.5cm each set of wings. Exhibited, *ConVerge, 2002 Adelaide Biennial of Australian Art,* Art Gallery of South Australia, Adelaide, March 1 – April 25, 2002.

Direct, physical engagement is not the only means by which artwork can elicit a visceral response. For example, "Tissue Culture" created by Oron Catts et al. (Catts, Zurr and Ben-Ary 2002-2007) elicits the abject or visceral reactions in a surprising way. Most of the artworks are small, at a scale that seemed to call for a much nearer look. A few users at several of their exhibits did get very close, as the Petri dishes are difficult to see within its environment. The Petri dishes and substructures for the growth of "tissue" were very strongly suggestive of a scientific laboratory, and cultures for bacteria. Next, the growth of the tissue was on a time scale that didn't solicit an immediate response; it was more like watching corn grow. Finally, the cells did not cohere in a way we normally recognize as coming from an animal; they were uniform, without anything that resembled veins, tendons, or other textures. Thus, the visceral response I had hoped for curiously did not coalesce for me, or apparently for many others. It *did,* I would argue, solicit the a modest sense of the abject, as expressed by those who attended the exhibit. But this sense of abjection later seemed to "flow" into a visceral sense, which came afterwards, after *thinking* about the exhibit, mulling it over and over in reflection or in discussion. That in itself is noteworthy, because the visceral response is one that *should* be pre-reflective and immediacy itself. The same holds true for Eduardo Kac's *GFP Bunny* (Kac 2003, pp.97-102). It is the apocalyptic scenarios we imagine that elicit horror or abjection, not of course the "Bunny" itself, whether it is confined to the lab (and destroyed, as planned) or not. So different might the responses be if the animals were the GFP Sea Slug or the GFP Giant Roach.

In sum, this third characteristic, which springs from specific technologies, ranges across many forms of interactive art and technology. What is at play is, first, novelty, which elicits the well-known "friend or foe" response, though this is usually tacit. Other factors are the undeveloped technological sophistication of the system, like the early virtual environments. This area is the one that will continue to change as the technological forms evolve, and so less can be predicted here than in the realms of interactivity and agency. Forms of AI, BioArt and biotechnologies appear to be the ones that will continue to more regularly elicit an abject or visceral sense, as the Frankenstein-like, out-of-control aspects of human creations gone awry is one of the common narratives and metaphors that concern the public (Thacker 2004, pp.1-12), as evinced by a plethora of articles in the press, movies, and Internet content. Beyond the fear these technologies may provoke, however, is the partial, human-like aspects they can engender. Finally, some of these works, like that by Symbiotica or Bioteknica, curiously do not seem to provoke an internal resonance, though users regularly expect the work to do so.[20] It must be reiterated that my position is not one of technological determinism — human first and foremost create and put technologies to use. Nonetheless, each technological form has certain characteristics that delimit what can and cannot be done with them. To reiterate Merleau-Ponty and Gibson, these affordances provide the ways in which the mind/body intertwines, in specific ways, with the world, whether that world is a technological simulation or nature.

Finally, the fourth aspect of interactive art is that it works in *a context of globalization.* The provocation of senses such as the proprioceptive sense, once limited to VR and entertainment rides, are now strongly solicited through non-conscious mimicry. Recall the human "flying" scenes in *Crouching Tiger, Hidden Dragon* (Lee 2000) or *House of Flying Daggers* (Zhang 2005). What was once passed as passive forms of representation, such as film, are now understood to be more internally provocative than they were once considered (Sobchack 2004, p.6). Though less intense than the directly interactive forms of mimicry, these so-called internal "resonances" or "simulations" have been scientifically investigated (Gallagher 2005, pp.220). They seem to be contemporary versions of the ideas Sherrington presented in the early 1900s and Benjamin articulated in the 1930s, and others have articulated in more recent times (refer to table 2.1).

New technologies and common representational forms, such as film and the Internet, that elicit these resonances are globally available. As Manuel Castells argues (Castells 2000, 2003), the context of globalization is disrupting many areas of life, from the nation-state to individual identities. Many of the effects of globalization may be understood to be negative; however, like most change, there may be arguably positive aspects at play as well. While some may long for a

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[20] As observed at five of their exhibitions (2003-2006), and in discussions with the artists.

connected oneness of humanity and collective intelligence, one may also desire to experience the vast differences among humans as well. As an essential component to the life of the human, the visceral may likely be experienced in both similar and dissimilar ways in different cultures.[21] Gunther von Hagen, the creator of "plastination" methods mentions this on the explanatory texts that accompany his exhibits. Death and the way corpses are treated and displayed are considered in numerous ways across cultures, and, I would add, across different individuals. A physician, for example, might well experience the plastinated corpses with no visceral response, while a person who has never experienced death, or who has been brought up to revere dead bodies may not. An example of this was an experience I had when exhibiting *Dancing with the Virtual Dervish: Virtual Bodies.* Some members of Canada's indigenous people (First Nations) considered being immersed in an environment that was from an MRI of my body, considered it "profane." Thus, they chose not to participate in the VR artwork.

Figure 3.6. Website advertising *Body Worlds*. von Hagen, G 2006, Anatomical Exhibition, Medium: Human Corpses, proprietary plastination process. Exhibited Museum of Nature & Science, Dallas, Texas, December 9 – May 28, 2007.

Gunther von Hagen's "plastinated" corpses (fig. 3.6) should be an example of Kristeva's abjection. That is, a feeling of disgust would seem to be one response. However, going through the exhibition in the 60 to 90 minutes that are recommended, the experience of these exhibits begin, I suggest, immediately as a visceral register. It is striking to see a large space filled with plastinated corpses in various poses. The exhibits are relatively dark, with spotlights on the corpses. However, over the course of the 60-90 minutes, I believe the users develop a visceral

[21] Thus, the author is extending the *Meditation Chamber* to other cultural practices of meditation outside of North America: India, China, and Turkey through a Presidential Research Grant from Simon Fraser University.

sense. Moreover, I would argue that part of the reason the exhibits of these corpses work in this way is that they are contextualized primarily in "scientific" and "educational" terms. The scientific framework seemed to provide a suggestion that one could and should look at the plastinated corpses and body parts from an objective distance. It also seemed to effectively dissuade people from feeling a sense that this exhibit was profane. Nonetheless, one could still smell and see bits of obviously organic tissue and hair that remained. It was made evident that the later corpses were once living humans who willingly signed consent forms that said that they were agreeing to have their bodies plastinated after death. They were thus making a contribution "for science." In the text of the exhibition, the question of whether or not these plastinated corpses may or do count as art is always raised by von Hagens himself in each "mega show," but only as a provocative, unanswered question. However, von Hagens literally and very visibly signs his "most impressive" works.[22]

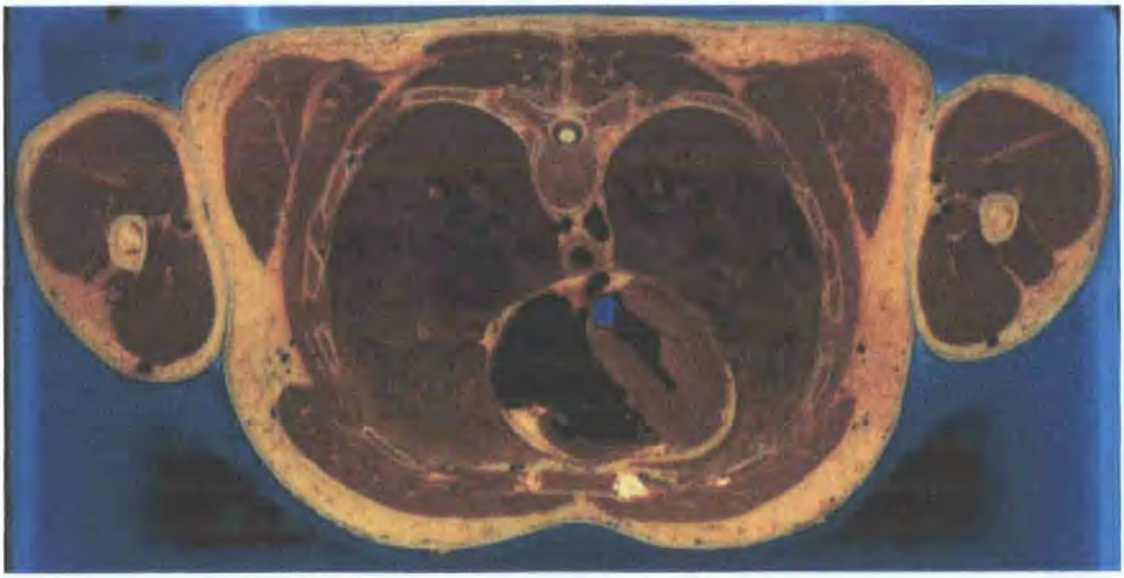

Figure 3.7. An image from the *Visible Human Project.* Spitzer, VM and Whitlock, DG 1991, *Visible Human Project.* Website (CD-ROM, database), Medium: Transverse CT, MRI and cryosection images. Dimensions: 1056 x 1528 pixels at 0.174mm intervals.

The *Visible Human Project* is an example of how and why Merleau-Ponty's conception of "world" (i.e., contexts) matter. The "meat" in the image above might appear to provoke a sense of abjection. However, the blue green background ameliorates some of that response. If we would not know it is a slice of a human, this might appear to just be a slice of meat. However, any sense of the abject at all appears to fall away when the *Visible Human* is animated and its 3D instances are offered for "anatomical study" (anyone can buy these "medical" applications).

[22] Observed at the Minneapolis Science Center, 12 June 2006.

Being able to "drive" through the *Visible Humans* and interact with the images appears to completely do away with any lingering senses of repulsive abjection. The mass cultural fascination with the *Visible Human Project* and *Body Worlds* is of course not new in the course of human history. What is new, however, is the ability to get intimately close without apparent regard for contracting infectious diseases and to "play" or interact with the images of the *Visible Human*. Cultural critics and other humanists might discuss this fascination in terms of psychological "mirroring," while Charles Sherrington would have called it a "physical resonance," as would dancers; Benjamin would term it a physical mimesis. In the last five years, scientists have found "mirror neurons." When watching a member of one's own species, or like species, (i.e., primates and humans), these neurons are thought to "light up" in exactly the same part of the brain that is activated when the observer actually does the activity that he or she is observing (Gallagher 2005, p.220). Essentially, this is considered an internal simulation of another's behavior. It takes place at what Shaun Gallagher (Gallagher 2005, p.237-238) calls the prenoetic or pre-reflective level. This resonance or internal simulation can remain in the pre-reflective realm, or we may bring this sense into our conscious awareness.

3.8 Methodology and Goals

The mind/body systems that comprise the visceral, common to all humans, involve highly subjective experiences. The methodology employed is therefore one that takes experience, including mind/body experiences, seriously: the existential phenomenology following Maurice Merleau-Ponty. The most important aspect of it is a "faithful description" of a perceptual experience from a first-person point of view, staying with an experience until numerous aspects of it are revealed. Further, the arguments about a perceptual experience need to be backed up by examples within that experience. Objective, scientific forms of knowledge can be incorporated, but only if appropriate to furthering the argument, without falling into the complex, abstractions that scientific inquiry can engender.

While this methodology is built upon Merleau-Ponty's work, some aspects of it are necessarily the result of contemporary, scholarly extensions of his work. The inclusion of Leder's work on the visceral, for example, is necessary as Merleau-Ponty did not deal with this aspect. Methodologies of existentialist phenomenology combine first-, second- and/or third-person points of view. Following this phenomenological method, the methodology itself is altered in response to the goals and creative intentions of contemporary existentialist phenomenologists. Thus, highly subjective, first-person explications that are the hallmark of existentialist phenomenology are interspersed with traditional scholarly writing and with scientific results that issued from the specific works that demanded them, such as the *Meditation Chamber*. Other works, such as *BioMorphic Typography* and the *MeatBook* are squarely artworks to "perform" or exemplify phenomenological ideas; thus, the inclusion of scientific, quantitative data lies outside of the artistic intention, and partially outside of textual description. That is, the artwork *itself* is an important aspect, some of which cannot be reduced to textual form.

Early forms of phenomenology set out to provide a counter balance to scientific methods, which were considered abstractions that employed a method that did not account for context or subjective experience. While Merleau-Ponty was concerned with the assumptions that scientific practice is built upon (Carman and Hansen 2005), he nonetheless did indeed keep abreast of scientific understandings, particularly regarding perception and neuroscience, and was not opposed to phenomenologists who used but questioned scientific methods, especially those who combined them with subjective, experiential components. Thus, when the intention of my work is to produce design, and when I closely collaborate with computer scientists or physicians, I include scientific methods and data. However, while I find this information usefully suggestive, I understand it to be but one component of my phenomenological practice. It is always combined with my subjective, experience and artistic aspects.

As an artist and designer who is interested in bridging scholarly and artistic practices, this thesis also necessarily includes the creation of artwork and the technological systems upon which they operate. It should be noted that while I collaborated on some of the technological systems that were built and recognized as innovative (refer to Appendix 1), such as the *Meditation Chamber*, I primarily developed the initial system for *BioMorphic Typography* (90%), solely developed the first technological system for the *MeatBook*, and most of its second system (80%). However, the technology is subsumed to the goals of the artworks and should not be considered in terms of Computer Science. The aim of this research is to work toward developing a theory of the viscera, from what I term the visceral register to the visceral sense, as well as a new kind of artistic practice, each of which continually informs the other in recursive loops and iterations. Some artworks were created as experiments, while others stand as exemplars of points to be made that arguably must exceed textual inscription. The new media theorists Shaviro (Shaviro 2005) and Thacker (Thacker 2004a) have made this point about the limits of textually describing sensation, including the MeatBook (Thacker 2004a).

Thus, theory and practice necessarily must function side-by-side because this is an ontological investigation (an investigation of being). As such, to repeat, it takes subjective, embodied experience seriously. A material, experiential instantiation, — that is, the creation and exhibition of artwork — is a crucial aspect of the research, one that brings the research outside of a purely textual account (refer to the enclosed CDROM).

The functions of the artistic practice in this research are threefold: an artistic method of *testing* theory beyond textual practices, *an embodied tool-to-think-with* (conceptually and technically, as technological systems are developed specifically for each artwork) and *an embodiment and performance of theoretical precepts* in their own right. The groundwork outlined in this document serves as the foundation for developing a coherent, systematic theory of the visceral register and sense, and for testing and embodying it in the praxis of art making. Likewise, the creation of artwork is as often a starting point for the development of a theory as are the textual claims. The resulting intertwining, co-development of artwork and textual research may in turn contribute to a more rigorous and systematic kind of theoretically-entwined artistic practice that may help create the sustainable bridges to related research discourses. This has been the core of my intention and practice for the past two decades, and includes the publication of a co-authored book, numerous publications in art, design, and computer science journals and books, along with some publications in Humanities books and journals (refer to Appendix 1, which is a list of publications, lectures and exhibits that were produced during my enrolment). For work which precedes this time, refer to www.siat.sfu.ca/~gromala.

3.9 My Artistic Background and Context

My interests in the visceral realm and in perception generally have very deep roots in my lifelong experiences. Those are described in a first-person point of view, in the Preface and in italics, at the beginning of most chapters. More recently, while working as a designer at Apple Computer, Inc. in the mid- to late 1980s, I co-designed the interface for HyperCard and it's marketing. Since no other multimedia application existed, part of my job was to imagine what people would use it for. Our creative discussions focused not wholly on combining animation with text, sound, and video, but, more to the point, on a user's perception, senses, and physical experience (though we never realized smell as a component). In the late 1990s, I extended these ideas at the Banff Centre for the Arts. As one of the very first artists to explore immersive virtual reality, I was obsessed with the physical effects it could elicit, so I chose to work with choreographer Yacov Sharir. As he taught me the mostly orally transmitted knowledge that dancers have of their bodies, I shared the difficulties I had with chronic pain and my method to live with it: meditation. Despite our intentions, VR exhibited effects that were surprising. As is the practice of an artist with his tools, we realigned our artistic intention to include some of the aspects that the tool of VR provided; namely, the ability of VR to create a feeling of being "immersed" yet simultaneously physically registering gravity, and its ability to bring to awareness a sense of proprioception. In Merleau-Ponty's terms, the effect VR has in this kind of context is that of transforming or affecting at least one's "body image" (Merleau-Ponty 2004, p.104).

What interactive art offers is an alternative to the textual accounts Sobchack refers to: material and virtual instantiations of differing aspects of the corporeal, and first-person experiences. Among these artworks, the visceral offers that which occurs before reflection — in the split second before experience becomes consciously beheld — and enables users to bring into conscious awareness what otherwise remains obscured: a register or sense of the visceral.

3.10 Summary

Interactive art may provide for or provoke the visceral in new ways that extend beyond the abject. In doing so, it may extend Merleau-Ponty's work because it delves below the primarily surface aspects of what Merleau-Ponty termed *flesh,* and the active, adult, healthy humans who concerned him (Ihde 2001, p.15). The visceral includes our innermost workings that are necessary for life, and thus may enable various forms of awareness and transformative experiences that prior forms of the fine arts did not, or that achieved them in fundamentally different ways.

3.11 Organization of Subsequent Chapters

This research is informed by Art, Design, Medicine, Physiology, Philosophy, and the Humanities, no one of which offered the specific forms of bodily knowledge and processes that were required. The subsequent Chapters 4 through 6 explore the artworks that were created for this thesis: the *Meditation Chamber, BioMorphic Typography,* and the *MeatBook.* Chapter 7 offers a conclusion.

Appendix 1 is a list of publications, exhibitions and lectures produced during the time of study. Appendix 2 is the user studies of 411 participants in the *Meditation Chamber.* These may be accessed at www.sfu.ca/~dgromala/thesis. Human Subjects Review and Permission require a user login in order to prevent the results from reaching the general (not academic) public. Thus, in order to access the user studies, the reader should first access this website: at www.sfu.ca/~dgromala/thesis; second, click on the <Appendix> link; third, type in the login as <feral>; and finally, type in the password <computing> in the window that appears. Appendix 3 is a collection of transcribed questionnaires from users of *BioMorphic Typography.* Appendix 4 includes user feedback from the *MeatBook.* The book *Windows and Mirrors* is included as a separate volume.

Chapter Four: The *Meditation Chamber*

4.1 Introduction

The *Meditation Chamber* is one of a suite of projects that comprise this thesis and deals with various facets of the visceral, including developing an awareness of and potential control over the visceral sense; the focus of this project is the autonomic aspect of the visceral, including heart rate, breath rate and galvanic skin response (GSR). Although GSR is not included as a measure of the visceral, I argue that it has an indirect place, as GSR is suggestive of state change, especially that of mood. "The galvanic skin response (GSR) signal is an indicator of skin conductivity, and is measured via two small silver-chloride electrodes. An imperceptibly small voltage is applied and then skin conductance is measured between the two electrodes" (Picard 1997 p.162). While we cannot perceive our own skin conductance, it is affected by the hormones that are produced by the gut, many of which are responsible for mood, and thus, they belong in the visceral realm, though indirectly.

This chapter describes the design, implementation and analysis of the *Meditation Chamber*, a bio-interactive, therapeutic, virtual environment. It was initially exhibited at SIGGRAPH 2001 and after minor refinements, is now in use at Virtually Better,[23] along with its 20 partners. The goal was to design and build an immersive virtual environment that used visual, audio and tactile cues to create, guide and maintain a user's guided relaxation and meditation experience. Real-time biometric data was used to partially control most of the environment, thus shaping the user's experience. The methodology for this project combined objective and subjective data collected from the participation of over 400 attendees at SIGGRAPH 2001.

Because the *Meditation Chamber* was designed for a clinical context, objective measures were appropriate and necessary. For the purposes of this thesis, subjective measures were simultaneously gathered with objective measures. In the spirit of Merleau-Ponty's methodology, both objective but primarily subjective measures are used. The objective measures should be understood as suggestive of the ability of users to use biofeedback and guided meditation techniques to relax in a greater state of calm than sitting quietly. A lengthy discussion of the technical aspects begin this chapter, while a discussion of Merleau-Ponty's ideas are interspersed within the chapter and concludes it.

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[23] Virtually Better is a treatment facility in Atlanta, Georgia. Patients who suffer from phobias, traumatic-stress disorders, addiction, anxiety and other disorders are guided through their experiences in immersive virtual environments by their psychiatrist or psychologist. www.virtuallybetter.com

4.2 The Effectiveness of Meditation

It is estimated that meditation has been systematically practiced at least for a millennia with scientific certainty (Gethin 1998, p.1). In the last decade, meditation has assumed legitimacy in Complementary and Alternative Medicine and Integrated Medicine in North America and some European countries. Scientific studies have largely affirmed its benefits, including its psychological and physical efficacy and claims (Zamarra et al. 1996; Schneider, et al. 1995; Walton et al. 1995; Barnes et al. 1997; Wenneberg et al. 1997). Moreover, significant inroads to the acceptance of meditation in normative Western medical practices have been made by physicians such as Dr. Kabat-Zinn (Massion et al. 1995) at the University of Massachusetts' Center for Mindfulness, researchers who belong to the Mind and Life Institute (predominantly neuroscientists and psychologists) and the regular inclusion of meditation practices at numerous Centers for Pain Management[24] in the U.S. More than any other practice, meditation enables users to become intimately familiar with their autonomic and interoceptive (stimuli arising from within the body) phenomena, from breathing, heart rate and blood pressure to visceral sensations, depending on the specific meditative practice.

It can be argued that bio-feedback achieves similar abilities. Dr. Neal E. Miller, a pioneer of biofeedback at Yale University states, "Most people are poor at correctly perceiving their visceral responses, such as blood pressure . . . They are like a blindfolded novice trying to learn to shoot baskets. Feedback provided by a device that provides prompt measurement of a biological function has been called biofeedback" (Miller 1978, p.137). Miller continues to say that biofeedback ". . . can be used to help animals and people to learn to improve the perception of certain visceral events" (Miller 1978, p.1). The employment of the biofeedback device chosen (Thought Technologies ProComp+) is utilized for its feedback for users and ease of putting on the sensors. The author and her collaborators follow Rosalind Picard's sense that biofeedback devices are only suggestive of changes in states (Picard 1997), and are not able to tell us, for example, when a user is in a meditative state with any absolute certainty.

We chose to integrate a biofeedback device with an immersive virtual environment in order to enable users to get real-time feedback and to gain a sense of control over their autonomic functions. However, it must be made clear that a biofeedback device does not of course offer any strictly parallel scientific or objective measures of being in a meditative state. It gives us a good indication of the relative change in physiognomic states, and after decades of testing, is

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[24] Personal communication from Dr. Sullivan from the University of Washington, Seattle; Dr. Hord and Dr. McKenzie-Brown from Emory University Hospital, Pain Management; Dr. A. Herrera, Yale University School of Medicine; Dr. S. Mackey, Stanford University Pain Management Center and Dr. P. Palmer, Director, UCSF Pain Management Center.

indicative of the relative states of those who are in a meditative state. The most reliable and sensitive measure is by EEG (electroencephalography); however, this device requires 24 carefully measured points of contact on the scalp, and thus was not viable for an exhibition. Further, as measured by an EEG, the lines that indicate a meditative state are very close to those of an incipient epileptic seizure. For our purposes, an adequate indication of changes in real-time states was sufficient by our use of respiration, heart rate and galvanic skin response.

According to Varela, Thompson and Rosch, (Varela, Thompson and Rosch 1993, p.23) the word *meditation* in contemporary America has four most generally used folk meanings:

> "(1) a state of concentration in which consciousness is focused on only one object;
> (2) a state of relaxation that is psychologically and medicinally beneficial;
> (3) a dissociated state in which trance phenomena can occur; and
> (4) a mystical state in which higher realities or religious objects are experienced.
> These are all altered states of consciousness; the meditator is doing something to get away from his usual mundane, unconcentrated, unrelaxed, nondissociated, lower state of reality."[25]

While these definitions suggest a primarily secular adoption of ancient religious practices, they are the opposite of the Buddhist practices of mindful/awareness that Varela, Thompson and Rosch were interested in. The purpose of Buddhist practices of mindful/awareness "is to become mindful, to experience what one's mind is doing as it does it, to be present with one's mind" (Varela Thompson and Rosch 1993, p.23). Since this takes a great deal of regular practice, the most we could hope for in the short time of testing the *Meditation Chamber* was to introduce users – particularly novices – to their abilities to perceive some of their autonomic senses. Once perceived, the user can then learn to exert control over this sense. While difficult to achieve at a one time session at SIGGRAPH, more sustained use at Virtually Better enables more practice and thus greater control over autonomic processes. Meditation is a process whereby a user continually shifts attention to their autonomic senses and back to their conscious states, just as Merleau-Ponty explained using the example of hands touching hands. In Merleau-Ponty's example, however, the exteroceptive senses were involved, while in the *Meditation Chamber*, more interoceptive senses are engaged. The difference is that in Merleau-Ponty's example, attention was shifted between outlying, visible hands whereas in the *Meditation Chamber*, attention shifts between that which usually remains in the background of our awareness — the autonomic senses — and the foreground of the mind. This is not as simple a

[25] The authors' "linguistic intuitions" about these categories were reinforced by a content analysis of 189 students at U.C. Berkeley.

process as described, however, because with each breath, one tries to "quiet" or "put aside" conscious thoughts in order to focus. The user can then more easily "tease" out sensations within, pay attention to them, decrease their goings on, and bring them to the foreground of attention. This is reversibility of a different sort, one which Leder terms the "vertical" aspect of Merleau-Ponty's otherwise "horizontal" explorations. Merleau-Ponty might take issue with the way in which Leder abstracts this difference, however. I would instead use a topological metaphor, or return to Merleau-Ponty's example of a sock that can be turned inside out. Leder's perspective will be examined in more detail later in this chapter.

Meditation can be understood to be an inversion, because it inverts Merleau-Ponty's method of examining pre-reflective perceptions — an inversion because *mind* is understood to be what initially registers and then controls the autonomic senses in a feedback loop, not pre-reflective perception. One strives for "detachment" from worldly concerns *in order to gain a sense of* autonomic senses. In meditative practices, it is *mind* that affects the world, but Merleau-Ponty would instead point to the inextricability of mind from body and both from world. Mind, after all, is directly affected by the hormones and other mood-altering substances created in the viscera. Similarly, one's state of mind can also influence one's body. So while I assert that meditation is a form of what Merleau-Ponty termed reversibility, it is surrounded by both Eastern and Western articulations of the process that perhaps inadvertently privilege the mind. In Eastern meditative practices, for example, I found that only by studying them in depth will one find it clear that they consider mind and body to be two inextricable aspects of the same thing. I have not discovered yet that this is also true in Western practices, except as they reference Eastern forms.

An often-unquestioned issue is why would one want to develop an awareness of the visceral. Awareness of interoceptive sensation usually makes itself known when serious phenomena, like food poisoning or cardiac arrest are imminent. By bringing into consciousness some of our visceral aspects, I argue, can one learn to exert some control over them. In doing so, we can become more aware of our visceral selves, which may be transformative. It is transformative in a superficial way, in that we can develop an awareness that we did not already have. However, the effects of this new knowledge may be transformative at deeper levels, if it is practiced and accessed daily. For example, if it can reduce our stress levels, it would have long term transformative effects on both our minds and bodies.

Our initial concern was with stress, which affects almost every part of the visceral systems. The seriousness of stress is often dismissed, underrated or misunderstood. Stress has extremely negative consequences: it negatively affects immunity and endocrine production and is "linked to the six leading causes of death: heart disease, cancer, lung ailments, accidents, cirrhosis of the liver, and suicide" (CMHA 2007). Similarly, in 2004, the World Health Organization (WHO 2004) stated that stress was indicated as a major factor in 60% of all non-infectious diseases. But a keenly developed visceral sense, honed, say, through meditation, can be a powerful form of prevention. Thus, alternative therapeutic techniques related to relaxation and the management of stress are increasingly employed to augment traditional treatment by drug-based, medical therapies. This would seem to be a transformative aspect of meditation.

A growing body of results presented in the literature demonstrate that these alternative treatments show great promise and warrant continued use and study. Drug-resistant epilepsy, hyper-tension, asthma, anxiety disorders, depression, chronic pain, ulcers, colitis, migraine and AIDS/HIV make up only a handful of the medical problems that have been successfully addressed through relaxation/meditation techniques. A 1995 study showed that a group of HIV infected men with sub 400 T-cell counts who were exposed to a collection of relaxation techniques improved significantly when compared to a control group on dependent measures including T-cell count, mood, anxiety and self-esteem (Taylor 1995). Countless studies support the use of relaxation techniques, particularly Transcendental Meditation™, in the treatment of hypertension and other substrates of coronary heart disease (Zamarra et al. 1996; Schneider, et al. 1995; Walton et al. 1995; Barnes et al. 1997; Wenneberg et al. 1997). In addition, it has been found that as a complementary therapy, meditation may improve function in Parkinson's disease, multiple sclerosis and other neurological disorders (Chrisman 2007).

Stress is where the external world is perceived in such a way as to present the mind and body with difficulties, rather than as an endless realm of affordances. In the extreme, stress is produced most visibly when the "fight-or-flight" reflex is provoked (Cameron 2002, pp.10, 36, 84). The release and further creation of hormones that have a negative effects on the body is what scientists consider to be a result. These hormones have negative consequences for every visceral system if they are systematically at high levels over time, from raising blood pressure and heart rate to affecting sugar levels in the bloodstream. In addition, focusing on the anxiety produced also amplifies the excretion of the hormones responsible for emotional affect.

In Buddhist meditation, the everyday things one gets caught up in that are less important than they should be is called *samsara.* The point of Buddhist Meditation is to realize that samsara is considered to be illusory, and so one should detach oneself from it. "The circle of conditioned human existence is called *samsara*, which is visualized as a perpetually spinning wheel of existence driven by a relentless causation and pervaded by unsatisfactoriness" (Varela, Thomspson and Rosch 1999, pp.115). By realizing the illusory nature of samsara, the embodied mind, trained in Meditation, can be mindful of these distractions, and by perceiving them, then disregard them. Now freed from the fight-or-flight response, one can affect the world positively, but not responding and therefore adding to the illusory importance of samsara. Meditation reverses the fight-or-flight reflex. Thus, the visceral conditioning, learned through meditation, affects samsara (or the conventional or external world) by not reacting. Meditation is therefore an inversion of the fight-or-flight process because being mindful stops the visceral sense from affecting the mind, and vice versa. (Varela, Thompson and Rosch 1993). Stress can be seen as the external world affecting the body and by extension the visceral response of fight-or-flight, which then amplified and sustained by the mind that can't rid itself of attachment to the unimportant aspects external world.

Though not fully known, the root of the effect of these relaxation techniques on physical and psychological health is thought to lie in their ability to stimulate the production of certain important hormones, the majority of which are produced in the enteric system, a subsystem of the visceral. It has been shown, for example, that experienced practitioners of Transcendental Meditation™ create in themselves the same endorphin release reaction created by physical exertion in experienced runners, often referred to as the "runners' high" (Harte, Eifert and Smith 1995, pp. 251-265). It has also been shown that melatonin, thought to be important in health maintenance and prevention of diseases such as breast and prostate cancer, is found at significantly higher levels in regular meditators when compared to non-meditators (Massion et al. 1995). These are only a handful of the most notable and highly regarded studies. Many more are currently underway.

4.3 First-Person Description of Meditating

Meditation practices are varied across the globe, in conceptual or spiritual framing and in technique. In trying to come to terms with living with chronic pain for over 20 years, I have studied many forms of meditation. Despite the differences in technique, many of them share a focus on the breath, and initially seem to reinforce the mind/body split. In traditional forms of meditation, however, I have found that this is more the result of skimming the surface of understanding traditional forms of meditation, rather than understanding it in more depth. In the in-depth understanding, terms are introduced that make clear that mind and body are understood to be two facets of the same, or that there is little distinction at all.

This is a first-person description of my perceptions of meditating. Rather than describe the technique, which begins with focusing on my breath, I will describe the perception of it.

Closing my eyes, I spend some time trying to stay focused, while trying simultaneously to ignore the plethora of thoughts that seem to spring from nowhere. Oddly, these thoughts seem to have a spatial orientation near my head: "right," "left," "in front" or "in back" of me. Rarely do they seem to hover atop or below me. I try to turn my attention inward, which is sustained by the rhythm of breathing. Thoughts and sometime images still surround me, appearing and disappearing, but after awhile, they fade in intensity. When I strive to push away or ignore these thoughts and images, I am conscious of doing so. However, my attention oscillates between being aware of what I am doing, seemingly from a detached, or objective third-point of view, with feeling a sense of an inner self, from a first-person perspective. I do not notice when the thoughts and images are gone, but I seem deeper in myself, proprioceptively. It is as if all of me settles around my center (or what dancers and martial artists have taught me to term my center, somewhere inside and a bit below my navel).

Over time, all of my attention is focused inward. Time seems indeterminate and seems to lose all semblance of consistency. The black that surrounds me becomes a deeper black, suddenly, and I feel a sense of being less heavy. More time must pass, but I am ignorant of it. At certain times, the black seems to become blacker and I feel as though I am zooming backwards – not falling per se — but moving backwards as the surrounding black seems to expand around and in front of me, infinitely. My sense of backward movement seems almost to be initiated or pulled from my "center." Whatever body image I had becomes unsustainable, as my sense of self seems to blur at the edges that now oddly move now and then, and fade into the black. Almost indistinguishable moments of something like euphoria seem to slowing and gently wash over me, like small but gentle amounts of long-lasting opiates. I stay this way for an indeterminate amount of time, sometimes moving backwards, sometimes apparently lighter, but not quite floating. If I meditate for a long time, more levels of deepening black occur, plateau after lower plateau. I "register" any external stimuli, but it seems miles away; that itch disappears, the annoying sounds of a faraway dog, muffled. Nonetheless, I know what is going on in my surroundings to some faraway degree; they seem far away, but I know them to be instantly available. Yet internal goings-on make themselves known, some common, some novel. Some appear and dissipate, others persist and seem to merit attention. In traditional forms of meditation, I am supposed to pay attention to these, as they are indicators of something my body is trying to tell me.

My specific reason for meditating is to gain experience in resituating or "remapping" my visceral pain. This is perhaps the most inarticuable aspect, for the pain does not recede; rather, I "put it" in a different place. The affective states I associate with the chronic pain are definitely changed, as its physical location is "remapped" as I call it. But this remapping and spatial displacement is difficult to sustain — it lasts for a few hours when I am no longer meditating, but a few hours are an immense relief. The experience can be related to the TENS unit pain physicians give their patients – a variable electrical current, placed on either side of the pain is meant to disrupt the pain signal from using its usual pathways, which are likened to deep ruts in a road. The goal, like mine, is to create new pathways; physicians don't call this remapping, except for neuroscientists, like Ramachandran. I don't feel anything like electrical current, of course, but more of a "feathering" apart of sensation. Like the TENS unit, it is initially useful, but the mind/body's adaptability usually renders the effectiveness, after time, less than it was initially.

Emerging from a deep meditative state can be very quick; however, when I do this I often feel a vertiginous state, and am discombobulated. Rather, level by level, I intentionally emerge. I experience a few seconds of sleepiness, but after an hour or so, I feel reinvigorated, and clearer-headed. When clearer-headed, I can be fully present in a room of say, faculty disagreements, but they are not bothersome. This is usually termed "detachment," but I am fully present, in mind and body. The disagreements though, seem unrelated to me and I wonder why they appear so important to others. I don't emotionally or viscerally respond to the volatile situation; and this has an effect on the escalating tenor to stop in confusion. For if I don't respond to a volatile situation (As the Associate Director), how could it be so volatile to begin with?

Merleau-Ponty offers an insight: "My organism as a prepersonal clearing to the general form of the world, as an anonymous and general existence, plays, beneath my personal life, the part of an inborn complex" (Merleau-Ponty 1964a, p.84). The body schema is not a conscious image of the body, but a tacit sense of its abilities and of its relation to the world. Long term practice of meditation can transform our body schema, our comportment in the world, just as sports or dance can. Like learning how to play the piano or learning how to type, "The capacity of going beyond created structures in order to create others" (Merleau-Ponty 1963, p.175) is transformative by developing capacities that range from developing abstract of complex moments, by creating or employing tools and machines to facilitate our goals, in learning to care for others and the change in physical comportment that is required, and in learning to create and appreciate art.

4.4 The Mediation Chamber

However, for people who are new to the practice of any form of meditation, one of the difficulties is in knowing if or when their efforts are indeed achieving anything. Thus, Dr. Larry Hodges from the Georgia Institute for Technology and I, both longtime meditators and creators of virtual environments, hypothesized that using immersive Virtual Reality (VR) might provide users with real-time feedback, enhance their ability to know when they are changing physiological states and potentially decrease the time it took for users to learn how to meditate. The resultant *Meditation Chamber* is comprised of an immersive virtual environment, a biofeedback device, and customized programming, co-created and overseen by Dr. Chris Shaw, who was the first of two computer scientists who wrote the earliest VR application, MRToolkit.

Figure 4.1: The Meditation Chamber

One roadblock discovered to impede the effectiveness of relaxation therapies is the consistency and quality of the user's experience. Most formally trained medical doctors (or rather, their assistants) are not knowledgeable enough to administer alternative treatments. Also, some people have difficulty with visual imagery and are not good candidates for meditation exercises. The goal of the research project presented here was to design and build an immersive virtual environment that generated visual and audio cues to create, guide, and maintain a user's guided relaxation and meditation experience.

There are several possible advantages to using a virtual environment to support meditation and guided relaxation beyond providing new meditators with real-time feedback. Patients without good mental imaging skills would still be able to benefit from the use of meditation. Clinicians with minimal training in meditation and guided imagery would be able to provide a consistent, high quality relaxation/meditation experience to their patients with the system we created. Also, by providing specific meditation environments, we can guarantee that participants in future studies all receive identical training and treatment. The use of meditation and guided imagery is well established for its utility in the treatment and prevention of a number of several diseases associated with high cost in terms of both human suffering and financial cost. The possibility of increasing the effectiveness and repeatability of this type of therapy may receive a great deal of interest from the medical community, as has been the case (along with venture capitalists).

4.5 System Design

The system was designed over a period of several months by an interdisciplinary team of computer scientists (Larry Hodges, Chris Shaw), an artist (Diane Gromala) and a psychologist (graduate student Fleming Seay). Hodges and Gromala conceptualized the project. Hodges, Seay and Gromala researched multiple kinds of meditation in order to decide on which would be most feasible and accessible. Shaw and Gromala conceptualized the technical system, while Shaw oversaw its design and implementation. Seay and Gromala conducted research into the current use, successes and failures of meditation in the U.S. and its scientifically proven benefits. Seay also designed one of the quantitative user tests. Gromala was also responsible for the system's media —imagery, sound and interaction — along with the the design of several different iterations of the environment, integration of the media with user behavior, as well as the user testing of the control group. Gromala recruited 12 grad students in iterative, participatory design workshops. Decisions about the kind of sound, voice-over, imagery, and sequencing were developed and tested in these workshops. Each had five to seven versions which users tested, ranked and commented on. The end product was a three phase experience that offered a carefully choreographed sampling of basic meditation and muscle tension relaxation techniques.

4.6 Instrumentation

Galvanic skin response, respiration, and blood volume pulse were chosen as the biometrics of interest for this project. These biometrics were collected using the ProComp+, a commercially available device produced by Thought Technologies. The sensors described below are all standard biometric sensors produced by Thought Technologies for use with the device.

Galvanic skin response (GSR), commonly used in lie-detector tests, is a measure of the change in the electrical conductivity of the skin that results from the body's reaction to emotional stimuli. It is fairly useful in measuring user's general level of arousal as well as tracking changes in arousal as they relate to events in the user's environment. GSR is measured by attaching two electrodes to the user's fingertips and measuring conductivity changes in a reference charge passed through the user's skin. The reference charge is weak enough so that no sensation is created.

Respiration rate was measured using a flexible chest strap that was stretched around the user's upper chest and fitted just below the armpits. The strap was equipped with a length of rubber tubing that flexed and relaxed as the user's chest expanded and contracted during respiration. The change in the length and tension of the rubber tubing was measured and integrated to derive a breathing profile of each user that showed both frequency and amplitude of respiration. As an addition/alternative it is also possible to measure diaphragmatic breathing with an abdominal placement of the respiration sensor.

Heart Rate was measured using a blood volume pulse sensor that monitored cardiac pulse at the tip of the index finger. The data generated was rendered as a line graph showing change in heart rate over time.

The audio-visual content of the environment was delivered to the user via head mounted display. The head mounted display used for this installation was the VFX-3D, produced by Interactive Imaging Systems. This bi-ocular HMD does not have a stereo-visual display, but gives the user an approximately 60-degree field of view, which is larger than most. The unit's large, high quality headphones also figured in to its selection for their ability to deliver robust sound and cut down on the intrusion of external noise. A library written by Thought Technologies allowed us real-time access to the stream of data produced by the sensors. We were then able to write code that allowed us to use this data stream to manipulate aspects of the environment. This feedback loop — or Merleau-Ponty's reversibility — let the user's bio-rhythmic state alter the environment in subtle ways just as the environment worked to relax the user. Again, in Merleau-Ponty's terms, this is an intertwinement of mind/body and world. At the beginning of the meditation process, users subjectively look to the visuals to see if they can make a connection between what they see in the virtual world and what they feel internally. At this point, users are primarily engaging their exteroceptive senses in order to reach inward, to their interoception. They reverse between seeing as subjects and in a sense, being seen as objects, as others might see them, and as oscillating between subjects/objects that have some effect on other objects, namely, the visuals and audio.

Figure 4.2: Image of the sunset taken from initial phase.

4.7 Content: Interactive Animation and Sound

Artwork for the Meditation Chamber: Imagery

Larry Hodges, one of my collaborators in developing the *Meditation Chamber,* is one of the few computer scientists I've met who recognize that realistically recreating a scene is of limited value — there is no room for the user to imaginatively "fill in" between the visual or audio indications. In his *Virtual Vietnam,* for example, he only provided a few tropical trees and sounds of a jungle and helicopter. This was created for the treatment of Vietnam veterans who suffer from post-truamatic stress disorder. A veteran, accompanied by a psychiatrist, relives a traumatic experience while in the virtual environment. Hodges' approach is very successful, according to the veterans themselves. Similarly, in the *Meditation Chamber,* we wanted to provide as few indicators as possible, especially because the goal of the users was to focus inward, and progressively ignore outside stimuli.

We brainstormed in order to develop directions for the sound and visuals. We started with the most literal and expected images: the sun setting and the moon rising. While these provided clear indicators that a user was changing states, the images seem cliché. In addition, they didn't enhance or parallel the experience of meditating, from my point of view. The more effective visuals were that of jellyfish, which were abstracted. We feared that some users would quickly identify the jellyfish and thus be off put because of painful experiences they may have has with the jellyfishes' stingers. None of the users reported this, however. The reason for using the jellyfish is that I was searching for non-realistic images that moved fluidly, and that could parallel the rhythm of the user's breathing. The final contender for ideas of imagery was to capitalize on "medical visualizations," such as those used by cancer patients. In visualization practices, for example, the patient visualizes the tumor shrinking, being eaten, or destroyed by whatever metaphor was most appropriate to the user's imagination. Since we were dealing with stress, we thought that providing visualizations of the effects of stress would both aid in the meditation and provide suitable images. Thus, we developed a 3D visualization that depicted blood vessels constricting, tearing and cholesterol forming in the tears, with a voiceover explaining the effects of stress on the body. While this was certainly educational, it required constant attention, and did not provide a way for users to associate any of their perceptions with the visualization. Other images, like the fluid, abstract, moving lines like those found in the iTunes visualizer were explored, but again, these images seemed to pull the user's attention forward. In addition, they did not provide a cause-and-effect relationship. In testing the images among the faculty, graduate and undergraduate members of our labs, the more ethereal images were preferred, with the jellyfish as the clear front runner. Although we did not have time to overcome the technical difficulties of integrating the jellyfish movements precisely with the breathing patterns of the users through the biofeedback device, we did provide an indication that their was a cause-and-effect. The abstracted jellyfish also were successful because they were "hypnotic," which seemed to be in sync with breathing, and seemed to prime users for meditating by focusing inward. When users felt they were indeed relaxing or lowering their physiological measures, they generally closed their eyes. The abstracted jellyfish augmented this turning inward of attention by slowly dissipating and fading to black. At SIGGRAPH, we used both the sunset and the jellyfish. Because the abstracted jellyfish were more complex, they took longer to display. In the final, debugged version, however, this was attended to and now playback in real-time (refer to the CDROM: *Meditation Chamber*).

Artwork for the Meditation Chamber: Audio

Sound, on the other hand, worked in a different way than the visuals. There were two forms of sound: the voiceover that instructed users, and the ambient audio, which ended up sounding something like abstracted, flowing water.

The first aspect, the voice-over, was used to guide meditators, and was used as infrequently as

possible, so as to not interfere with the process, or to bring people back to the "exterior world." A number of voices were tested — the initial test subjects objected to all of them.
These initial test subjects in our labs at Georgia Tech almost always rejected voices because of apparent aspects of character and personality they attributed to each voice. For instance, users would say that one female's voice "sounded like she was a bitch," or that "she was annoying and probably clingy." Male voices fared slightly better, but again, comments ranged from "he sounds like he's trying to be on the cover of GQ (magazine)" to "he sounds like a wuss."
We then found more trained, expert voices from members of the Theatre department. They fared little better, with comments that ranged from "he sounds like a robot – is he an Electrical Engineer?" to "he sounds like a salesman – he's trying too hard." In the end, to our surprise, the voice of our collaborator, Fleming Seay, troubled very few test subjects, so we chose his voice.

Many sounds from nature were tested, with the idea that they would serve as ambient sound. Our exploration began with voice-less, and the least sugary "New Age" and First Nation's wind instruments, along with very quiet but deep bass drums. Users found all of these cliché. Electronic, ambient music was tested, as well as slower versions of "jungle" and ethnic music. These seemed to demand more attention and had rhythms that seemed to work against meditating. The original recordings of a stream did not test well among our test subjects at Georgia Tech, though some test subjects said it had promise. Some users found it distracting, (especially if any birds were heard), some said it was monotonous, while a few said it elicited in them the "urge to pee." The abstracted version of a running stream, particularly without birds, did not seem to bother users. This background, more abstracted ambient sounds that we found most pleasant also tested well.

In the final version of testing, we decreased the volume of the ambient sounds when the voice-over was playing, and slowly decreased it during the time users were to lower their physiological states, though this was not interactive. At SIGGRAPH, the audio and the headphones also served to muffle the noise of the conference, from people talking as they walked by to the blings, buzzes and clicks of nearby electronic work. Though we asked for a quiet space and were supplied velvet curtains to muffle sound, the top of each station could not be covered, according to the fire marshal, so finding a dark and very quiet space was impossible.

Phases of Meditation in the Meditation Chamber

This initial phase served to relax users and introduce them to the experience. After being asked to breathe deeply and relax, the user was presented with a visual depiction of the sun just before sunset. A narrator's voice told users that the sun would drift lower and lower in the sky as they relaxed, breathed deeply, and flushed their mind of worldly concerns. The sun would then start to move downward very slowly, toward the horizon (see Figure 4.2). As the user began to relax and their GSR declined, the rate at which the sun moved would increase until the sun went beneath the horizon, giving way to a peaceful though highly abstracted night scene (i.e., a horizon), replete with chirping crickets. If the user was unable to become relaxed or if their GSR increased, the sunset would slow down. After the sunset, the second part of this relaxation phase operated in the same way as the first, but depicted a moonrise instead of a sunset. As the user relaxed and lowered their GSR, the moon would rise higher and higher into the sky. The user's GSR measure determined the frame-rate at which the sunset / moonrise animation would play.

At each measurement interval, the current GSR reading was compared to the previous GSR reading, and if the GSR value had increased over the time period, the current frame of the sunset/moonrise animation would be paused. If there was a decrease in GSR, the sunset/ moonrise animation would step forward one frame. The measurement period for this GSR comparison was one second, although the system was continually reading data from the ProComp unit at its update rate of 120 samples per second. This simple scheme of stepping forward a frame at every decrease in GSR reading helped solve the problem of users' GSR readings being different from person to person. It also helped ensure that users progressed through the animation, and successfully dealt with the arrival of extreme GSR values, since only second-to-second decreases resulted in a shift in sunset/moonrise imagery.

Depending on the frame-rate the user achieved, this combined sequence took 2-4 minutes to complete. Users were not told explicitly of the relationship between their GSR and the frame rate of the animation so that they would make no effort to "play"[26] the environment and would instead concentrate on the experience of relaxation.

The second phase of the experience was a guided, progressive muscle relaxation exercise. The user was coached to flex, hold, and release a set of eight different muscle groups including the legs, arms, abdominals and shoulders (see Figure 4.3 and 4.4). Each muscle group sequence was accompanied by gender-appropriate visuals depicting the described motion, usually from a first person perspective. Visualization of mouth and eye flexion necessitated the adoption of a third person perspective. Male users viewed a male body performing the exercises while female users

[26] Many SIGGRAPH-goers are technically expert in a variety of technologies. The more youthful participants sometimes exhibit a "hacker" mentality and are known to often try to "break" or "play" SIGGRAPH work.

viewed a female body, by unanimous preference.[27] This phase was not initially interactive, but instead asked users to listen to the narrator's instructions while mimicking the movement examples visually presented to them on the screen. The progressive muscle relaxation phase lasted roughly 6-7 minutes. The nature of flexing and relaxing the major muscle groups provided a tangible experience of the creation and, more importantly, the release of tension. The changing of first-person to third-person points of view did not seem to have an adverse effect. Further, as in keeping with Merleau-Ponty's *reversibility*, we designed the phases so that they would progressively flow from oscillating between first-person points of view to third-person points of view to more and more focus on first-person, interior-focused points of view.

Phase 1	**Phase 2**	**Phase 3**
Relax, Breathe deeply	guided, progressive muscle relaxation	"follow your breath"
2–4 minutes	6-7 minutes	7 minutes

Figure 4.3 Phases in the Meditation Chamber

Figure 4.4: Muscle relaxation. Phase two, the muscle relaxation phase, was guided by visuals and audio narration.

[27] In anecdotal testing, users preferred an avatar of their own gender, and reported that the opposite gender were "disruptive."

The third phase was designed to teach users a basic meditation called "following your breath." During this phase of meditation, users are asked to focus all their awareness on the sensation of their breath coming and going from their nostrils. If other thoughts entered their awareness during this time, they were told to push them aside calmly and firmly and to remain focused only on their breath. This phase lasted approximately seven minutes and was accompanied by an abstract visual display created by putting several image filters on top of video of a swimming jellyfish. The image seems to pulse in time with users' respiration. The audio during this segment sounded like calmly moving water and was sampled from sounds taken from a waterfall. It was the intent of the design that users would eventually close their eyes in an effort to more fully focus on their respiratory sensation, shutting off visual stimulus. The jellyfish images faded and disintegrated as users' biofeedback measures were reduced, and eventually faded to black. Most users reported shutting their eyes before the image faded to black.

Figure 4.5: In Phase 3, as users' reduced their physiological states, the jellyfish became increasingly abstract, eventually dissolving into black. Most users reported shutting their eyes before that time so they could better concentrate. Interestingly, they did not similarly find the audio to be distracting.

4.8 The Installation

The system was installed at the Emerging Technologies Exhibition at SIGGRAPH 2001. A four-station installation was created to accommodate as many conference attendees as possible while still keeping the installation manageable in terms of cost and staff. We used four VFX-30 head mounted displays, four ProComp+ biofeedback units and four PCs to run the installation. The PCs were networked to allow access to a common printer that was used to generate takeaway feedback forms for the participants. Due to high demand and the fact that the experience took roughly twenty minutes from beginning to end, we instituted a reservation system in order to avoid long lines.

When users arrived at their reservation time, they signed an informed consent sheet and were able to ask any questions they might have had about the experience. Users also completed a brief pre-experience inventory, an instrument that asked them how relaxed they currently were and to what degree they believed they could become relaxed given a calming, fifteen-minute experience. Users were told that their biorhythms would control the environment in subtle ways, but they were not told specifically how this would occur. Again, this design decision was made to minimize the degree to which users would attempt to "play" the environment, attempting to alter their respiration or other bio-rhythms in order to test the effect they might have on the environment. Having signed the form, users were seated in one of the private booths and fitted with the sensors and the HMD. Once users signaled that they were ready, the application was started and the user was left alone in the booth. The experience proceeded as described in the Content section above. The version of the environment exhibited at SIGGRAPH 2001 did not contain an implementation of heart rate and respiration based interaction due to technical difficulties. However, these data were still collected from each participant. GSR-based interaction was fully implemented as described above.

At the end of the experience, an attendant returned to the booth to help the user remove the sensors and HMD and then escort them to the debriefing area. In the debriefing area, each user completed a post-experience inventory asking how relaxed s/he felt following the experience, and soliciting any comments he or she might have about the installation. They also received a feedback sheet and a brief consultation from one of the project's principal researchers. (Refer to Appendix 2 for samples of the questionnaire.)

Each user's biometrics (GSR and respiration) were printed out as a line graph on the feedback sheet, which contained an explanation of how to analyze the graphical representations of his or her experience. The consultation included a visual analysis and explanation of the user's data as well as an interpretation of whether or not he had a relaxing experience based solely on what the data suggested. Following the consultation, the feedback form was returned to the user. Users were free to leave or remain in the area to discuss their experience further with another member of the research team. We observed that almost every user took their print-out, and approximately 85 percent of users remained to get more information. This area was always in high demand.

4.9 Results

Four hundred and eleven SIGGRAPH 2001 attendees experienced the installation during the five-day exhibition. Analysis of the biometric data generated by each participant could still be examined for purposes of Computer Science, but we are prepared to report preliminary observations about the data. Also, we can report on the completed analysis of the subjective measures of relaxation collected in order to assess how effective the installation was in providing each individual with a relaxing experience.

4.10 Objective Measures

We have analyzed the extensive amount of biometric data collected from the SIGGRAPH attendees, concentrating mostly on the GSR data. Preliminary analyses show that two general patterns of GSR profile can account for nearly 75% of the generated data and are each generally accompanied by two distinct respiration profiles. Just over half of the participants exhibit what can be called a "novice" GSR profile. This means that their GSR level starts relatively high, descends through the first phase of the experience, kicks back up and shows peaks in the muscle relaxation phase, and then begins to decline again in the final phase, ending up at or usually beneath the low established in the first phase. The top two GSR graphs shown in Figure 4.6 are typical of this profile. These two graphs are of two individual subjects.

Breathing patterns in individuals exhibiting the novice profile tend to be steadier and deeper in the final phase than in the first phase. The second profile, which accounts for nearly a quarter of the GSR data, is termed the "expert profile." Individuals exhibiting this profile show precipitous drops in GSR during the first phase, entering a very low and often flat GSR state before the muscle relaxation phase begins. This flat-line state is typically maintained throughout the remaining two phases, and is accompanied by a very steady but not necessarily deep breathing pattern. Individuals exhibiting the expert GSR profile also show very consistent respiration rate and amplitude throughout the experience. The GSR graph at the bottom of Figure 4.6 is typical of the expert profile as measured from data of an individual subject.

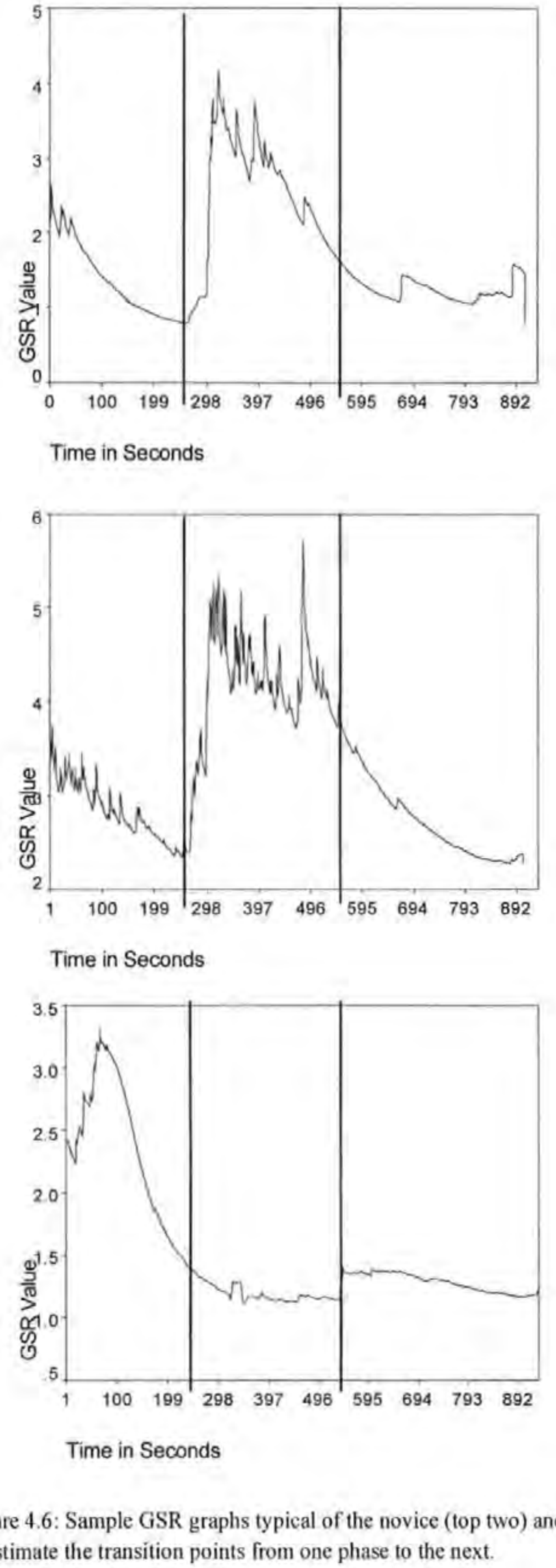

Figure 4.6: Sample GSR graphs typical of the novice (top two) and expert (bottom) profiles. Vertical lines are shown to estimate the transition points from one phase to the next.

To compare the response of all of the participants before and after the Meditation Chamber session, we compared the values of the post-session relaxation to the pre-session ratings per participant.

The average pre-session relaxation rating was 5.63, with a Standard Deviation (SD) of 1.75. Thus, before the session, participants were midway between relaxed and anxious. The Standard Deviation indicates where most participants rated their relaxation, with most participants falling in the range (3.88 .. 7.38) (Average – SD .. Average + SD).

The average post-session relaxation rating was 8.00, with a Standard Deviation of 1.69. Thus, participants were somewhat relaxed (8 out of 10) after the session, and about 68 percent of the participants rated their relaxation between (6.31 to 9.69).

To statistically test if these different averages were due to chance, we performed a statistical test called the t-test, which compares a pair of collections of measurements like the relaxation ratings, and computes a probability that the averages are the same. A high probability indicates that the two measurements are the same.

A repeated measures t-test showed that post-session relaxation ratings ($\underline{M}$=8.00, SD=1.69) were significantly higher than pre-session ratings ($\underline{M}$=5.63, SD=1.75), $\underline{t}(410)$= -24.45, p=.0001. That is, the probability is 0.0001 that the difference in before and after relaxation ratings is due to chance, which is highly unlikely, equivalent to one chance in 10,000.

Forty-nine of the 411 participants reported equal or lower levels of relaxation following the experience, with 18 of these reporting the same level, and 30 reporting decreases in relaxation of 1-3 scale points. The other 362 participants reported levels of relaxation 1-8 points higher following the experience, with a mean difference of 2.88 scale points between pre- and post-session ratings. There were no gender differences on either relaxation rating.

Twenty participants reported that they did not believe that they could become relaxed by the experience. Of these, 2 reported equal and 2 reported lower relaxation ratings following the experience. The rest reported higher levels of relaxation. As this suggests, there was no significant relationship between response to item two of the pre-session inventory and the difference between pre- and post- session relaxation ratings.

4.11 Discussion of Experiment

We decided to refer to the novice profile as such because people who reported little or no experience with meditation or other relaxation techniques displayed it most often. Similarly, the expert profile gets its name from its association with individuals who reported high levels of experience with relaxation techniques, meditation, yoga, and even distance running. The novice profile is characterized by relatively mild GSR drop in the first phase and an extreme GSR reaction during the muscle flexing activities of the second phase. In contrast, expert profilers show little if any GSR reaction during the muscle relaxation phase, maintaining a nearly flat level throughout the latter two phases, following an initial, precipitous drop. In terms of respiration, novice profilers are more influenced by the coaching they received in the third phase of the experience, causing them to show a deeper, slower breathing pattern in this phase compared with the first. Expert profilers seem to have a very consistent breathing pattern with which they are comfortable, as it is maintained without much change in frequency or amplitude throughout the experience. Breathing patterns for all participants are somewhat similar in the second phase due to the frequent held breaths associated with various muscle flexions.

The subjective data clearly suggests that most people who experienced the environment emerged significantly more relaxed than they were when they went in. Of course it can be pessimistically argued that this effect might be due to the fact that participants were able to sit quietly for fifteen minutes. Though we initially discounted the strength of this argument, a baseline condition in which participants are seated and monitored for the same length of time without exposure to the environment's audio or visuals was conducted.

4.12 Baseline Condition: Sitting Quietly

In the Baseline condition, each participant sat quietly in a room for 20 minutes with the Galvanic Skin Response (Skin Conductance) sensor, the breathing sensor and the heart rate sensor attached to the participant's body. To maintain conditions as similar as possible to the experimental condition above, participants sat in the same chair wearing the same type of sensors on the same Thought Technology measurement unit. Each participant sat in a quiet room with approximately the same light levels. The sound level heard by the participant was probably the same, but in the baseline condition, participants did not wear headphones, unlike at SIGGRAPH, where subjects wore a Head-Mounted Display with sound insulating headphones.

Participants were each asked to sit quietly and relax for 20 minutes in the chair while wearing the biofeedback equipment. During this time period, we collected GSR, Heart Rate and Breathing measurements. We collected data from 16 participants, all adults in the range of ages from 22 to 35 years.

The main findings are as follows: We took each sequence of GSR readings and transformed them. Because each participant had a different starting GSR value, we transformed each participant's readings to a percentage scale. This allows us to more reasonably compare readings between participants. The average value of a participant's GSR over the first minute of the experience is equivalent to 100%. In the graphs shown in the figures, all GSR readings are converted by dividing each GSR value by the participant's first-minute-average and multiplying the result by 100. Thus, in the graphs, readings of 100 mean that the participant's GSR is the same as when they first started.

Regarding GSR measurements, we found that each subject at least briefly experienced a relaxation curve similar to the ones we found at SIGGRAPH. That is to say, GSR readings dropped over the course of a few minutes and tended to level out. Upon analyzing the GSR graphs, we noticed 3 categories of response.

Category 1

Relaxers are people who exhibit lower and lower GSR readings during the 20 minute time period. Five of our 16 participants were Relaxers. The graph of participant 10 is typical of a Relaxer. After an initial period of higher GSR readings, GSR values dropped continually during the experiment period to less than 80%, and stayed below this level.

Category 2

Semi-Relaxers are people who briefly relax, exhibiting a drop in GSR over 2 or 3 minutes, followed by a briefer period of GSR readings above 100%. This contrasts with Relaxers, whose GSR readings may briefly increase, but never above 80%.

Category 3

Non-relaxers are people who do not experience a drop in GSR, but who instead experience readings that spike higher than 100%, often for more than half the time period. There are 8 participants in this category, of whom 7 of the 8 have average readings above 95% over the whole time period.

In summary, half of our subjects are not able to experience significant drops in GSR over the 20 minute time period of just sitting quietly.

4.13 Subjective Measures

The first question on the pre-session inventory asked users to rate their current level of relaxation from 1 (very anxious) to 10 (very relaxed). The second item was a YES/NO question asking whether or not the user felt that he or she would be able to become relaxed given a calming fifteen-minute experience. The post session inventory also contained two items. The first asked users to re-assess their level of relaxation using the same 1-10 scale, with 10 being very relaxed. Following this was a free response item that asked the user for any comments, criticisms of, or insights about the experience. (Refer to Appendix 2.) This questionnaire was filled out during the hubbub of SIGGRAPH, in about 3 minutes, so users did not have a chance to think very deeply about their experience.

Most of the subjective comments were nonetheless positive. Negative comments had to do with the heaviness of the HMD, and the noise from the other exhibits. One user complained that "the HMD cut off two" of her "chakras." The positive comments were that users felt relaxed, though many initially wrote that they did not expect to. Other users expressed enthusiasm about areas of possible application. At exit, when we gave users a copy of their changes in states, many users became even more positive and expressed surprise that they could "learn" how to lower their measures and "feel" them. Many other users, however, did not seem to trust their own sense of when their states were becoming lower. Therefore, the printouts seemed to confirm what they felt. Some, for instance, would point to the time markers on the print out and say, "yes! I *knew* I was doing it *there,"* or "this is when I first felt something."

In terms of visuals and audio, 72 users had positive things to say about the audio. The visuals were more problematic. While some users said that the sunset/moonrise helped them "figure out" when they were "dropping" their physiological states, they did not seem to know when they were having an effect on the system. More users preferred the jellyfish, which, according to several users, "seemed hypnotic" and seemed to "mimic what I saw when I close my eyes." Twelve users wanted more abstract visuals. Nonetheless, the majority of users did not know they could close their eyes, and thus felt distracted by both versions of the visuals. Many users, for example, seemed to fight the urge to close their eyes or they just found the visuals distracting, especially in the latter parts of the meditation. This may imply that in general humans are better at sensing interoception when they can block out much or all of the exteroceptive stimuli. Additionally, users often complained that they could not figure out what effect they were having on the biofeedback system, and many said that the system needed to be more "sensitive" and "responsive." Taken these two factors together, they seem to imply that there needs to be a closer tie between the system's visuals and the user's body – that the visual representations need to be directly mapped to the biofeedback processes. (This was the intent, but technical issues prevented it from being realized as completely as it was for the debugged, Virtually Better version.) This would offer users something to focus on (like the traditional method of concentrating on breathing). Two users users suggested that it would be helpful to hear their heartbeats. Taken together, the responses seem to indicate that users wanted a different balance: less of a guided experience and more of a self-directed biofeedback loop, though they did not want all of the guided experience to be dispensed with completely.

There were also a problem with users who felt like they had to decipher or beat the machine — one that we anticipated from a SIGGRAPH user group — which produced anxiety rather than alleviated it. This group also felt that the *Meditation Chamber* was too game-like. While we want users to understand that they are receiving biofeedback indicators, (thus having an effect on the system), care must be taken to keep it from becoming a game-like goal. Users indicated that it felt most game-like when the sun set and the moon rose. One of these respondents suggested that a pattern that pulses to the user's heartbeat would work better and would be less game-like. It is important to note, however, that none of the users at Virtually Better, who are as a group a generation older that the users who mentioned that the *Meditation Chamber* was game-like. Thus, of course, context seemed to matter.

As was my initial design goals, I wanted at least two different versions that users could choose from, but time prevented the realization of this. Current work is addressing this issue.

4.14 User Comments

Most users at SIGGRAPH 2001wrote in the area provided for "other comments." On the whole, comments were overwhelmingly positive. Many users spent time to suggest specific improvements for the next iteration, which we found to be an unexpectedly positive form of brainstorming. A few comments were too subjective to be useful for anything other than another version created specifically for that individual. Most suggested options and ideas for sound, audio and voice. Several users recommended that we try using the *Meditation Chamber* for the alleviation of pain for cancer patients. It was clear during the design, exhibition, and testing that sound far outweighed visuals in importance. It seems that visuals tend to focus attention outward, whereas sound can function in a more ambient way. A few users wanted immediate feedback from the biofeedback device so they knew "it worked." Many users wanted the experience to last longer, at least 40 to 50 minutes altogether.

Negative comments were grouped into two areas: the exhibition space and the equipment. It was not possible to build anything approaching soundproof booths at SIGGRAPH; many users found the sounds from other exhibitions to be distracting. Further, although we had fabric on all sides of each booth, light leaking into the booths was also found to be distracting, though not as much as sound. The single most distracting element was the head-mounted display, which was both comparatively heavy and forced the head slightly forward in an uncomfortable position. A few users mentioned the chairs were uncomfortable, and some wanted to sit on the floor. The voice-over, which was the most difficult part of the design, was also cited as being annoying, though none of the ambient music and sounds were. Some users fell asleep.

Thirteen users compared their experience to the specific kind of mediation they regularly practice and were generous in suggesting specific in-depth ideas to consider. We intentionally made this first prototype a general combination of the most common forms of meditation and muscle relaxation. Finally, six of the regular computer science SIGGRAPH-goers denigrated our exhibit but we encouraged them to try it as often as they taunted us. Surprisingly, all six tried the *Meditation Chamber* at different points in time; all came out unusually positive and markedly relaxed (measurably and in subjective terms). These last comments from regular meditators and those suspicious of meditation convinced Gromala that she should carry on with creating more culturally specific forms of meditation.

4.15 Discussion

Plans to fully implement the heart rate and respiration based interactivity originally designed to be included in the system have been completed. This version of the software is being used by Virtually Better and has thus become propriety software. Heart rate used to control the audio in the environment was less successful than we hoped, so we dropped that idea. In addition, so-called 3-D or spatialized sound was tried but was unsuccessful because in order to perceive spatialized sound, users must move their heads, which is distracting for those who are trying to meditate. Ambient sound, however, was not found to be distracting. Respiration is used to control the pulsation of the visuals. More time for meditation, in addition to "following your breath," are also included in later versions of the system.

A beta version of this later version of the *Meditation Chamber* has been distributed to twenty clinical partners across the U.S. for evaluation and feedback. With respect to the more general topic of bio-interactivity, members of the research team have explored the use of GSR and other biometrics in interactive art, kinetic typography, and augmentation of the sensing abilities of remote intelligent agents.

4.16 Merleau-Ponty, Leder and Mind/Body Unity

Meditation is a complex practice, and I can compare it to Merleau-Ponty's notion of reversibility only so far. In the *Meditation Chamber,* for example, users' experience from a subjective aspect in terms of looking at the visuals, hearing the sounds, trying to focus and reduce their physiological states. But users also reverse this to an objective state when they "see" themselves from the outside, as others might. The constant struggle between the two, though two sides of the same "coin,"is the beginning phases of meditation.

But Merleau-Ponty examined, primarily, our exteroceptive senses — senses which are outward-focused, expansive. Leder calls this the "ecstatic" aspect of ourselves, though he means expansive, and not "out of body." This is easily understood when we look into the horizon. We feel, in some sense, this extension of ourselves, of our ability to see farther than where our bodies are located in the here and now. Conversely, Leder calls our usually quiescent and invisible inner aspects, such as our visceral sense, "recessive." We have little control over our visceral sense, especially if we have no practice to sense it. When we are hungry, as Leder uses as an example, we feel twinges of hunger, but also, our arms feel heavy, we perceive an overall sense of fatigue. If we delay eating, this sense seems overwhelming, and propels us to find food. When we eat an apple, we taste it, chew it, feel it slide down our throat — but then it is gone, disappearing inside of ourself. We can sense later a bit of reflux, perhaps a sound of gas within, and later, an urge to defecate. These are just moments of being conscious of what is otherwise unavailable to us, our viscera. This is an example of what Leder means by the recessive nature of our viscera, our *absent body.*

Further, Leder suggests that Merleau-Ponty's analysis requires a deeper concern for the "deeper blood relation with the world" in the form of the visceral body. In Leder's words, "I am not just gazing upon the world but one who breathes, feeds, and drinks of it, such that inner and outer corporeity intertwine" (Leder 1990, p.38). Leder continues to argue that a proper description of flesh "must also include a consideration of how Being conceals itself in our visceral relations with the world: how Being, for instance, can be found in the background provided by the functioning of vital organs which make vision possible" (ibid.). The visceral, he claims, introduces "another sort of depth, another sort of invisibility, a 'vertical synergy' to complement the horizontal nature of fleshly transcendence" (Steeves 2001, p.148).

So deeper in meditation, when we are almost completely focuses inward, it would be difficult to continue with Merleau-Ponty's sense of reversibility, because we are struggling not to be concerned with anything but our inner sense. We are not looking at or touching something outside of us, some object. We are rather looking inward, *into* ourselves, into our viscera, which generally functions to be invisible, to not make itself known except in cases of disease or dysfunction.

To repeat, *Flesh* was the term Merleau-Ponty used to refer to the "corporeal consciousness" (Merleau-Ponty 1968, pp.151), which the body is productive of. "The flesh, then, is neither subject nor object, and forms a medium between the two for the appearing of Being. (Merleau-Ponty 1968, p.149). Yet,

> "flesh is not a chaotic structure based solely on chance, but is rather grounded in a series of divergences and levels that already partially determine what the world can mean for consciousness. Flesh involves an open and dynamic medium for the appearing of Being, that is neither subjective or objective, organic or chaotic, but a system of levels and dimensions in which Being can become meaningful" (Steeves 2004, p.150).

If we continue to explore Merleau-Ponty's concept during the deeper phases of meditation, we need to understand our flesh as "a series of divergences and levels that already partially determine what the world can mean for consciousness" (ibid.). The divergence in this case is our ecstatic and recessive aspects of our own body. Further, according to Merleau-Ponty, "flesh involves an open and dynamic medium for the appearing of Being" (ibid.), an openness to explore our innermost viscera. Our body, to reiterate, "is neither subjective or objective, organic or chaotic, but a system of levels and dimensions in which Being can become meaningful."
At this point, reversibility is less important, less useful for our understanding than flesh, than "its systems of levels and dimensions" (ibid.) that we explore when we meditate. In meditation, a unity of mind and body is what one strives for, not unlike Merleau-Ponty's striving to undo dualistic thinking. Except for the cultural times in which he lived, it is odd then that Merleau-Ponty did not explore meditation.

In *The Absent Body,* Leder compares the way different spiritual practices strive for a unity of mind/body and world in different ways. "Unlike the Christian ritual," he says, "which infuses something pure into the body, Zen purified the body/mind by a stripping away" (Leder 1990, p.170). This involves ridding ourselves of ways of thinking and acting that reinforce dualities such as good versus bad or self versus Other. Slightly akin to samsara, according to Zen, we cling to an illusion that is a personal "I" but this "I" is always a source of fear, threatened by pain and death. Even Leder seems to avoid the issue of meditation for phenomenology, saving it for his last chapter, and leaving the best to footnotes of that chapter. Accordingly, in Zen meditation, one,

> "begins to suspend, examine and overcome this" (ibid.) separation of mind and body. "The lived experience of the inner body may be better expressed by certain non-Western medicines and cosmologies than by anatomical descriptions of the West. Chinese Taoists picture the viscera as centers along greater and lesser pathways for the circulation of *ch'i*, a blood/breath energy. Similarly, Buddhist envision a "subtle body" as well as a physical, with charkas, nodes through which *prana*, a subtle breath, flows. Such schemas are meant to have not only explanatory but phenomenological power, charting experiences open to the ordinary person or to those who engage in spiritual practices. These energetic portrayals may capture the subtle and shifting quality of inner experience better than an image of fixed, massy organs" (Leder 1990, pp.182-183n10).

Many if not most forms of meditation focus on the breath. According to Leder, "physiologically, respiration stands at the very threshold of the ecstatic and visceral, the voluntary and involuntary. While we can modulate our breathing at will, it is primarily an autonomic function" (Leder 1990, p.171). "Inside and outside, self and Other, are revitalized, porous, each time one takes a breath" (ibid.). Striving for a unity between mind and body is not limited to breathing, however. Other traditions focus on chanting, moving, or ingesting hallucinogens, to cite a few. For Leder, "In eating, breathing, perceiving, moving, the body transcends itself through its commerce with the world" (ibid.). By transcendence, again, he means not overcoming the limitations of the body, but of an ever fluid and elastic body whose perceptions can go far beyond the body, but be suited in it simultaneously, as the basis of those perceptions.

4.17 Summary

The *Meditation Chamber* was created to enable users to reduce their stress levels by relaxing through meditation. Technology, of course, is not necessary for meditation, but our virtual environment, combined with a biofeedback device, provided users with indications of when they were lowering their physiological states, particularly their GSR, but also heart rate and breath rate. While these indicators are not sure signs that the user is in a meditative state, they are known in biofeedback circles to be strongly indicative of those states.

We tested the initial version at SIGGRAPH 2001, a large conference comprised of computer scientists and artists. We found that the *Meditation Chamber* works better than just sitting quietly. We also found from user reports that the feedback, as was originally designed, needs to be in a tighter feedback loop. After the initial testing, we debugged and refined the *Meditation*

Chamber, which is now used for therapeutic purposes at Virtually Better and its partners. Through the design of the *Meditation Chamber,* we learned that audio is far more effective at guiding and providing the user with feedback than visuals. Visuals seemed to rather interfere with meditating, probably because it keeps the user's focus outward.

In terms of Merleau-Ponty's reversibility — the ability of users to feel that they are both object and subject — occurred initially, when users employed their exteroceptive senses to look at and hear the feedback from their bodies. But because users were focusing inward, trying to experience their interoception, the notion of reversibility needed to be understood, as argued by Leder, in terms of the ecstatic/recessive body. Thus, the *Meditation Chamber* necessitated a more complex understanding of Merleau-Ponty's notion of reversibility. Nevertheless, the way Merleau-Ponty ultimately articulated it in terms of flesh does not cease to function because one is inward looking. Rather, it is an example of how fluid and complex the body can be.

The *Meditation Chamber* can be understood to be transformative because people largely experience relaxation, subjectively and "objectively." With longer term practice, the possibility of transformation increases from a more intimate awareness of our inner viscera, but through the control of it, it may potentially transform the practitioner's relative health, sense of unity between mind and body, and, by the way they *don't* respond to stressful situations, may transform their local environment as well.

According to Merleau-Ponty, "The body and its distances or differences" (such as that holding between the visceral and the exteroceptive), "participates in one same corporeity or visibility in general, which reigns between them and it, and even beyond the horizon, beneath its skin, unto the depths of being" (Merleau-Ponty 1968, p.149). But this can be transformative too. In Merleau-Ponty's words, "Gesticulations and simple skills of balance and posture are developed through practice into personal styles of living, and these shape the way the person feels about herself and interacts with others" (Steeves 2004, p.2). These practices may include a deep development of a craft, of working as an artist, or by meditation or practicing yoga. These transformations, almost imperceptibly, transform our comportment, and our ways of relating to the world and to others.

4.18 Computer code:

For the pre-proprietary computer code, refer to: www.sfu.cs/~dgromala/code/medchamber

Chapter Five: *BioMorphic Typography*

My long history of type design began with a chalkboard in my grandmother's house. The top of the chalkboard depicted the alphabet in upper and lowercase, in a bright, neon orange. At four years old, I was still maddeningly illiterate but obsessed with drawing these English letterforms. Mastery of doing things with these letterforms was to ensure my escape from the Eastern European chatter of my relatives, tons and tons of relatives, up there, pounding on the table in a way Americans didn't dare — and didn't like. Somehow, I thought, if I could crack this secret code, I would be freed from this borscht-smelling house, be freed from the derision of the neighborhood kids, and be an American, unquestionably.

Later, the death of my father provoked a trail of subsequent traumas. His death necessitated a physical relocation, back to the myopic, xenophobic conservatism of an excessively small town in middle America. Ripped from the cocoon of my West Coast Montessori school, from my liberal friends and teachers, from mountains and hippies, I landed with a thud, face-down in a strict Catholic school. Unable to adapt, I clung to the one small comfort the nuns could offer me: designing and cutting letters from felt for the weekly banners in church. It was the one — the only one — remnant of a Montessori-like independence.

The entire first year of graduate school at Yale necessitated drawing letterforms without the aid of measuring devices of any kind. "You need to depend on your eyes," was the instructor's admonition. She spoke in a harsh German accent that kept her spine— and mine — straight. "You should feel this in your bones." Eyes, bones, hands. Where was this expertise really supposed to reside in my body anyway? A theory was not conveyed — it was an apprenticeship in a very old European tradition, a transference of physical skill by keenly observing the "master." If lucky, one could subvert this into a bit of self-discovery, perhaps — one wrapped loosely in a cloud of impotent fear and denigration of the sort that powered boarding schools.

The tradition of graphic design, at least from the perspective of the European immigrants that comprised most of the Yale faculty, was grounded in typography. I had just returned to grad school after years of working at Apple Computer. We had our typography class on Saturday and Sunday mornings, since our instructor commuted from Boston. The first assignment: trace a letter from Caslon in Illustrator. The second was to trace the entire typeface and apply it to a poster. They were kidding right? I politely asked if I could pursue the assignment further, since I was well acquainted with the use of a computer. My question was summarily dismissed.

Nonetheless, I felt I had some responsibility to learn something, anything. So I quietly used Fontographer, reinterpreted a version of ancient Phoenician, programmed it to have left and right axes, and multiple thicknesses. At the time, these were new uses of technology and typography. My poster wrapped around the front of our building, which was, deliciously, a former fraternity house. The poster was comprised simply of my typography, marking out the words: A GARDEN OF PURE IDEOLOGY.

— Diane Gromala: Artist's Contextualization from a First-Person Perspective

5.1 BioMorphic Typography: Introduction

Through *BioMorphic Typography,* I primarily seek to explore and provide an example of Merleau-Ponty's conceptions of a chiasmic reversibility. Further, because typography is involved, it seems necessary that Merleau-Ponty's conception of language is also examined. Finally, I briefly contextualize and relate *BioMorphic Typography* to some of the processes that were initiated by the invention of the printing press, namely, the changed relation between a writer and his or her body, and the change in modes of thinking — transformations that occurred over a long historical period.

The intent of *BioMorphic Typography* is more than a Romantic return to the involvement of the hand. After all, our hands are involved in using keyboards, but this of course does not quite enable as direct a connection to one's body as using a pen, pencil, or calligraphic tool. Rather, through *BioMorphic Typography,* I intend to return writing to the very primal, or, in the terms of Merleau-Ponty, "wild" (Merleau-Ponty 1968, p.201) processes of the body that are necessary for life: breathing, heart rate, and galvanic skin response. By engaging with *BioMorphic Typography,* users become aware of their visceral, autonomic senses; learning to control or manipulate these senses takes users surprisingly little time.

Using some of the biofeedback-related elements of the technical system developed in the *Meditation Chamber* as a starting point for a later and massive reconfiguration, *BioMorphic Typography* was initiated as a long-term project. The typeface entitled *BioMorphic Typography* morphs, in real-time, according to a user's continually changing physiognomic responses, as he or she types. Each user is hooked up to the ProComp+ biofeedback device. So, for instance, as a user types and breathes, the typeface displayed, in real-time, expands and contracts along with the user's breathing (fig. 5.1; for a real-time depiction via a videotaped documentation, refer to the accompanying CD: *BioMorphic Typography:* Exhibition Projections). As this entails more complexity than a primarily print-based typeface, and because the number of colleagues who share in the necessary skills is relatively rare,[28] it is anticipated that the design of this

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[28] Thus, forming a collaborative team seems a distant hope. The drawing of a new typeface itself usually is a long-term process, taking a year or longer. This is different from "typographic design," which involves the examination and use of existing typefaces, aspects of visual rhetoric and "formal" aspects such as placement, color, spacing, and so on.

The time-consuming skills required to create an entire typeface is not regularly taught in universities. The design of an entire typeface includes the creation of letterforms, numerals, punctuation marks, matrices of spacing between the differing shapes created by the combinations of letterforms, and scaling modifications for differing sizes. These are but a few of its major aspects. In the United States, the skills required to design an entire typeface is rarely taught except in introductory terms at the graduate level at Yale University, Cranbrook Institute of the Arts, California Institute of the Arts and North Carolina State University. This instruction has become intermittent, and depends on the availability of highly specialized designers of fonts, who come as visiting lecturers. These and other American universities, such as Carnegie Mellon University, offer time to create a typeface *if* the graduate student pursues this direction specifically. To reiterate, few designers have created an entire typeface. Of these, fewer still have the typeface will take more time for full realization. Further, as discussed in *Windows and Mirrors* (Bolter and Gromala, 2003 p.168), *BioMorphic Typography* is not one typeface, but is intended to be a postmodern pastiche of various fonts, including those I developed over the last decade. Since the concept for this typeface is to ultimately be comprised of a pastiche of fonts, and since the technological aspects have so many individual variables, the design of the typeface could easily take two or more years, depending on funding. However, the existing font depicted here and on the accompanying CDROM (CD: BioMorphic Typography), based on Adobe Garamond, demonstrates most of the conceptual ideas. The remaining conceptual possibilities are discussed later in this chapter, 5.13: Future Work.

What was developed during the time of my study, however, consisted of two basic technical approaches. The first is a *record* of what states the writer's body assumed during his or her writing. Thus, the changes in each letterform, as it is typed and displayed, instantly reflects the user's physiological state, and is then "frozen" and functions as the form of a record. As the writer continues to type the next letter, she can view the expression of her now-altered bodily state in real-time on the screen (or projection). To restate, each letterform morphs as it is typed. As the next letterform is typed, the prior letter "freezes." The second approach *was a constantly moving font,* where all letterforms continue to respond to the writer's bodily state in real-time. The first trial of this version seemed less interesting than what was eventually developed, since the entire paragraph or writing block moved at the same time, with the same effect. A later revision and the approach settled on retained and repeated each movement of each letterform, and is thus closest to the first approach. They are real-time representations that are impermanent[29] yet expressive.

5.2 Context and Methodology

The Meditation Chamber was a work of design; that is, its intention was for pragmatic, if potentially enlightening, purposes. Thus, factors such as user studies make a great deal of sense for the *Meditation Chamber*. However, *BioMorphic Typography* and the *MeatBook* are works of art. The intentions are very different. Therefore, such controlled user testing does not make a great deal of sense and is inappropriate for an artistic context. One, for example, would probably not glean much from user studies of reading a novel by Franz Kafka, or of users experiencing a contemporary painting, sculpture, ceramic piece, interactive music, or theatre, to name a few art forms. Artwork is generally assumed to be the work of a skilled individual (or groups of them).

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programming skills necessary to work on BioMorphic Typography. From a survey of North American design programs' online curricula and an interview with Prof. Louise Sandhaus, Cal Arts, July 27, 2005.

[29] It is possible to record the writing and typographic forms that are created, but few users seem to value this aspect and prefer the real-time experience.

Thus, the artwork cannot be generalizable, falsifiable, or reproducible, according to the standards of, say, Computer Science. In comparing art with science, Jerry Gill states,

> "The fact that aesthetic significance, by definition, must remain at the tacit level, never being given a single focus of meaning, endows it with an open-ended character that is not present in more direct dimensions of experience, as for example in science. While creative imagination is clearly required in both artistic and scientific endeavor, once the latter has achieved explicit articulation, those seeking its comprehension need not enter into it through imaginative interaction and integration; they simply need to follow the empirical and logical factors so specified" (Gill 2000, p. 139).

Similarly, in comparing science to art, Polyani states,

> "The capacity of a creative artist's imaginative vision may be enormous, but it is only the vision that he imparts to his public that enables his art to live for others. Thus the requirement that they provide is a basis for their re-creation by the imaginations of their viewers or readers. The *use* of a work of art by others is not, therefore, like the use of an invention. . . we do have to achieve an imaginative vision in order to 'use' a work of art that is, to understand and enjoy it aesthetically" (Polyani 1975, p.85).

According to John Carey in *What Good Are the Arts,*

> ". . . to know even one picture or book or piece of music, you would have to know all these responses. A work of art is not confined to the way one person responds to it. It is the sum of all the subtle, private, individual, idiosyncratic feelings it has evoked in its whole history. And we cannot know these, because they are shut away in other people's consciousnesses" (Carey 2006, p.31).

For Merleau-Ponty, art is especially important. Though he focused on primarily on painting, his observations can easily be extended to other art forms, which he mentioned in numerous works.

> "Only by drawing direct connections between what we learn from the exemplary expressive power of artists and what we already know of ourselves and each other by knowing our characters, Merleau-Ponty believed, will we come to appreciate the philosophical significance of perception and the body" (Carman and Hansen 2005, p.15).

Because the nature of art is different from the academic norms of the sciences, because it bears an "expansive" nature as described above, and because the avant garde view of art is to enable viewers or users to see the world in new ways, methods of determining its significance are not generally well-understood in academia. As Graeme Sullivan argues, " . . . existing misconceptions about the intellectual status of learning in visual arts means that the scholarly, cultural, and social significance of art is grossly undervalued" (Sullivan 2005, p.xi).

The relative "success" or merits of such works do, however, have well-established methods of adjudication. Evidence of these can be found in Appendix 1. Meritorious artwork of a living artist, for example, should be refereed or judged by experts, and the stature of the exhibition should be considered. The artwork should also be critically examined or referenced by expert "critics" and referenced in leading art journals and books. These are some of the methods that are used to determine the significance and worth of artworks and to determine tenure and promotion at North American universities, for example, and parallel some of the methods in the Humanities. Unfortunately, the rigor of these methods is usually not readily apparent or familiar to non-artists.

There are some sign of change, however. The National Science Foundation in the U.S., for example, recognizes the value of the Arts and Humanities.[30] According to them, the Arts and Humanities ask research questions that are not within the tradition of the sciences, but that are nonetheless useful. Further, as Paul Dourish makes clear, including interactive art and employing a phenomenological viewpoint can refocus some emerging areas of Computer Science, such as Tangible Computing and Computer-Supported Collaborative Work (CSCW), especially because both art and phenomenology insist on exploring the *meaning* of the interactions (Dourish 2004, p.12). Thus, familiarity with the methods of determining the value of artistic work may grow with initiatives and publications like these, and with scholarly collaborations with artists.

Because *BioMorphic Typography* lies in the interstices between art and design, one would expect to find it exhibited and written about by both artists and designers. Indeed, this has been the case. It has been referenced by those who concern themselves with new forms of graphic design, typography, and writing (refer to Appendix 1). *BioMorphic Typography* is distinguished from other technological experiments with typography because it is the first form of typography is driven by the physiological states of its users.

Although formal, user testing is not appropriate for an artwork like *BioMorphic Typography,* observations can nonetheless be useful during the creation of the piece. Thus, I informally kept track of what I and others observed during the development of *BioMorphic Typography* and during its exhibitions. For a discussion of these observations, refer to 5.6: Findings in this chapter.

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[30] Since 2003, the NSF has supported interdisciplinary graduate programs that combine scientific fields with the Arts and Humanities through their IGERT program (Interdisciplinary Graduate Education in Research and Technology). Its meeting at MIT in 2004 enabled first-hand observations about the genuine desire for including the Arts and Humanities in interdisciplinary and predominately scientifically-oriented graduate programs. The hoped-for outcome is to "crack" the trend of graduate programs in the sciences becoming more myopic and rigid. More importantly, the stated desire is to foster innovation so that graduate students in the U.S. remain globally competitive. (Refer to Appendix 1.)

5.3 System Design

The basic setup of *BioMorphic Typography* consists of a Procomp+ Biofeedback Device connected to a computer that is continuously drawing and redrawing the letterforms entered by the system's user (refer to figure 5.1). As the user types, the current reading of the Procomp+ is measured and associated with the letterform just typed. The entire page of text is then quickly and almost imperceptibly redrawn (appearing like an animation), with each letter morphed according to the user's biological readings. The program bioFontMorph.exe was developed to read ProComp+ data and draw the letterforms. The Procomp+ enabled differing modalities to change the visual character of the *BioMorphic Typography:* respiration, galvanic skin response, and heart rate. By observing tests with students and the public in the later exhibitions (refer to Appendix 1 and the CD: *BioMorphic Typography)*, it was clear that users could not make sense of more than two simultaneous modalities; most users preferred a singular mode.

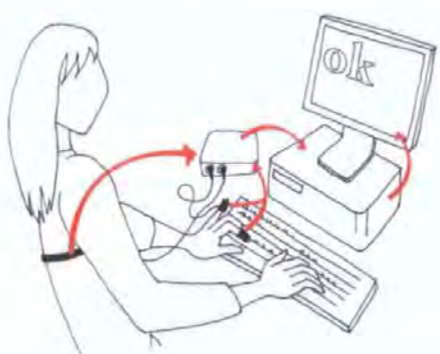

Figure 5.1 Data of a user's breath rate is gathered by the ProComp+ chest band. Data of a user's galvanic skin response and heart rate are gathered from sensors attached to the user's fingers by Velcro. This data is input to the ProComp+ box, and transferred to the computer. The incoming data changes the appearance of each letterform, as the user types. The effects on users of seeing a visualization of their changing physiological states via the morphing of typographic forms is an open-ended question. However, many users said that they get "caught" in "feedback loops," especially regarding heart rate.

The graphical aspect of the typography was implemented using Open GL. Each letterform (upper and lower case), punctuation and other typographic elements, were first taken into Fontographer, where they were reduced to their Bezier curves. A Bezier curve is a type of smooth curve specified by a sequence of 4 geometric points (figure 5.2). The first and last points specify the end-points of the curve; the middle two points specify the intervening curvature.

Figure 5.2 Example Bezier curve showing the 4 control points.

Fontographer automatically marks the Bezier curves, delineating the boundary of the letterform, which, when manipulated, changes the shape of that part of the letterform. These marks were also automatically numbered. The automatic placements of the Bezier marks were rarely in a position that would enable aesthetically pleasing "expansion" (as in the example using respiration) and other forms of manipulation. Thus, the Bezier marks had to be individually moved to be in line with drawings I created to anticipate the movement of each letterform and renumbered — a tedious process indeed. Where letterforms "morphed" from thin to thick, for example, the numbered Bezier markers had to be individually moved to be in exactly the same place on both letterforms (figure 5.3).

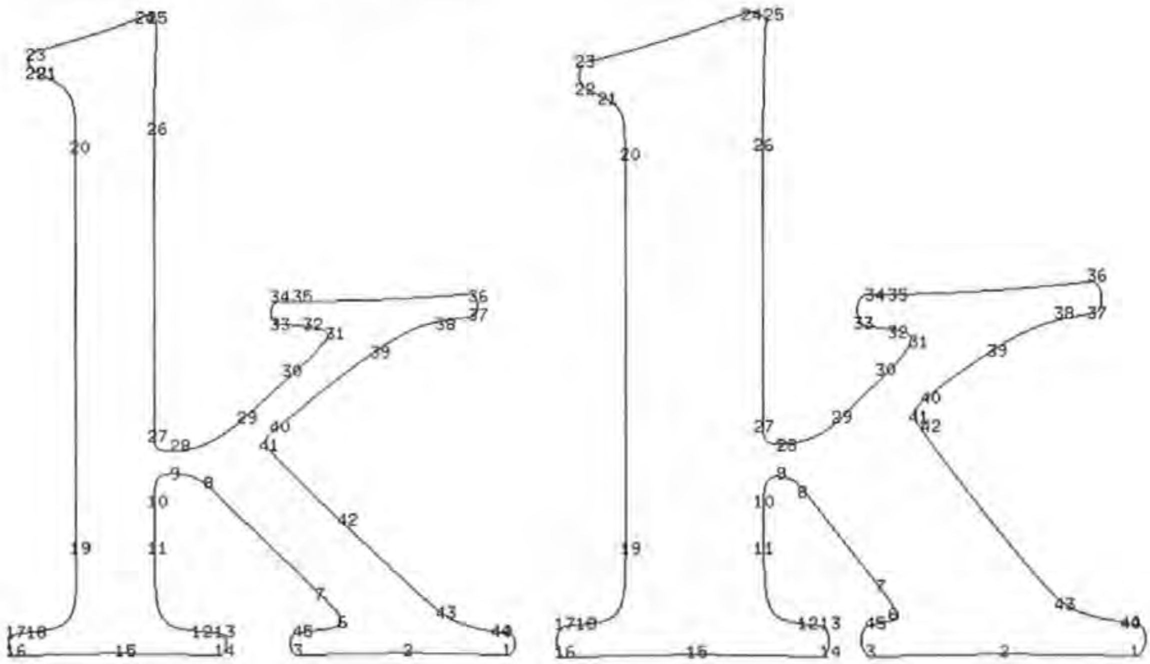

Figure 5.3. The numbers of each Bezier curve needed to be placed in exactly the same points "by hand," the results of which are shown above. This is because Fontographer assigns numbers to the Bezier curves automatically and apparently randomly.

Care was also taken to ensure that each letterform rested on a common baseline. This had to be done because of the aesthetic, Gestalt or visual illusions created by straight letterforms versus round letterforms. The round letterforms, for example, need to hang slightly below the common baseline so that they do not appear to "float."

After testing, these marked-up letterforms were imported into bioFontMorph, which was written using OpenGL. Though none of the typeface movements created for each biofeedback modality were intended to be "skeletal," some of them worked much better as such in terms of aesthetics. In other modalities, each letterform was "filled in" in real-time.

Figure 5.4 BioMorphic Typography. In the "skeletal" example above, the typography is altered, in real-time, according to the user's respiration. The word on the left depicts the state of exhalation, while the same word on the right depicts inhalation.

5.4 Morphing Letterforms

To morph letterforms in real time, I created a font based on Adobe Garamond that was intended to represent "neutral" biometric readings. Then, for each biometric value, (breathing, GSR, and heart rate), a new font based on the "neutral" font was created that was intended to represent the extreme readings of the biometric value. Thus, for inhalation, or large chest expansions, a very "fat" variation of all of the letterforms was created. This mimics the expansion of the chest when one inhales by a parallel expansion of the font. For large GSR readings, a very spiky set of letterforms was created, initially with certain letterforms such as i, u, o, k and g. These were chosen because they represent a range of spatial issues: thin, thick, round, straight, with an ascender and with a descender. For large heart rate readings, modifications to the p and d letterforms were initially developed. For the extreme font of each biometric reading, a complete font file of Bezier curves was then created. Each letter in the "extreme" font has a set of Bezier curves that correspond directly to the Bezier curves of the same letter in the "neutral" font.

Therefore, to morph from the neutral font to the extreme font for one reading (say, GSR), the corresponding Bezier curves for each letterform of the "neutral" font needed to morph to the Bezier curves of the "extreme" font. In fact, *each* Bezier curve in the neutral font can morph to its corresponding Bezier curve in the extreme font. Since all letterforms in the extreme fonts have the same number of curves per letterform as their corresponding neutral letterforms, this process will not create broken letterforms.

Thus to morph a letterform simply means that each Bezier curve must morph. To do this, a parameter value was established that lies in the range between 0 and 1, inclusive. This parameter p controls the blend between neutral and extreme. Where p=0, the neutral curve is the result. Where p=1, the extreme curve results. When the program reads in the font curves, it pre-processes each of the extreme curves by subtracting away the corresponding geometric value of the neutral curve. Thus, for each extreme curve, the difference between the extreme and the neutral curve is stored. For each curve, this means storing the 4 (x,y) difference values of the control points. That is, we store x_{diff} and y_{diff} for each control point. When the letterform is to be drawn, for each of its Bezier curves, this is computed:

$x_{morph} = x_{neutral} + p * x_{diff}$.

When $p = 0$, $x_{morph} = x_{neutral}$

When $p = 1$, $x_{morph} = x_{neutral} + x_{diff}$, which we previously computed as $x_{diff} = x_{extreme} - x_{neutral}$, so $x_{morph} = x_{neutral} + x_{extreme} - x_{neutral} = x_{extreme}$.

To morph between *two* extreme fonts using two readings, the same operation is done with a parameter that corresponds to each font.

$x_{morph} = x_{neutral} + p_1 * x_{diff1} + p_2 * x_{diff2}$

At startup time, each extreme font has its difference computed so that it can be added to the neutral font according to its corresponding biometric reading.

5.5 Biometric Readings

When bioFontMorph starts, it takes a number of baseline readings of the various biometric values, such as breathing, GSR, or heart rate for the first 10 seconds of the runtime of the program. This rapid start-up was required to quickly enable the user to see the effects of the biofeedback measures. These raw values were then used to derive "resting" values from which future values would deviate.

For breathing, the maximum and minimum values of the first 10 seconds was taken. These values were used to compute the parameter $p_{breathing}$. As new readings arrive, $p_{breathing}$ = (newBreathReading – min)/(max-min) is computed. This approach was used because users were expected to take at least one breath during the first 10 seconds. As the program runs, it is ensured that $p_{breathing}$ does not fall below 0 or exceed 1. This results in a font that is a little fatter than the original neutral font, but it allows for the user to see the range between fattest and thinnest.

For GSR, the average of the incoming readings was computed; this value was used to correspond to $p_{GSR} = 0.5$. $p_{GSR} = 0.5 * (newGSRReading / GSR_{average})$ was computed. Similar to the Meditation Chamber, the GSR readings varied somewhat from person to person, so this approach of dividing by the initial average was adopted. As the program runs, it is ensured that p_{GSR} does not fall below 0 or exceed 1.

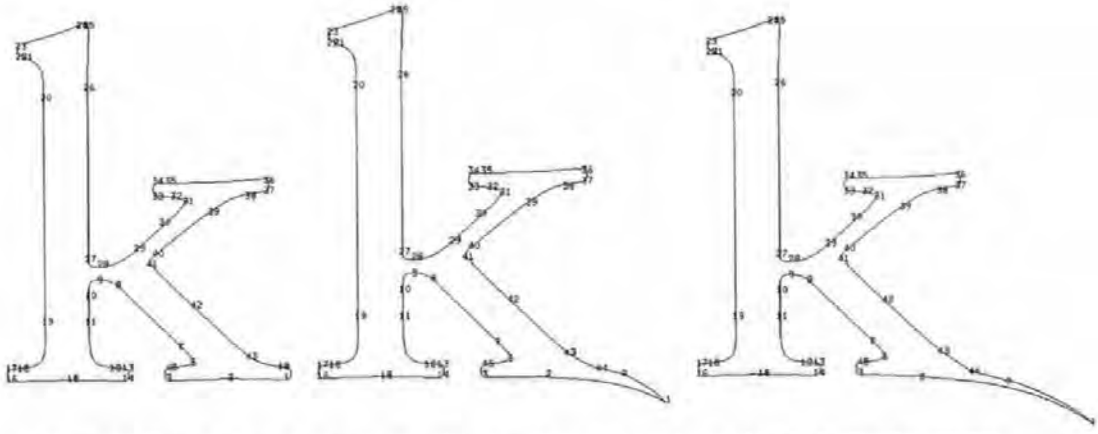

Figure 5.5 These are tests for two simultaneous modalities: respiration and GSR. Respiration creates thinner or "fatter" letterforms, while GSR creates deformations of the serifs. They represent values, left to right <respiration 0, GSR 0> <respiration 0, GSR .5> <respiration 0, GSR 1>.

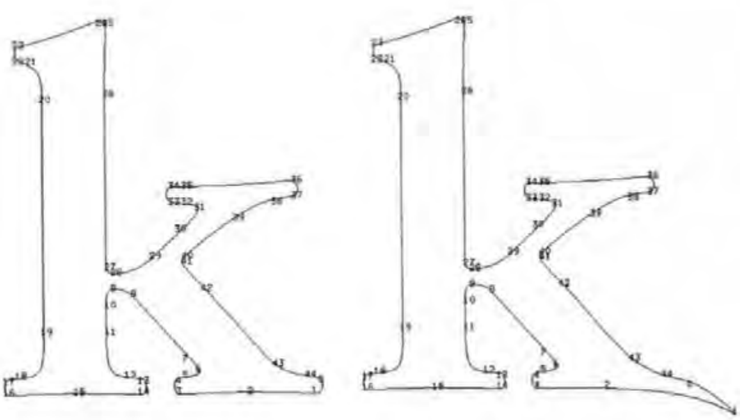

Figure 5.6 These are tests for two simultaneous modalities: respiration and GSR. These two represent values, left to right <respiration .5 GSR 0> <respiration .5, GSR .5>.

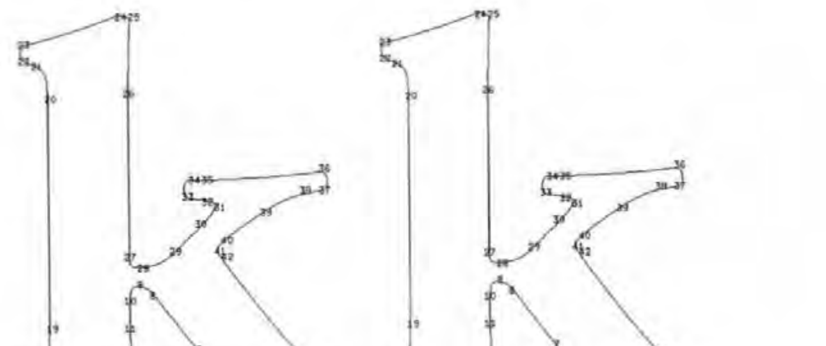

Figure 5.7 These are tests for two simultaneous modalities: respiration and GSR. These two represent values, left to right <respiration 1, GSR 0> <respiration .1, GSR .5>.

For heart rate, raw Blood Volume Pressure (BVP) readings were collected from the ProComp+ sensor, and the number of peaks over the initialization period was counted. The number of peaks in 10 seconds was multiplied by 6 to get the approximate value of beats per minute. Since normal resting heart rates are in the range from 40 beats per minute to 110 beats per minute, we were able to set p_{HR} = newHeartRate -40 / (110-40). Any heart rates above 110 yielded $p_{HR} = 1$.

To count peaks, we continued to collect BVP readings into an array representing the most recent 10 seconds of readings. As a new reading arrived, it overwrote the oldest value in the array as it cycled over the array. The maximum and minimum values of BVP were then computed. We then passed over the array a second time and added to the peak counter when the BVP value first rose above 90 percent of the range. To prevent counting this high value again, we stopped looking for high values until the current BVP value fell below 80 percent of the range. This allowed for small variation in readings to not cause false peaks, since readings would have to jump rapidly from 80% to 90% to be counted. Counting over the 10 past seconds allowed the maximum and minimum BVP values to slowly shift as the user continued to use bioFontMorph.

5.6 Findings

In the first two years of development, approximately 39 undergraduate and graduate students at the Georgia Institute of Technology students informally tested and provided feedback. Of these, nearly half were Computer Scientists, a quarter were Industrial Designers, and a quarter were in the Humanities (from the School of Literature, Communication and Culture). In addition, 3 faculty members (Prof. Eugene Thacker, Prof. Chris Shaw, Prof. Jay Bolter) consistently tested *BioMorphic Typography* throughout its development. During this time, it was discovered that most (all but three) students and all faculty members could not discern more than two simultaneous modalities. Most preferred mastering one modality, which took no longer than 15 minutes. None reported having any problems with "oscillating" their attention among typing, reading, and consciously trying to change their biofeedback output.

Of the modalities, it was assumed that respiration would be easiest to control. This was the case. However, almost all users preferred the "more challenging" modalities of galvanic skin response and heart rate. GSR seemed to many students to "be mysterious" and "cool." When other students were nearby, they would try to provoke the student who was experimenting with GSR. This was a bit reminiscent of the Milgram experiments, especially because the provocations tended to escalate. Heart rate was the modality that was most surprising to users. It was assumed that since heart rate is relatively more difficult to control, users would not be interested in experimenting or "playing" with it. This was not the case. The faculty members did have difficulty with this modality. The students, however, initially expressed frustration, but kept at it until they sensed that they could "control" their heart rate. This was even more "mysterious" to them than GSR. A phenomenon quickly evolved: when students first learned to control their heart rate, they became excited and reported getting into "weird feedback loops." That is, when they first sensed that they could manipulate their heart rates, they became excited, which increased their heart rate. They noticed this increase and tried to reduce their heart rate, but found this more difficult than they anticipated. This frustration increased their heart rate even more. A few students tried to keep this going; most simply stopped looking at the screen (in order to no longer see what their heart rate "readings" were) and focused on typing until they felt more relaxed. They then resumed experimenting with their heart rates, as expressed in the morphing font. "News" of this weird feedback loop quickly spread among other students, and many more wanted to try *BioMorphic Typography.* However, at that point, work had to be refocused to debugging the program and preparing it for upcoming exhibitions.

Figure 5.8 BioMorphic Typography. By using a biofeedback device, a user changes the visual character of the typography (letterforms), in real-time, according to his or her continually changing physiognomic states. In the example above, the typography is altered according to the user's brainwaves. This modality was the least popular among users, probably because altering brainwaves proved to be more difficult than altering other modalities. In addition, the sensor was cumbersome and difficult to keep on (the hand in the photo was necessary to keep the device on). The device (BrainMaster) is relatively easy to manage in technical terms, but is also not the most accurate of devices of its kind. The most accurate device requires keeping 24 sensors in direct contact with a user's scalp. This would render it too cumbersome to use in art exhibitions. In addition, the method of manipulation distorted the letterforms in such a way as to render them illegible. For all of these reasons, using brainwaves was dropped from further experimentation early in the process.

Exhibitions

The proximity of the monitor to the user was also tested during this time, as were monitors versus projections, both large and small. Across the board, a "close" (12"-18" away) computer monitor was preferred for its "intimacy" and "privacy." Only two students preferred the projections. For them, the larger and closer the projection, the better. Thus, for exhibitions, one or two computer monitors were placed in a dark and quiet area. With approval from the user, one projection was mounted outside of his or her view. This projection enabled others in the exhibition to see what was happening. The real-time projections of users' typing were interspersed with a video that briefly explained the concept of *BioMorphic Typography* (refer to the CD: *BioMorphic Typography:* Videos).

In the exhibitions, the most important issues were finding quiet and dark areas that provided privacy for the user. Either one or two computers attached to the biofeedback device(s) were used. Each required that an "attendant" be there at all times in order to help users attach the biofeedback sensors and start the program. During openings (usually the well-attended first evening or "launch" of the exhibition), users rarely engaged with the piece for more than ten minutes. However, during the day, when fewer people were around, users were observed to stay engaged with *BioMorphic Typography* for longer time intervals. According to the security guards and attendants, this ranged from 15 minutes to 45 minutes, with the average time being 20-30 minutes. The work at the exhibitions included singular modalities of heart rate, GSR, and respiration. Users chose which modality they wanted to use.

As with the earlier student testing, the modality of the heart rate was surprisingly popular. However, GSR was the most interesting modality for users in the exhibitions. This may be because there were no other users or bystanders who would act to "provoke" the user. When GSR readings were in plateau stages, a few users asked the attendant to "provoke" them by asking about their taxes, co-workers, or other self-specified issues.

In the exhibitions, users cared more about their privacy than did earlier testing with students and faculty. Several users went to the extent of asking the attendant to either look away from the computer screen or the leave the area for a short time. The "content" or the words that were typed ranged from "nonsense" or randomly typed letters and numbers to "messages," aphorisms, quotations they remembered, very short stories and poetry. Users told the attendants that they most enjoyed the expressive forms of the typography and offered ideas for other ways to depict it. While some users (roughly, 1 in 20) found it difficult to attend to typing and paying attention to their physiological states (expressed as "trying to walk and pat ones head at the same time"), most users did not appear to be frustrated. Some users said the experience "was like meditation." Across the board, however, users expressed a "sense of wonder" that they could quickly learn to control their physiological states of respiration, GSR and heart rate, according to the attendants.

5.7 *BioMorphic Typography* and Merleau-Ponty's Chiasmic Reversibility

By becoming aware of one's physiognomic state as one types, *BioMorphic Typography* demonstrates Merleau-Ponty's notion of reversibility. This is because as the writers type, they bring their ideas outward, to the world, "for others" (for the most case); alternatively, the writers also became aware of their own physiological states and quickly learn how they can manipulate these physiological states by focusing inward. Thus, most writers constantly alternate between an outward intention and an inward attention. Akin to Merleau-Ponty's example of one hand touching the other, most users said that they could not simultaneously attend to their inner physiological states, typing, watching how the letterforms morphed, and writing.

Through taking notes from the attendants and security guards at the exhibitions in the mornings and early evenings, and through my daily observations during each exhibition, we found that users took little time in "figuring out" how to reduce or heighten their physiological states of heart rate, GSR, and breath rate. As with all other work with biofeedback, I was again intrigued that heart rate was the one aspect that users, for the most part, found most "mysterious" and the one they spent the most amount of time with. Users who were tested while I was creating *BioMorphic Typography,* along with users at the exhibitions were eager to try to explain to us the "feedback loop" that led to escalating heart rates. When asked if they experienced feedback loops in the GSR or breathing modes, they typically replied, "yes, of course, but I *knew* how I was doing that." This was surprising because "knowing how to affect" GSR would seem to be as mysterious. Second, a relatively dark and quiet area at the exhibitions was necessary in order for users to concentrate. Yet, even in those areas, users seemed extraordinarily concerned about their privacy. This appears to indicate that the experience was indeed an example of Merleau-Ponty's reversibility. This is because one the one hand, users were typing, reading and looking at the visual aspects of the typography from a first-person perspective. On the other hand, they were also able to "reverse" this and "see" themselves as others would. Some of this was due to the nature of what they wrote; much more often, however, was that, as one user said, "I just don't want other people to see what is going on with *me,* with my biofeedback . . . you know, it is kinda like they can look *into me,* inside of me. I know they can't, but still . . . " Clearly, this user was considering herself to be an object *and* a subject who was writing and who was trying, through the representation of the typeface, to control her inner states. A few users tried to write and to "be" so that their physiological states reflected what they wanted to communicate through the differing forms of the typeface. One user, for example, was writing a poem, inhaled very deeply and tried to simultaneously "tweak" his GSR so that it would cause the serifs to "spike." "This is where I wanted 'the words to *shout*'" he said.

Finally, the attendants and I found that there were basically two kinds of users. The first group either read about it or questioned the attendant and left, or, if they stayed, it was only to "figure out" how the system worked. The second group were those users who stayed, usually between 15 minutes and half an hour, or, in one case, half the day. At the exhibition at Georgia Tech's *TechnoPoetry* symposium, attendants noticed that 4 users returned at least once, and that two other users brought their friends on a different day than their first visit. The exhibition at Georgia Tech appeared to garner the most interest, even though the system was not yet debugged. While users at the exhibitions in England and Sweden were more enthusiastic, they were less apt to actually hook up to the biofeedback device, and instead wanted the attendant to show them how it worked. The European exhibits, both focusing on typography, were for the most part a homogeneous group of designers, while the exhibit at Georgia Tech included designers, computer scientists, writers, poets, and members of the university and city of Atlanta, representing a diversity of age groups. This may or may not have been a factor. The exhibit in Sweden, however, may have had something to do with *BioMorphic Typography* being in English, as three users said that they were embarrassed to try it, since they might misspell words. Finally, the attendants had much to offer about factors we could take into account in a redesign, such as using smaller words, providing examples in our descriptive video that depicted each state, trying voice, and designing a case and ways to attach the sensors that were more user-friendly.

Observing users at the exhibitions was much more useful than using questionnaires. With the questionnaires, although these users also engaged in *BioMorphic Typography,* at least two factors were at work. First, the initial group were students. Even though they filled out the questionnaire after I turned in my grades, their comments seemed to suggest that they were writing down what they wanted me to hear, even though the directions made clear that they should avoid this. Second, although they were given an hour to think about it and write about it, none put in an hour's worth of effort. Thus, what they wrote seemed extremely superficial. Third, this was a homogenous group in terms of age, and that was obvious. The next set of questionnaires was given as *BioMorphic Typography* was being prepared for an exhibit. Users "played with it," but were eager to go and not interested in filling out questionnaires. Finally, the questionnaires that were developed for the first exhibit, the *TechnoPoetry* symposium resulted in total non-compliance. Students and local artist said that it was "improper" or "Downright stupid" to have a questionnaire for an artwork. A few users just laughed at the idea and walked away. However, more in-depth answers or feedback may have been garnered from my colleagues, however, many of them knew me (and thus may probably have not been objective), and others had to catch their flights right after the exhibit closed. For all of these reasons, and the ones given in section 5.2, the questionnaires were abandoned. Nevertheless, the initial responses can be found in Appendix 3.

Excretia

Excretia, a font or subunit of the *BioMorphic* family, was the first test of the ideas of *BioMorphic Typography.* It is discussed at some length in *Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency* (hereafter referred to as *Windows and Mirrors*) (Bolter and Gromala 2003, p.162–169). As described in the book, *Excretia* serves to embody the oscillation between transparency (reading "through" the font to the ideas) and reflexivity (reading and paying attention to the interface as an interface). This oscillation between the two seems to typify not only Merleau-Ponty's idea of reversibility, but also contemporary understandings of new media experience, and of new media as a "media form" rather than a form of computing. In reading "through" the interface (and font) to the ideas, one is in a subjective position, while paying attention to the biomorphic aspects of the interface itself, one can be in an objective position. I say "can be" because one could also "be in tune with" or feel the cause-and-effect of the biofeedback on the shapes of the typeface. Nevertheless, I would argue, we more often than not constantly "reverse" our positions, as Merleau-Ponty suggested. This is explored in more depth in the subsequent paragraphs.

In Western culture, writing has generally been supposed to be a window onto the world described or mediated by the language. Especially in the age that followed the invention of the printing press, with the exception of some specialty books produced by artists, poets and theorists, letters and layout of the text were supposed to disappear. Obviously, *Excretia,* a subunit of *BioMorphic Typography,* is different.

> "Demanding to be seen and appreciated by the reader, *Excretia* belongs to the tradition represented by Japanese and some Islamic calligraphy and by the illumination of manuscripts in medieval Europe, in which words and images are inextricably joined" (Bolter and Gromala, 2003 p.168).

Further, "writing can also function as an interface between the writer and himself" (Bolter and Gromala 2003, p.168).

> Like earlier forms of writing such as calligraphy, *Excretia* is a reflective interface that reveals the author to himself – again, not a perfect or single reflection, but a myriad of refracting planes in the transpositions and changing angles of the letterforms" (Bolter and Gromala 2003, p.168).

In the Western tradition, writing seemed to lose any physical connection to the writer. Rather, writing is:

> "usually thought of as an exercise in abstraction. When a writer writes, she leaves her body behind and creates a version of herself that is abstract and reasonable – a Cartesian or even Platonic ego (though Plato supposedly disdained writing). This notion of writing has survived into the computer age" (Bolter and Gromala 2003, p.169).

In the early days of "cyberspace" (beginning around 1990), cyber-enthusiasts such as John Perry Barlow and others wanted to claim that cyberspace was the realm of Mind, a place where one could ideally download one's consciousness and "leave one's problematic, physical 'meat,'" disabilities and prejudices behind (Gromala 1996, p.224). "They were thinking of verbal e-mail, chat rooms, and MOOs" (Bolter and Gromala 2003, p.168), during a time that preceded the widespread explorations of more directly physical forms of technology, such as tangible and ubiquitous computing, CSCW, responsive spaces, wearables and so on. The trick of leaving our bodies behind, as we have seen since,

> ". . . never works. *Excretia* insists that we cannot leave our embodied selves entirely behind . . . (it) seeks to remind us of our bodies, and the self that *Excretia* reflects is a combination of symbolic writing and imagery – of abstraction and embodiment" (Bolter and Gromala 2003, p.169).

The oscillation and combination referred to in *Windows and Mirrors* was an initial exploration of Merleau-Ponty's reversibility. It led to more pragmatic, technologically workable experiments like *BioMorphic Typography,* and a more in-depth exploration of Merleau-Ponty's chiasmic reversibility, since it seems that reversibility takes place on numerous levels.

5.8 *BioMorphic Typography* and Merleau-Ponty's Concept of Language

Merleau-Ponty encountered the linguistics of Ferdinand de Saussure as he began to write his earlier book (Carman and Hansen 2005, p.2), the *Visible and the Invisible* (Merleau-Ponty 1968). With Merleau-Ponty's main emphasis on the body, it seems inevitable that he should have had to provide some account for language beyond gesture, or argue for gesture as the groundwork for language. Indeed, in his later book, *Phenomenology of Perception* (Merleau-Ponty 1992), Merleau-Ponty expressed a hope that it was possible to derive a language directly from an expressive experience. Saussure seems to have wanted to disabuse Merleau-Ponty of this notion, but was mostly unsuccessful. Nonetheless, Merleau-Ponty was respectful of Saussure's work, and entertained "The theory of signs, as developed in linguistics, perhaps implies a conception of historical meaning which gets beyond the opposition of *things* versus *consciousness*" (Merleau-Ponty1988, p.16). Accordingly,

> "the phenomenology of perception brings about a displacement of the *cogito,* from the personal "I" to the prepersonal "one" *(l'on),* it likewise opens up a space of collective social existence between the first- and the third-person points of view. . ." (Carman and Hansen 2005, p.16).

Merleau-Ponty considered "this shared social space . . . and its ground" as lying in the "impersonal symbolic domain that places meaning *outside* individual consciousness" (Carman and Hansen 2005, pp.16-17), but not outside of the body. Language as a collective, inter- or transsubjective sharing did not lead us away from the body, but to its other aspects. Merleau-Ponty reminds us that the body is an expressive medium, and is more than just a kind of special language of its own. For Merleau-Ponty, language is *rooted* in the "development of gestures into a general symbolic structure of signs and symbols" (Steeves 2004, p.29). The body is 'innately equipped with natural abilities to express its needs and fears and to communicate those feelings others' (ibid.). Merleau-Ponty argued, for example, in *Prose of the World* that "the primordial level of language must be approached by *defining* [emphasis mine] signs" (Merleau-Ponty, 1973, p.28). What Merleau-Ponty means by this "primordial level" refers, of course, to the body, to its ability to use language, in a way similar to the propensity of birds to sing, or ants to communicate via their chemical excretions. In Merleau-Ponty's terms, the question at hand was: what is it about the biology of humans, their imbrications in the world, and to other humans (and animals), that "solicits" language?

It appeared that Merleau-Ponty entertained Saussure's fundamental notion, his "diacritical structure of language." That is, according to Saussure, the relationship between the signifier (sound image) and the signified (concept), according to Saussure, was arbitrary. Language, in Saussure's terms, was a system of differences, references within the same language (or media) to other arbitrary signifiers and signifieds. But Merleau-Ponty agreed with Saussure only to a point; he did not fully accept the idea that language is completely arbitrary in the Saussurian sense. Further, Merleau-Ponty's conception of language was fundamentally different from Saussure's in that Saussure was not concerned with posing the question of the ontological value of language, but rather in transforming the "object domain" of linguistics. This difference or appeared early in *the Visible and the Invisible* (Merleau-Ponty 1968, p.31).

As Merleau-Ponty wrote, "Yet, there is a world of silence, the perceived world. There is an order where there are non-linguistic significations" (Merleau-Ponty 1968, p.171). Further, Merleau-Ponty claimed that there is an ontological dimension of language (Merleau-Ponty 1994c, p.19). In *The Phenomenology of Perception,* his final work, Merleau-Ponty argued that "the body-organism is linked to the world through a network of primal significations which arise from the perception of things" (Carman and Hansen 2005, p.19). As we have seen in earlier chapters, it is the flesh that gives rise to perception in its very becoming.

The aspect of language for Merleau-Ponty seems the least developed, perhaps because he died before finishing his book on it. Further, although Merleau-Ponty respected Saussure (Carman and Hansen 2005, p.18), he had an aversion to the highly abstract forms linguists were using to explore this common, everyday aspect: language. Phenomenologists, to repeat, are most concerned with the everyday, and do not attempt to create overarching, abstract theories, generally.

If we follow Merleau-Ponty's philosophy, *BioMorphic Typography* works at several levels. In his words, Merleau-Ponty states, "What there is is a whole architecture, a whole complex of phenomena 'in tiers,' a whole series of 'levels of being'" (Merleau-Ponty 1968, p.114). The user sees the changing typeface as a subject, from a first-person point of view, but can also "reverse" this by assuming more of a position of an object, to "be seen" as others might see her. This reversibility isn't just a possible, one time occurrence, but arises from the very structure of our flesh itself. The user thus *sees* the visual aspect of the continuously changing typeface, but also *sees* it *as others would,* from a third-person perspective. On another level, this works with writing and reading as well. The user writes words, but engages in the reversibility in order to read the words as others might. This is both an individual and a social act, since words are learned and written not only for the self, but to communicate, to commingle with others.

At another level still, the biofeedback manipulations of the typeface one uses as one writes/types partially expresses "the primordial level of language," in this case, literally via the biofeedback effects on the typeface. What can be more primordial than the autonomic senses of heart rate, breathing, and galvanic skin response? When caught in the feedback loops described by users, it seems clear that these are felt, ontological dimensions of language, dimensions that are usually, as Merleau-Ponty said, the "background" of our being. But the biofeedback device, affecting the visual character of the typeface, is brought into the conscious realm.

Writing is most generally assumed to be "of the mind," with its physical traces but vestiges of another time. *BioMorphic Typography* insists that users become aware of how their physiological states and how they affect the shape of their writing. In observation of users at the *TechnoPoetry* conference, those who considered themselves Humanists more so than being an artist (many practice both), had the most trouble with "doing both," that is, with writing/typing and with being aware of the physiognomic states. In their words, it was "like walking and tapping the top of one's head," simultaneously. They were not hesitant to say so. Those who defined themselves primarily as artists, on the other hand, had little difficulty. Neither did undergraduates and most of the public. The poets, in particular, were extremely interested in the project, though it was still in its beta version. This might seem an interest obvious to poets, but not many contemporary poets are as concerned with *how* the written (typographical) aspect of their work functions,[31] despite many historical examples to the contrary. However, poetry disseminated by oral and multimedia means (so-called "poetry slams") have enjoyed a resurgence in popularity in North America (Bruce and Davis 2000, p.122).[32] These were the poets who were most enthusiastic about *BioMorphic Typography,* and wanted to perform it, along with their voices.

5.9 *BioMorphic Typography* and the History of Writing

The printing press, over the centuries since its creation, led to widespread effects: social, political and economic. According to Elizabeth Eisenstein (Eisenstein 1980, p.683), "Within the space of a century and a half a revolution had occurred in the way in which men regarded the universe." In terms of writing, it also led to a division of labor, separating the writer from direct production of his or her work. Further, a reliance on moveable type rather than hand held and operated tools such as pens, quills, and pencils, led to a distancing of bodily knowledge and awareness[33] and/or a reconfiguration of which senses were necessarily dominant. As Marshall McLuhan also claimed, "Any culture is an order of sensory preferences, and in the tribal world, the senses of touch, taste, hearing and smell were developed, for practical reasons, to a much higher level than the strictly visual" (McLuhan 1962, p.240). Further, McLuhan idealized this "tribal society." He claimed, "Into this world, the phonetic alphabet fell like a bombshell, installing sight at the head of the hierarchy of senses. Literacy propelled man from the tribe,

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[31] As evinced by examining the poetry section, book by book, in Chapters, Borders, and specialty bookstores in Atlanta, Georgia, Manhattan, Paris, and Vancouver, Canada. Very few books were observed to have any layout different from one size of text, broken into phrases. This is considerably different from the so-called Poetry slams that are on the BBC, PBS, the CBC, and websites devoted to more multimedia forms of poetry.
[32] For two of the most accessed websites, refer to: IWPS (Individual World Poetry Slam) and http://individualpoetryslam.com/ National Poetry Slam http://nps2007.com/
[33] Theorists such as Walter Ong, Marshall McLuhan and Eric Havelock have suggested that the increase in literacy over the centuries has shifted or at least emphasized the cognitive or "mind" over physical or crafts-forms of knowledge. Although Elizabeth Eisenstein does not articulate this, her work does point to similar directions.

gave him an eye for an ear and replaced his integral in-depth communal interplay with visual linear values and fragmented consciousness. As an intensification and amplification of the visual function, the phonetic alphabet diminished the role of the senses of hearing and touch and taste and smell, permeating the discontinuous culture of tribal man and translating its organic harmony and complex synaesthesia into the uniform, connected and visual mode that we still consider the norm of 'rational' existence" (McLuhan 1969, p.240). Thus, according to McLuhan, the change in the "ratio of the senses" in turn resulted in a changing in the mode of thinking, to a detached, rational, linear one.

Though these are just a few of the results of the invention of the printing press, *BioMorphic Typography* enables users to bring back into conscious awareness more than their so-called five senses — the innermost, illusory, autonomic senses of respiration, heart rate, galvanic skin response, and brain activity. *BioMorphic Typography* "reflects the writer in a way that printed or static type does not. It offers a new interface between the text and its writer (and later readers as well). It reunites the act of writing with a physical awareness, a unity that the printing press denied" (Bolter and Gromala 2003, p.167). *BioMorphic Typography* is intended to produce a mode of thought entirely different from abstract, linguistic modes of reasoning that purportedly have resulted from the invention of the printing press. Further, it problematizes the dualisms of mind/body and reading/corporeally-sensing, among others. However, *BioMorphic Typography* is not widespread, and so its results cannot be compared to the effects of the printing press. It is an example, however, of how technologies of our age can possible have modest, transformative effects.

5.10 Physical Trace of the Writer

> ". . . much of the nomenclature of both writing and typographics – hand, face, character – are metonymies of the absent human body and of the subjectivity which we presume is responsible for them."
>
> — Margaret Morse, (1986 p.72).

Throughout the history of writing is a concern with its relation to the body (Meggs 2006, p.5). During the incunabula – or the first fifty years of moveable type – this concern was taken quite seriously. For during that period, the script of a human hand was replaced by metal type that bore little resemblance to the calligraphy of monks and copyists. Early typographers therefore drew their fonts according to matrices that were of the proportions of the human form. A few of the more decorative fonts actually included pictorial drawings of the human body bent into positions that created each specific letterform. Less literal aspects were the adoption of the slant of the counterforms (or negative spaces) of each letterform. This slant underpinned the slant of the calligraphic hand. Other desires for traces of the human body led to the development of italics. In the words of linguist and semiologist Georges Jean, the Venetian printer Aldus Manutius (1449-1515) created beautiful letterforms that were used throughout the 16th century. "Seeking to reproduce handwriting, Aldus was also inspired by the writing of Petrarch to create Aldine, or italic, an elegant, slanting cursive script. Luca Paccioli's *De Divina Proportione* (1509) attempted to create a script by reducing the proportions of the human body to geometric shapes, in the style of drawings by Leonardo da Vinci" (Jean 1992, p.98).

So strong was this desire for a relationship to the human (or its trace) that the nomenclature developed referred to parts of metal-based fonts; for example, the mass of each form of the fonts are until today still referred to as the "body" of the font, comprised of the spine, ears, feet, arms, and so on. The dispute between whether a typeface should resemble writing with the hand or take on aspects more "natural" to the new technology continue to this day (Blackwell 2004, p.187-188). *BioMorphic Typography* seeks to re-engage writers with some of aspects of their own bodies, in a most literal way.

The Japanese story of how personality is visible in handwriting from the novel *The Tale of Genji,* referred to in *Windows and Mirrors* (Bolter and Gromala 2003, p.165) is still relevant since its creation shortly after 1000 A.D. (refer to Figure 5.10). It is still believed that certain characteristics of a writer's personality and psychological propensities are visible in their handwriting. Handwriting is still relied upon as a legitimate forensic form, for example, in profiling, and was further legitimized after handwriting experts started to accrue scientific methods. According to the FBI, "Handwriting comparisons are based on the principles that no two people write exactly alike and that characteristics reoccur throughout every person's writing, although no one writes exactly the same way twice. This combination of characteristics is unique to every individual and is used by document examiners for comparison" (Held 2001).

In the eleventh-century *Tale of Genji,* Genji is with his lover, Lady Murasaki, when he receives a letter from his prospective wife, the Third Princess. Murasaki doesn't need to read the contents of the letter. Once she glimpses the handwriting, she concludes that the girl will not be a threat to HER. Genji is embarrassed by the childish writing. "You see" he says to Murasaki, "you have nothing to worry about." (2001, 558)

Figure 5.9 *BioMorphic Typography: Excretia.* By using a biofeedback device, a user changes the visual character of typography (letterforms), according to his or her continually changing brainwaves and breath rate (indicated by the bold aspects of the fonts used here). The version above appeared in *Windows and Mirrors.* Based on a story within the classic Japanese novel The Tale of Genji (c. 1000 AD), Gromala "performed" both characters while wearing the biofeedback device. The performance included some improvised, non-programmed alterations, such as the change in typeface.

5.11 Literacy, Presence & Sensorial Shifts

What textual writing omits is an important aspect of human history: presence. As scholars such as Marshall McLuhan (McLuhan 1962 p.17), Walter Ong (Ong 1982 p.42) and Eric Havelock (Havelock 1988) suggest, it is the lack of human presence made possible by writing and its reproducibility that led to a loss or attenuation of bodily forms of knowledge. In the words of Ong, ". . . chirographic cultures regard speech as more specifically informational than do oral cultures. Where speech is more performance-oriented, more a way of doing something to someone. Second, the written text appears *prima facie* to be a one-way informational street, for no real recipient (reader, hearer) is present when the texts come into being" (Ong 1999, p.177). These include the ability to read the subtleties of gestures, of ways of physical comportment, of variations in voice that would render a reading or oration according to one versus another rhetorical meaning, attendant smells, and kinesthetic ways of resonating with the reader or orator. Some argue that we lost bodily forms of knowledge as described above, while others more cautiously argue that an emphasis of sensorial modalities shifted, privileging vision over all others. Although Elizabeth Eisenstein did not make this same claim, some of her suggestions come very near to articulating what the other theorists do: that our sensory or perceptual knowledges are less than they were centuries ago, as our fixation on textual forms reduce or compress our sensory knowledge primarily to the visual. This is not just a change in the ratio of our senses as McLuhan would have it. Since the mind is shaped by the body and vice versa, and since the mind and body function together, as one, a difference in sensorial emphases results in different ways of thinking and being. According to Havelock, "As the change toward literacy occurred, it has produced changes in the configuration of human society." And further, "The adjustment that it caused was in part social, but the major effect was felt in the mind and the way the mind thinks as it speaks" (Havelock 1986, p.100).

5.12 Prior Art

Numerous graphic designers and interactive artists have created animations of fonts and fonts themselves that bear characteristics of movement for semantic, performative, or other purposes. One of the most prominent pioneers in this area, Muriel Cooper, formed the Visible Language Workshop at the MIT Media Lab in 1975. There, many students developed numerous "computationally expressive tools" whose basic underlying principles were of "transparency," "adaptability" and "blur" (Abrams 2007). John Maeda's students at the MIT Media Lab are carrying on Prof. Cooper's experimental work in typography. As the personal computer became ubiquitous, fonts such as *Beowulf* changed its character when it was printed out. Currently, many designers and artists are exploring this realm. Among the more notable are Jason Lewis' *TextOrgan,* which responds to voice and has numerous forms capable of manipulation. Over the last year, my graduate students and I have scoured the web and contacted numerous professors around the world (primarily Europe, India, China, Korea, and Brazil) to see if any such experiments relate to biofeedback forms. To date, none have been identified.

5.13 Future Work

The original intent for *BioMorphic Typography* was in part to enable users to become aware of, and to be able to assert some control over the part of their visceral system (breathe rate, heart rate and GSR) that generally is termed "autonomic." In its exhibitions in the U.S., England and Sweden, it can be observed and said that this was accomplished. (Refer to Appendix 1.)

Pragmatic (i.e., more design-like) future applications have been explored with Dr. Thad Starner, for possible use in Georgia Tech's Aware Home. The goal of the Aware Home is to develop ubiquitous technology that will enable the elderly to remain in their own homes for a few years longer (Abowd et al. 2000, p.2) Starner developed a "gesture pendant" that can be worn[34] by the Aware Home's inhabitants (Starner et. al 2000, pp.87-92). This pendant can

[34] Issues of privacy are among the most important aspects of the Aware Home. http://www.awarehome.gatech.edu/projects/index.html#technology/ However, the gesture pendant can be worn or taken off whenever more privacy is desired. http://www.gatech.edu/innovations/futurehome/index.php#gesture/

be re-engineered to measure the user's heart rate and/or mobility. Its data is wirelessly beamed to the data structure of the house and that data can be accessed by whomever the inhabitants desire. So, say the son or daughter wants to keep track of how well his or her parents are doing without being a daily pest. A small window could be available on his or hers computer screen that would display a general sense of how the parent is doing. Ambient movement of the typography could portray information, such as a general state or the amount of movement. When certain parameters are exceeded, the font could become more insistent, such as becoming faster, brighter, blinking, or augmented by sound.

An application that is more literally "visceral" is under consideration. It would utilize one of several Japanese toilets that were designed to measure and displays the relative health of an individual through weight, mass and chemical analysis of the urine or feces. Some come equipped with a blood pressure measurement cuff. According to one research team, "For the purpose of health care monitoring during daily life, we attempted to devise a non-conscious monitoring system, set up in a lavatory, for the automatic acquisition of body weight, weight of urine and feces, together with ballistocardiogram as an index of cardiac function during relieving nature" (Yamakoshi et al. 1996, p.67). Another toilet is designed to automatically measure other data, such as body fat, and to analyze the urine for glucose levels, iron deficiencies, and other indicators of ill health. However, the chemical analysis is relatively difficult for a non-expert to understand.

While this concept would retain the chemical readings, an application of *BioMorphic Typography* could provide a more abstract but perhaps easier to understand visualization. For example, acidity could be displayed as a color or "fraying," other chemical properties could be depicted by a change in shape. A "fatter" font, would, for instance, indicate that too much fat was consumed. A major obstruction to the pursuit of this idea is that currently, the toilet cannot be exported to Canada or the U.S.

Currently, *BioMorphic Typography* is designed for singular users. It would be fairly easy to construct *BioMorphic Typography* so that it shared among two or more people, as with Thecla Schiphorst's *Whisper[s]* (Schiphorst, Baker, Burgoyne et al. 2005), where at least two users can become aware of each other's heartbeats. Because Schiphorst's training was in Theatre and Dance, she is aware of and works upon the notion that when in a room, dancers who are focused upon a common goal will often unknowingly synchronize their heart rates with each other. This aspect has not yet been developed, but initial plans have been.

To expand the work further, beyond a singular user or a pair of users to an entire city, another application that is under review is to enable users, through the typography, to become aware of the general state of a city's output. That is, instead of directly hooking up users to biofeedback devices, *BioMorphic Typography* would be instead parameterized with a city's sewage processing plant. Many larger American cities have real-time (and sometimes hourly) digital data regarding the city's sewage in order to add the proper amounts of chemical treatment. Its morphing state, the data from the city's treatment plant would be displayed on an electronic billboard of that city. Factors that affect the city's "output" would be discerned, where possible, and also displayed in order for its citizens to become ecologically aware of how their output is influenced by, and influences the important part of the city's ecological state. These include climate, human effluents, soil, and plant groundwater quality, to name a few (Mahmood 2003, pp.55-65). Similar to Tissue Culture, what would probably elicit a visceral response here might be less indirect; that is, instead of "resonating" with an object or artwork directly, the visceral response would be the result of thinking about sewage. Initial research was begun with the City of Atlanta; however, my relocation to Canada has made this opportunity more difficult. Thus, I have begun to make inquires with the City of Vancouver, Surrey and New Westminster in British Columbia. The workers at the city's sewage plants are more accessible to, and appear to support the project more than the workers who represent the city. In this application, the inter-twinement of mind, body and world would be the most literal and direct example of Merleau-Ponty's phenomenology, since the "world" of the city's sewage and its inter-connectedness to people, the weather and so on would be obvious.

Through *Biomorphic Typography,* I set out to explore, in real-time, the relationship between drawn typefaces and the physiological responses of a user's body. In using *BioMorphic Typography,* users oscillate their attention between typing and trying to control or change their physiological states of respiration, GSR or heart rate. In other words, *BioMorphic Typography* is an example of Merleau-Ponty's idea of reversibility. For example, when users are reading what they are typing, they are, in effect, in Merleau-Ponty's term, in a state of "objective existence" (Baldwin 2004, p.247). That is, they are oriented "for others" in seeing how their writing can be understood by others. Similarly, users can attend to the visible representation of their physiological states — the changing shapes of the typography that objectify their inner states. This is a slightly different form of perception, because what is usually in the background of our sensibility are the autonomic senses that the biofeedback device allows to be brought into conscious awareness. They are, ironically, our pre-linguistic, primordial, "brute" or "wild" sense

(Merleau-Ponty 1968, p.13). However, when users reverse their attention by focusing on their interoceptive and visceral senses, by feeling and manipulating them, they "reverse" to "subjective experience" (Baldwin 2004, p.247).

Bringing to the forefront the connections between technologies of writing and a user's conscious sense of their physiological states, I am continuing to address the contemporary concern of bodily estrangement that results from the ever-increasing degree of complexity and sophistication of some communication technologies. Other technologies, such as ubiquitous computing, wearables, and sensing technologies, meanwhile, promise similar self-awareness.

5.14 Summary

I intended, through *Biomorphic Typography,* explore the relationships between drawn typefaces and the physiological responses of a user's body, in real-time. Bringing to the forefront the connections between technologies of writing and a user's physiology, I am continuing to address the contemporary concern of bodily estrangement that results from the ever-increasing degree of complexity and sophistication of some new and emerging communication technologies. Other technologies, such as ubiquitous computing, wearables and sensing technologies, meanwhile, promise similar, self-aware bodily engagement.

Biomorphic Typography represents a very intimate and expressive technology that allows closer scrutiny of a user's own state of mind and body in interaction with technology, thus allowing for a new avenue of aesthetic expression. With attention to the creative nuances of mind embodied in dynamic flesh, *BioMorphic Typography* places the body squarely in the agenda of the implementation and consumption of technologies of expression. They are real-time, and sometimes "felt" representations that are impermanent yet expressive.

By experiencing *BioMorphic Typography,* Merleau-Ponty's idea of reversibility seems to work at several levels. As they type, users become aware of their continually changing physiological states, as measured by a biofeedback device. As users type, they are bringing their ideas outward, to the world, "for others," seeing it at others might. Reversing this, writers also become aware of their physiological states by turning their attention inward; here, they are first-person subjects who are trying to manipulate a change in their inner states. This isn't a one-time phenomenon, but oscillates and arises, according to Merleau-Ponty, from the very way that flesh itself comes into being. As with Merleau-Ponty's oft-repeated example of one hand touching the other, users reported that they could not simultaneously focus inward and outward. Nonetheless, users seem to oscillate between a subjective, or first-person point of view and an objective, third-person point of view, when they can "see" themselves as others might, or when they "read" the changes in typography without feeling a cause-and-effect. This seems to be exemplified when the majority of users demanded more privacy because they did not want others influence them as subjects, or to "see their states" as objects.

On another level, reversibility works with reading and writing too. The subject-user writes words, but then "reverses" to read their words as others will. This is both an individual and a social act, since words are learned and written not only for the self, but to communicate, to intersubjectively "be" with others.

At the lowest level, the morphing of the typeface, made possible via the mediation of the biofeedback device, *as one* writes/types, is an expression of Merleau-Ponty's "the primordial level of language." This primordial aspect, occurring before language refers to, in this case, the autonomic senses of breathing, heart rate and GSR. Users describe being "caught" in "feedback loops." This seems to indicate that these are felt, ontological dimensions of language, dimensions that are usually, as Merleau-Ponty said, the "background" of our being. But these ontological aspects of language, even though language works on a prepersonal, collective level, is brought back into the conscious realm, via the biofeedback device and the ways in which it affects the typeface visually.

Merleau-Ponty argues that language is prepersonal, yet that it issues from our bodies nonetheless. As he puts it, language is a coiling over or an enfolding over of flesh that doubles it. Language, for Merleau-Ponty is of another order than prereflective perception. Nevertheless, *BioMorphic* Typography can bring at least some of its primordial aspects into the conscious realm.

5.15 Computer Code

For an example of the computer code for *BioMorphic Typography,* refer to: www.sfu.ca/~dgromala/code/biomorphic

Chapter Six: The *MeatBook*

The MeatBook is one result of a youth spent in an extremely isolated part of the United States and a thirty-seven year fascination with meat, from decades of photographing roadkill, medical procedures and medical waste, to gutting deer and dissecting whatever the DNR (Department of Natural Resources) could offer. This was not a "rural" place rife with farmland, but simple forested wilderness. Its population is less than one twentieth of was it was in the late 1800s, when workers of the booming the iron and copper mines were as active as the French Canadian priests in attracting Enrico Caruso. Surrounded by a large national forest, two Great Lakes, a decaying Native American reservation and an Air Force base never seen by the public, it is still only a place were one goes to forget or to be forgotten. In the case of the U.S. military, since it is one of the three least populated places in the contiguous states, ultra-low-frequency grid testing and other experiments that no other American population would permit, frequently take place there. In my case, my Eastern Europeans relatives went there to "not be found," ever distrustful after 800 years of foreign rule.

Though I did not live on a farm, it was common practice to befriend those who owned farm animals, though their environs could hardly be described as anything as structurally coherent as a farm. Thus, I often "knew" my future dinners by name and — in the case of beef or pork — watched them grow up. Similarly, shooting and gutting deer was an annual chore, as was making sausages of every description. Duck blood soup and the pickled male sperm sacs of herring, it might be pointed out, are Eastern European delicacies, and so were also amid the more viscerally provocative of chores. There was no distinction between the ongoing intellectual education my father insisted upon, and what we learned from earth-bound phenomena. In addition, watching out for the wildlife and forests was as keenly attended to as was watching out for one's own, perhaps a form of ecology brought over from the "Old Country," or a sense of belonging that preceded the time before factories blackened the south of my relatives' homeland. Thus, criticisms rendered by globally, ecologically and ethically certain scholars, such as Carol Adams' The Pornography of Meat (Adams 2003) *or Michael Pollan's* The Omnivore's Dilemma (Pollan 2006) *seem to suggest that I was either raised in a different country, or in a different century altogether.*

— Diane Gromala: Artist's Contextualization from a First-Person Perspective

6.1 Introduction

The previous works created for this thesis — the *Meditation Chamber* and *BioMorphic Typography* — enabled users to bring into their conscious realm a register or sense of their viscera, almost directly, primarily through the aid of a biofeedback device. The *MeatBook* differs in two ways. First, it focuses on the enteric component of the visceral system and second, it is intended to elicit or provoke a visceral sense, through means unlike the others.

This chapter is an investigation of an artwork I produced – the *MeatBook* – in order to address one of the dimensions of the visceral: the enteric system, or what others commonly refer to as "the gut." Made of meat,[35] this artwork interacts and moves in differing ways—from vibrating to gross motor movements—as a user turns the page. The interactive book appears to breathe, beats as a heart would, and/or quivers when users approach it (refer to the enclosed CD: *MeatBook*). As the *MeatBook* rots over the course of a day — infusing the space in distinct and spatially specific ways — it both progressively loses some functionality *and* becomes more insistent in its programmed movements. What is "read" is not text, but, as an example of Merleau-Ponty's reversibility, an intertwinement of a user's own viscera as subjective experience and objective existence — in interaction with the *MeatBook*.

The chiasmic reversibility that characterizes flesh is operative in the *MeatBook*, in a kind of continual dance between a user's experience of being a subject and, by resonating with the book, an object. This resonance is similar to Walter Benjamin's mimetic sense of becoming and behaving like something else, to determine what is me and not me, though, in Merleau-Ponty's terms, what is and is not me "encroach" upon each other. This phenomena is also related to Sherrington's and Simondon's sense of "resonating" with something or someone else, DePraz's sense of empathy, or in more recent scientific terms, activating one's mirror neurons (refer to Table 2.1 and section 6.6).

The *MeatBook* has been in three exhibits thus far and is scheduled for several more; each provides an opportunity for refinement, further experimentation and observation (refer to Appendix 4).

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[35] After a myriad of tests at the Banff Centre for the Arts residency, beef flank steak from the North American butchery practices was found to be the best choice for its grain and relative longevity. Note that countries butcher cattle in differing ways; these cultural differences are thus reflected in each MeatBook created for exhibition outside of North America. Pork, lamb and fish were also tested.

6.2 Initial, First-Person Descriptions of User Experiences: Version One

Most users laugh unexpectedly when they first see the *MeatBook.* As Walter Benjamin reminds us, laughter "opens up the body," in a way that enables us to change our habitual comportment toward something unexpected, like an interactive book made of meat. In discussing Benjamin's essay on Surrealism,[36] Michael Taussig states, "Here he finds revolutionary potential in the way that laughter can open up the body, both individual and collective . . ." (Taussig 1993, p.23). Taussig posits another dimension of laughter: "But there is also the possibility that this sudden laugh from nowhere registers a tremor in cultural identity, and not only in identity but in the security of Being itself. This is like Bataille's laugh; a sensuous explosion of smooth muscle composing Being in the same instant as it extinguishes it" (ibid.). A tremor is an apt metaphor, for when most users first see the *MeatBook* and laugh, their physical and affective responses are obvious: they throw their heads back, turn their bodies sideways, cup their hands to their mouths, and/or shudder with laughter in big or small ways; but intermittently, they also walk closer and crane their necks to see the artwork in closer proximity, even as they turn away for a moment—not unlike a cat with a novel prey or a child with an unfamiliar toy.

Once the meat of the *MeatBook* is recognized, the fact that it is undeniably shaped into the form of a book seems to elicit both amusement and befuddlement. Users, for instance, had no hesitation in asking why it was a book, and why it didn't have words. From an artistic intention, what the reader could and hopefully should read is their visceral responses to the odd combination of meat and book. Some users articulated an awareness of what the books of yore were made of: animal skins, cat gut bindings, ink from squid and glue from boiled animal (especially horse) parts, to name a few. Most users, however, did not seem to be aware of this history, and joked that if we had a barbecue, we could literally "eat none of the words."
A few users did hang around, shyly asking if it was my intent to comment on the knowledge contained in and transmitted by books. I responded, yes, to an extent, but that this exhibit wasn't meant to be "a comment," like something one would trade over a cup of coffee. Rather, it was meant to *elicit* a visceral response, to *embody* rather than comment on knowledge passed down through books rather than through orally, or through bodily practices.

In addition, many users who first touched the *MeatBook* did so with obvious physical trepidation, interspersed sometimes with glee. These "tremors" seemed to be physical enactions of "opening up the body" to a novel experience, and in some ways paralleled the initial

[36] Benjamin, W 1978, "Surrealism: The Last Snapshot of the European Intelligentsia," In *Reflections,* ed. Peter Demetz, trans. E. Jephcott. New York: Harcourt Brace Jovanovich. pp. 177-92.

quivering movements that the *MeatBook* made. As users settled in to interact with the *MeatBook,* their comportment did seem to change into one of focused and concentrated testing — as if they were putting their toes into water to check its temperature for the first time — and gently prodded the meat to see how it responded. This was interspersed with something of a gentle familiarity, as users' comportments were steadier in one place as they recalibrated their movements to more carefully caress or turn the pages of the book. Far fewer users displayed disgust as had been initially expected. Most users chose to wear the rubber gloves provided, while a small percentage just touched the raw meat, at least before it became rank. These were the most common reactions and interactions with the *MeatBook.* In the extreme, a small proportion of users just shrugged, unaffected by meat, while another small number passed it by in disgust. The possible and discernable reasons for these reactions are discussed in section 6.10: Findings.

The objection to the *MeatBook* by those who follow Adams' writings (section 3.3) is a curious one indeed. My use of meat is minimal — so minimal that it wouldn't even register in grocery store sales. Of course, that is not the point. The point is about the processes of objectification of meat and of women. To reconfigure meat into a book that people caress, to make it interactive, to imbue it with movement, is a reminder, I argue, of death and of being alive. Further, by problematizing the distinction between it being both animatedly alive but certainly dead, throws a productive wrench into a complex argument that turns too easy in the hands of those who do not delve into its depths. An irony is at work here — a book, a long lasting repository of knowledge, has no words, and is as short-lived as one can stand from its smell (it has not yet been exhibited long enough to attract blowflies and maggots). Made of meat, pork uteri and tripe — viscera itself — it reminds those who are aware of the history of bookmaking that knowledge was once inscribed using dead animals, at least in some parts of the world. In addition, like communications that preceded books — tablets, papyri and other systems of leaving marks — this book, unlike others, requires a presence of "readers" that is as short lived as orally exchanging stories over a fire. The "knowledge" is not contained within the book in traditional terms; rather, the book only provokes, for some, a reader's sense of their own viscera, itself surrounded by other forms of viscera: the beautiful texture of honeycombed tripe. This is not a book that belongs to a library, but to a group of people who will likely never see it again, whose bodily sense or knowledge is carried within them, in a form of knowledge that exceeds textualization. Further, this *MeatBook* could hardly be easily commodified. Its point, following Merleau-Ponty's, is that through the symbolic marker of language (a book), we can return to the "Brute" and primordial aspects of ourselves. As Merleau-Ponty remarked,

> "[M]y body is not only an object among all objects, . . . but an object which is sensitive to all the rest, which reverberates to all sounds, vibrates to all colors, and provides words with their primordial significance through the way in which it receives them" (Merleau-Ponty 1989, p.236-237).

The way in which we "receive" the *MeatBook* is explored in greater detail later in this chapter, in section 6.6.

6.3 Ethics

Two of the most frequent questions that arose during the testing and exhibitions of the *MeatBook* were that of ethics and a "waste of food." Since the ethical question was so common in all of the exhibits, it merits exploration. Though Merleau-Ponty never developed a comprehensive discussion of ethics, "his body-centered epistemology points to an approach to ethics," according to Maurice Hamington (Hamington 2004, p.46). As Merleau-Ponty suggests, if our bodies are the "general medium for having a world . . . then the body must be our medium for having morality as well" (ibid.). In Merleau-Ponty's words, "The things — here, there, now, then — are no longer in themselves in their own place, in their own time; they exist only at the end of those rays of spatiality and temporality emitted in the secrecy of my flesh" (Merleau-Ponty 1968, p.114). Hamington makes a strong case for the way our "embodied habits of being" and our imagination, according to Merleau-Ponty, are the ground for embodied ethical considerations.

While I can relate to and respect Carol Adams' *The Pornography of Meat* (Adams 2003) now that I am fully urbanized, my experiences in childhood and young adulthood seem terribly distant from or are on the unclaimed margins of her argument. This is not just the exclusion of one person, but an issue that merits the cultural, gendered, economic and geopolitical considerations that are at the basis of her position as a cultural critic. To some degree, her work transcends some important boundaries, especially in the way global capitalism works, though she comes from a very North American and European point of view. She excludes, for instance, people who do not live in urban centers and communities that are termed by unrelated entities as living at a "subsistence level," either inside or outside of cities. These communities, I would guess from experience, would render some of her claims beside the point. She compares the ways in which the invisible processes that led to the objectification of and violence to women (beginning in the 1800s), are closely intertwined with those that led to objectifying meat in ways that make its everyday consumption palatable. What is forgotten are, as she defines them, the patriarchal, inhumane ways in which the animals are brutally raised, butchered and processed as any other commodity. The power of her argument lies in the fact that these commodities — animals and women — are alive, and the processes are still at work.

While Upton Sinclair's *The Jungle* (Sinclair 2004) did affect on some of the ways in which American factories processed food a century ago, his critique and revelation was very focused. Adams' work, however, is extensive, referring back to practices that are over one hundred years old. While she has enjoyed a following for the past 20 years, one wonders if she and her followers can have any effect on the forms of global capital that rely on meat. One also wonders about some of her followers, such as the ones who attend interactive art exhibits and vehemently decry the "casual" use of meat, not knowing the slightest about my background or intention. This is not uncommon for a group of any considerable size. For it is here that Merleau-Ponty's observations speak perhaps louder than a knee-jerk reaction to displaying meat at all. Most of the users touch and caress the *MeatBook, as if* it were an animal, or as if it bore sentience. For some users who returned later in the day "to see how it was doing," their touch was gentler still, *as if* the book was dying. Thus, the kind of attunement to the *MeatBook,* users' physical comportment of care (Hamington 2004) shown to the meat object of an art exhibit would seem to be in line with Adams' desired results, as was expected. Nonetheless, a few strident voices decried the use of meat on any terms.

An ecological work, *The Omnivore's Dilemma* (Pollan 2006), is a related polemic about raising food — in this instance, corn — on a global, industrial level, along with all the attendant processes (economic, geographical, chemical, biological). Pollan makes an even stronger argument in my opinion, because its far-reaching and current horrors seem unstoppable, and the empathy toward corn results in unexpectedly strong reactions despite the lack of horrifying images.

But these are writers. Artists working a bit before Carol Adams wrote her book — usually feminist artists — at times made similar statements; others, like Carolee Schneeman's *Meat Joy* (Schneeman 1964), made the issue arguably more dense and paradoxical as the "joy" of her title implies.

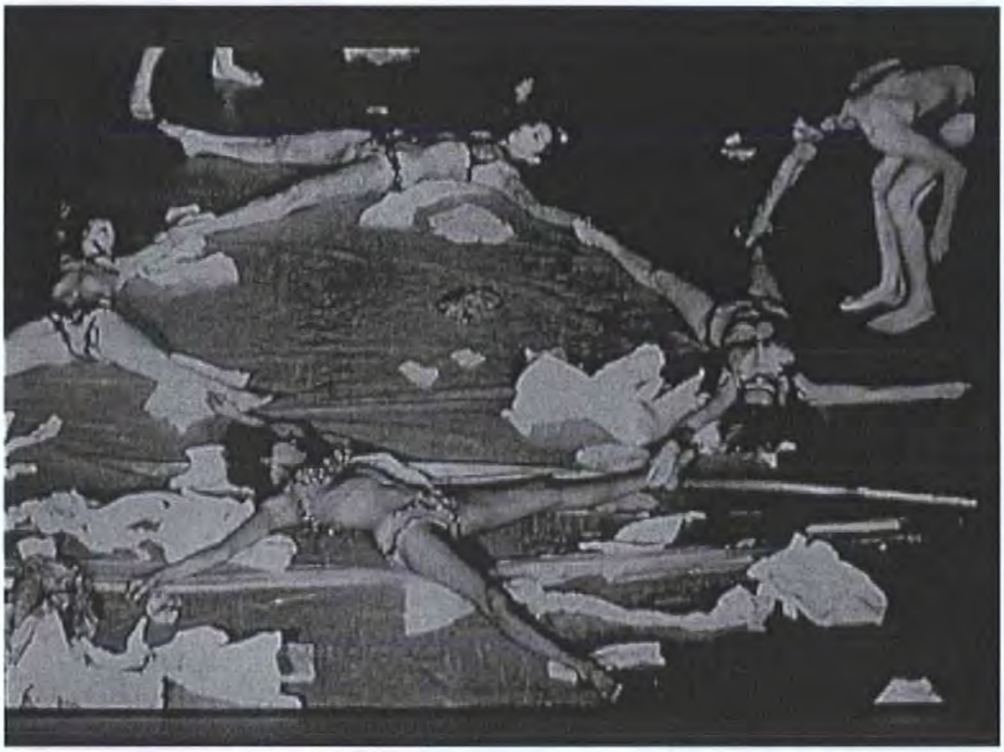

Figure 6.1 Carolee Schneemann, *Meat Joy,* 1964. Performance. Medium: Raw fish, chicken, sausages, wet paint, transparent plastic, rope, shredded scrap paper. First Festival of Free Expression, American Center, Paris.

On the other hand, Canadian artist Jana Sterbak's *Flesh Dress* enacts Adam's point in a more immediate and definitely visceral way, though I cannot keep thinking that her point would be stronger if others (and not just Sterbak) were able to wear the dress. Because Sterbak's *Flesh Dress* is a material instantiation of Adams' work, the use of meat, in this context, seems appropriate for Adams' followers. This is because by wearing the *Flesh Dress,* Sterbak exemplifies Adams' point about how the same processes that make meat a palatable commodity are the same by which women are commodified. If anything, Sterbak's *Flesh Dress* is a non-textual instantiation of Adams' point. For this borders on a commodification of a young, attractive woman, however abject are her clothes or her artistic intention. Would the *Flesh Dress* work if it was worn by a 60 year-old, overweight woman? A surgeon? A butcher? The readings, in those cases, of the *Flesh Dress* would render altogether different meanings. As Merleau-Ponty was quick to cite over and over again, perception, meaning and experience change from context to context. A context "forms a constellation . . . " of differences between things (Merleau-Ponty 2004, p.250).

Figure 6.2 Jana Sterbak, *Vanitas: Flesh Dress For An Albino Anorectic,* 1987. Installation. Medium: beef and thread. Exhibited, National Gallery of Canada, Ottawa. Note that for the most part, understandably, the dress was hung on a dressmaker's form and was note usually worn. Again, this change of context colors the meaning of the *Flesh Dress.*

6.4 Prior Art

Prior art which relates to and which preceded the *MeatBook* includes primarily non-interactive art. Survival Research Labs' "re-animation" of a dead rabbit (Rabot) on metal armatures (Survival Research Labs 1982), for example, appeared to elicit a visceral sense among the audience, perhaps because like the *MeatBook,* it was animated: seemingly both dead *and* insistently alive. Stelarc's *Extra Ear* (Stelarc 1998) is "cultured tissue" that he is trying to implant onto his arm. This work seems rather to elicit a sense of the abject, especially because it quite literally disturbs our body schema. Merleau-Ponty defined the body schema as,

> "This basic experience of the body developed into habits of perception and action, exposing a person to new ways of relating to his environment. Even within this very basic structure of existence, a virtual dimension of possibility is found in the form of a virtual body, a body that a person can imagine assuming and from which he can view the world from a different perspective" (Steeves 2004, pp.6-7).

For viewers to feel a disturbance of their body schemas would mean that they are seeing Stelarc's work as subjects, but are also identifying with the Third Ear and/or Stelarc's arm as objects, or as others might see them. That is, the elicited a sense of the abject or of the visceral is another example of Merleau-Ponty's reversibility thesis.

There is a difference, however, in how viewers see Stelarc's third ear, one that may involve all of the works cited in this chapter. That is, it is one thing to witness Stelarc in person, at a conference or gallery with his ear, and quite another to see it on videotape. The videotaped version is safe: one cannot smell the ear, wafting of its bio-helping agents, and one cannot infect it or be infected by it, if that were possible. Thus, seeing it in video forms appears to render Stelarc and his extra ear more viscerally provocative than horrifying. Meanwhile, Wim Delvoye's *Cloaca* (Delvoye 2004) is a machine of sorts that parallels our enteric system. Food goes in, gets processed, and is expelled out as excrement. It seems to fascinate rather than to repel most viewers, and its mechanic basis, comprised mostly of motors, transparent tubes and glass where possible, appears to make it more "safe" than if it were created out of a real cow's enteric system that one could buy in specialty grocery stores. It is unclear, however, if this "recognition" of our own bodily processes evokes a visceral sense in its viewers, who seem to rather be caught up in the "magic" of a natural but otherwise invisible process.

John Slepian's *Little One* (Slepian 2005) is a computer graphic of something that resembles a tumor or a fetus who has developed in ways that have distinctly gone wrong. The computer graphic appears in a crib, the monitor wrapped as if in swaddling clothes. It, at first glance, seems viscerally repulsive, but simultaneously cute and humorous nonetheless. The sound — of recorded baby gurgles — seem only to render it more funny, for how can this monstrous humanoid elicit any sense of a physical ethics of care, except for its infant-like sounds and its movements? Nevertheless, some users do stand around the crib with nurturing postures.

Damien Hirst's shark (*The Physical Impossibility of Death in the Mind of Someone Living)* (Hirst 1992) and David Falconer's *Vermin Death Star* (Falconer 2000) apparently created quite a stir when they were first exhibited. By the time I saw them, however, they were artworks like any others. Arguably, these works were in the realm of the abject: the rats seemed horrifying enough, but at the same time, they were safely encased in a thick, transparent, hard plastic-like substance. What seemed horrifying was that one could stop to really *look* at the rats, instead of catching a view of them scuttling away. Some viewers clearly claimed that Hirst's shark elicited more of a visceral sense; "it can't hurt you in any way" said a viewer standing next to me, "but it is really . . . dunno . . . *big.* I can't help from feeling a threat even though I know it is dead . . . hell, it was even in a movie, yeah? But still, it is *big.* And I know it would eat me if given a chance." The most interesting artworks in this realm, in my opinion, were those that problematized the distinctions between being a representation and those that were the things-themselves. Hirst's and Falconer's work fall somewhere in-between: embedded in a plastic-like substance, no concern for bodily harm, escape, disease, or offensive odor was left. Yet what is notable about Hirst's shark is that the insides and outsides are simultaneously visible, as if it were a different instantiation of the *Visible Human — a* different species, thicker slices, but inescapably reminiscent all the same. The difference from the *Visible Human* was important, as the larger-than-human scale of Hirst's shark would make a perceptual difference. At the time I saw the exhibit, users could not walk through or near the slices of shark, but if or when would have, it could well have elicited a full-body, visceral sense.

Other artists employ meat in a variety of ways, from *Chantal's Embroidered Ham* (Fresh Cream 2000, pp.220-222); a parquet flooring made of cold cuts *(Marble Floor No. 30,* 1998) (ibid.); and Mosaic 90-324-BLO (ibid.), which are printed ceramic tiles that appear to have feces one them. The meat and pictured excrement are used here in a decorative fashion that overtakes any possibilities of a visceral response, in my opinion.

6.5 Meat, not Cultured Tissue

The *MeatBook* is often compared to the works of Tissue Culture (Oron Catts, et al. 2002, pp. 365-370). The differences though are extensive, from concept and intent to process and consumption. "Tissue Culture" refers to a group of artists who grow "tissue" or groups of cells, seemingly made as if from scratch. The tissue though has an origin, visible or not; if animal cells are grown, the originary (and usually stem) cells came from an animal. However, the same issues are and are not at play with the *MeatBook.* It is possible, but not a standard practice, to get these originary "meat" cells without killing the animal. But first-hand knowledge of how the process was created (by frequenting the NeuroEngineering Lab[37] during my time at Georgia Tech) certainly does involve killing animals, primarily cats. Such images, let alone the technological wires that hang out of the living cats, certainly produce a strong sense of the abject. If this process was known, the artistic works resulting from using this new technology, tissue-grown "BioArt," would then seem to elicit either a visceral or abject sense. Most often, however, strangely it does not. It seems to raise a visceral response of a different sort – one that is not immediate, but which comes after *reflecting* about the piece, not by directly observing it. In addition, these works and the pseudo-biological exhibits and performances of Bioteknica display a sense of a scientific, biological laboratory that also colors users experiences. In the words of Eugene Thacker in *BioMedia,* "Indeed our very cultural associations with biology evoke its material, even visceral basis: dissections, lab rats, microscopes, digestion, disease, reproduction, and decay . . . for biology has arguably always been enamored of the 'stuff' of biological life" (Thacker 2006, p.9).

[37] Dr. Steve Potter, who worked with Catts in the early days, is the Director of this lab.

Again, the experience of some of these works are examples of Merleau-Ponty's reversibility. First, the cells are grown on mesh substrates and are difficult to keep alive. Thus, as clumps of cells, they do not get very large. Second, undifferentiated from other types of cells, colors or textures, they are difficult to perceive as anything different from gelatinous food. Probably since the scale is also and necessarily small, it lacks a definite smell or any sense of an animistic threat. And finally, the time it takes the cells to grow is beyond direct human visual perception. The Frankenstein-like aspect is emphasized by the kind of tissue involved in the artworks and their titles. For example, *Pig Wings* (refer to Figs. 3.4 and 3.5), pork cells grow on a substrate mesh that looks like bat wings. Though a humorous take on a well-known adage, there was still something creepy about it. In addition, Stelarc's cultured *Third Ear* evokes a sense of the abject when one considers that he plans to implant it on his arm; thus disturbing one's sense of bodily boundaries. This can be viewed as *reversibility* of a user because in order for bodily boundaries (or schemas, in Merleau-Ponty's terms) to be disturbed, one must necessarily be aware of one's body as a subject, and be aware of the disturbance by (inadvertently) resonating with the artwork as an object — a constant reversing of experiencing me-as-subject and me-as-object.

6.6 Merleau-Ponty's Reversibility: A Befuddlement

The "thingness" of the *MeatBook* seems to befuddle animate/inanimate, organic/inorganic, and live/dead distinctions. If the user actually turns the pages (with or without the available rubber gloves), the book "behaves" (mechanically and sonically). The deterioration or rotting of the meat is a component of the book; as the meat rots (variability in *how* it rots depends on temperature, humidity, and how fresh the meat was when it was obtained), the armatures become more mechanically insistent, as does the sound. How the technical components eventually breakdown is still under scrutiny, and has always been part of the piece. This is because it adds a dimension of indeterminacy — though we try to control the electronic components with how the meat rots, there is no telling when the changing chemical (de)composition from the meat will dissolve our electronics encasement and cause the components to behave erratically, or to stop moving altogether, though they lasted to the end of every exhibit so far. Thus, with each *MeatBook* that is created daily, few electronic components can be retrieved and used again. This is also affected by the fact that with each *MeatBook* made for that day, it had to remain frozen until set up time. Some of the electronic components, therefore, were frozen in the meat. So far, this has not resulted in any damage.

I intended the *MeatBook*, of all of the artworks, it to be the most literal, though poetic, incorporation and material instantiation of a user's experience of the continuum of the *visceral*

register to a *visceral sense.* To reiterate, unlike the other two artworks, no biofeedback device was involved to help users understand their changing physiological states.
How then did users have or take note of a visceral reaction at all? My hypothesis is that the aspects of "resonance, empathy and mirror neurons" (refer to Table 2.1) were at work, along with the fact that we recognized that meat — that which is usually internal and invisible, in terms of our bodies — as decontextualized. This incites a basic reflex or instinct of "is it friend or foe?" Further, its quality of being technically animated partially sustains the friend-or-foe reaction, until the reflective understanding of it as meat and as a book was understood. The scale and placement on a podium or exhibition plinth made it clear that the meat served no threat, unless the threat was one of some infectious disease. The recontextualization of meat outside of a grocery store or restaurant seemed to attract users first; other aspects, such as its quality if interactivity, served to maintain interest among at least among most users.

Upon first seeing the *MeatBook,* users have no doubt that the meat is both real and "dead." This becomes more obvious over time, as the meat turns gray, and paradoxically becomes more insistent in its movement over time. As the *MeatBook* rots, it physically — through movement — becomes mechanically more "alive," or more insistent in its movement and responses, as if it were struggling to survive. The intentions for the interactivity, from the *MeatBook's* initial recoiling from users, movement toward the user (accompanied by sniffing sounds), the aggressive movements provoked by aggressive users, to its death throes appeared to be interpreted by users very closely. Very few users interpreted the movements in distinctly other ways, though my presence at the exhibit could have skewed what the users were willing to say. Nonetheless, when I left the *MeatBook* in the hands of attendants, the comments did not appear to change significantly. In addition, when I was there, I made a point of not explaining my intentions in order to be open to their interpretations.

In first engaging with the *MeatBook,* many users saw, understood, and touched it from a first-person, subjective perspective. They were subjective users, and the *MeatBook* was an object that they are touched. Many users, as they tried to figure out how their movements affected those of the *MeatBook's,* appeared to try to mimic it. Like Benjamin's mimetic faculty, users moved and behaved as if they were trying to figure out what the *MeatBook* was and how it moved; in other words, they were trying to determine the limits of what was me and not me, intertwined as they were with the book. Though Benjamin's notion of a mimetic faculty and Merleau-Ponty's concept of reversibility may seem related, they assumptions under which both theorists worked, in philosophical terms, were very different. Merleau-Ponty argued that the body is the basis and "ontogenesis" for all pre-reflective and reflective understanding. Benjamin, more so than his

Neo-Marxist colleagues, privileged the body in many ways, but did not understand it to be the very *basis* of perception and meaning in every way. Further, Benjamin attributed some deterministic qualities to the then-new technologies he was examining, while Merleau-Ponty understood technology to be part of the world and part of the human. To put it contemporary terms, for Merleau-Ponty, the mind, body and world intertwine in differing ways, ways in part determined by the "affordances" of the technology, the state of mind, and the characteristics and needs of the body. Context, in other words, made all the difference.

To return to Merleau-Ponty, these users were enacting *reversibility* — at times becoming (or at least moving like) the *MeatBook,* and at other times, being their "subjective" selves. As the book rots and its movements become more insistent, users crossed over again to perceive the book as dead, rotting meat. Over the course of the day in all of the exhibits, a few users returned often, and said, at the end of the day, that they were "sad" that it was "alone and dying" in such a "horrible way." A few users made mention of the slaughterhouse from which the meat came, and spoke of it as if we were "doubling" "its" suffering. When asked if they thought that meat "suffers" when we eat it, they just said, "no, of course not." One of this group of users, a vegetarian, said "of course — it isn't just the animal that suffers all caged up like that, and then frightened and killed, but the *cells* that are in the meat don't 'just die' immediately. Some cells," the user said, "live on for quite some time." I happened, at that exhibit in Vancouver, to have with me a book made of a viscous silicone — it was the book we practiced sewing on and implanting electronic components in. When I showed her our "vegetarian version," she replied, "nice, but it misses the point completely. I guess you *do* have to use meat."

Affect

Users at the *MeatBook* exhibit, more than at the *Meditation Chamber* or the *BioMorphic Typography* exhibits clearly demonstrated emotions. Some were gleeful, purportedly at the paradoxical novelty; a few were indifferent; some seemed confused in a way that was affective and some grew "sad." Merleau-Ponty accounts for this in his reversibility thesis because he applied it even to "perceptions of inanimate objects" (Merleau-Ponty 1993, pp.121). In addition, "An advantage of Merleau-Ponty's philosophical approach to perception is that perceptions and emotions can be thought as together, as co-presently implicated" (Evans and Lawlor 2000, p.189). Further, ". . . We may regard our emotional apprehensions *as* ways *of being touched,* of being affected, by some perceptible object or other" (Evans and Lawlor 2000, p.191).

Merleau-Ponty's reversibility thesis, in the case of the *MeatBook,* I argue is somewhat (lopsided) when the object we are touching or seeing is dead. Hamington explains this as well, when she touches a dead relative. "Apart from this strange sensation, another sort of crossover takes place when we encounter dead flesh 'in the flesh.' Although we may momentarily identify with it, we do not remain for long" (Hamington 2004, p.193). Grasping the hand of her relative to say goodbye, Hamington continues, "My touching reverses to a sense of being touched, of being 'cut off' — by the Hand of Death, which momentarily has *me* in *its* grasp. The sidedness of the perception is confused, crossed over, so that, absorbed in the horror of this 'griping' experience, one no longer knows who is perceiving and who is being perceived" (ibid.). An experience with a dead human, of course, is different from one with an animated book made of meat. One way the *MeatBook* differs is that it moves *as if* it were somewhat alive. And its movements are not just movements, but were responsive to the users' movements. Thus, while users *know* it is dead, they nevertheless *act*, to some degree, *as if* it is living. This was observed by the users' physical reactions and what they told their friends, for few users touched the *MeatBook* unaccompanied. The vast majority of users, much to my surprise, touched the *MeatBook* gently, prodding it gently and carefully, sometimes laying their hand over the whole of it to feel it all at once. I rather expected at least some of the users to poke at it and perhaps break it in order to see what its limits were. This only occurred once. The gentleness of touch was especially keen when the *MeatBook* appeared to be breathing. Pages were turned with a hesitation, not because users expected a "surprise" as they told us, but "because . . ." of something they could not articulate. One young teenage girl said to her mother that "it feels like when (name withheld) was pregnant and I could feel the baby's elbow — I think it was an elbow. But this is just weird." The reversibility and commingling of user with *MeatBook* was usually short-lived. Users stayed for a few minutes until they thought they had experienced all that the *MeatBook* had to offer. Though the younger users seemed more "creeped out" by the *MeatBook,* this may have been telling of Hamington's observation of an "incompleteness in our 'interstitial commingling (or breach of boundary) a categorical distinction between the living and the dead" (Hamington 2004, p.193). Or, the interactions were simply limited.

The aspect of rotting was neither as slow as I had imagined, nor as complete, for the meat did not turn gray or smell in any neat way that I could anticipate with any accuracy. Nevertheless, when the meat started to turn grey and smell (the odor came much quicker when the exhibit is inside rather than outside), the users' relationship to it was "obviously and definitively altered" (Hamington 2004, p.196). Apart from the few users who came by from time to time, other users who visited earlier in the day seemed not to care to observe what happened, but did want to know "if it smelled yet."

6.7 Resonance or Mirror Neurons at Work?

As Bruno Wicker et al. makes clear in their research with fMRIs, seeing someone who displays disgust incites the same areas of the brain (the so-called mirror neurons) as feeling disgust itself (Wicker et al. 2003, p. 1). Their results indicate "that, for disgust, there is a common substrate for feeling an emotion and perceiving the same emotion in others" (ibid.). Though mirror neurons seem to indicate that observed actions create a sort of simulation in observers, some scientists offer a counter-hypothesis. One of these is that the role of mirror neurons "are involved in the prediction or anticipation of subsequent — rather than in the simulation of concurrent — actions of the observed individual" (Csibra 2005, p.6).

While the art and (especially) science of this type of work may incite PETA members, it is interesting that similar cultured tissue work at MIT does not. Biologist Susan Lindquist heads a project that uses yeast cells as "living test tubes" in the study of Parkinson's disease (Cooper, Gitler, Cashikar et al. 2006, pp.324-328). Unlike neuroengineer Steve Potter from Georgia Tech who originally helped the artists who developed "Tissue Culture" projects, Lindquist does not have any art projects associated with her work. Neither plant nor animal, yeast blurs the question of exactly what ethical questions one can or should be raised. After all, as Lindquist points out at the beginning of each of her talks, yeast surrounds us, is in the air, and has been put to human use for thousands of years. For Lindquist, there are no ethical concerns whatsoever, even though she is genetically modifying such a ubiquitous form – yeast. Further, no mention of enslavement arises, especially because the scientist refers to bread and beer, as if they were longstanding human rights. However, if the size of yeast were on a human scale, would this purported lack of ethical problems hold? It would be difficult to discuss Merleau-Ponty's ethical bodily attunements and comportments to a living entity that is on a microscopic scale. Finally, in the West, the conditions of raising and killing animals for food consumption is well understood — yet it is ok to raise plants in barbarous conditions, and to kill and eat them. While this appears obvious, it is not so in certain cultures that are still alive and well in India.[38]

While Carol Adams reminds us or reveals to us that certain qualities of processes have long historical roots, and capitalizes on the abject images of tortured animals and objectified women, hers is not a phenomenological study, important as it may be. The job of a critical theorist is to identify what some of our silent assumptions are and where they may come from; fewer warn us about the future.[39] While DNA splicing or "playing" around with growing meat in Tissue

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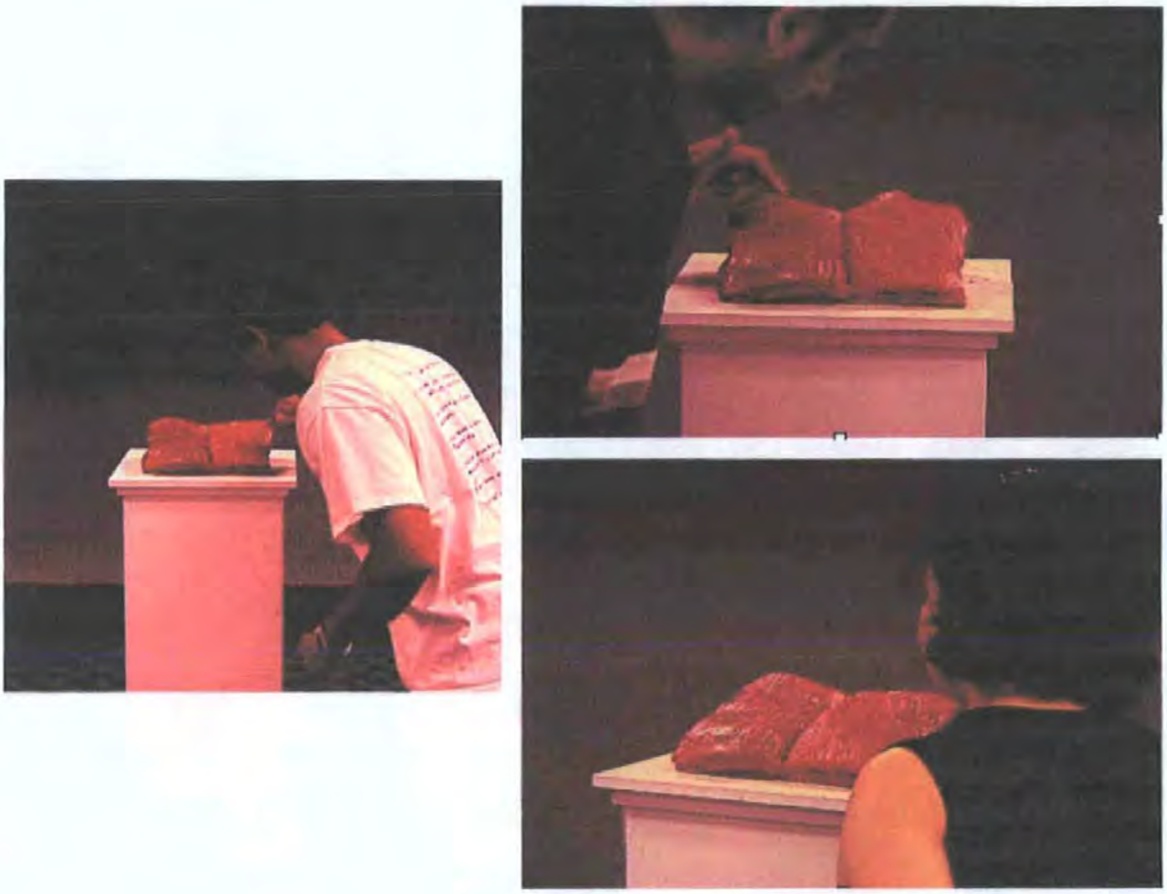
[38] For example, the Jains.
[39] Those concerned with BioMedia are notable exceptions.

Culture may provoke concerns about an uncontrollable future, the MeatBook does not. The *MeatBook's* only criticism has been as a waste of "good food" and for using meat at all.

Yet the smell and rot and Frankensteinian threads were left by the *MeatBook* to remind us just how fast it – and by extension, we – decay. As the meat rots, the interactions become more insistent, while a couple of interactions "die" out altogether. As the meat progressively turns gray over the course of a day, users stop laughing, and are more reticent to touch the once-bloody piece of meat. The reminder of sickness (the insistent smell of meat gone bad) and incipient death seems to get a little too close for comfort. Our visceral register, or more developed visceral sense is one that we would probably want to disengage with at the end of a day.

6.8 The *MeatBook:* Instrumentation: Version One



Figures 6.3, 6.4, 6.5. The first iteration of the *MeatBook*. Users shown interacting with the *MeatBook*: Left, Shridhar Reddy; top right, Chetan Mistry; bottom right, Nassim Jafariniami. Refer to www.sfu.ca/~dgromala/thesis and the enclosed CDROM: *MeatBook* for this and other related videos.

The first iteration of the *MeatBook* was made of four, two-sided "pages" of flank steak, sewn together with clear surgical thread. This version was embedded with a piezo-electric sensor and small, robotic-like armatures. It was positioned on a bookstand that had a hole cut out of its center, which the *MeatBook* covered. Servo and stepper motors slowly and gently pushed up through the hole from under the *MeatBook,* making the *MeatBook* appear as if it was breathing. As users approach the bookstand, 12"-18" proximity sensors embedded in the book stand's outer rim triggered intermittent "quivering" of the armature, as if the *MeatBook* was aware of the user and registered fear. As users moved closer, they "broke" the light hitting the photo-electric sensors, also embedded in the bookstand. This triggered more "aggressive" movements toward the user.

As the user, who generally puts on the provided surgical gloves, turned a page, the robotic armatures wriggled more insistently, as if the book was deriving pleasure. However, a Theremin and recorded but indistinct feral sounds emitted from the bookstand. The sounds changed according to proximity of the user, the pace of his or her movements, and the number of other users. At this point, depending on the time of day, indistinct odors emitted from the meat, which grew more intense over the course of the day. As its pages were turned, the book recoiled and emanated feral sounds.

At the dawn of each new day of exhibition, a new, frozen, pre-sewn *MeatBook* was connected to the technological components. The earlier in the day, the more fresh is the meat and its blood.

Instrumentation: MeatBook Version One

Software: C

Hardware: robotic armatures, actuators, micropositioners (servo & stepper motors)

Hall effect & piezo sensors (the Hall effect sensors were difficult to work with, especially considering the nearby Theremin, so they were eventually abandoned)

Theremin, speakers, electronics encasement material (home brew)

Materials: MeatBook Version One

Beef flank steak

Surgical thread

Podium/exhibit stand

Plastic

Sponges

Figure 6.6. A photograph of interim testing of the *MeatBook*.

6.9 The *MeatBook:* Instrumentation: Version Two

The robotic armatures of the first iteration were proprietary and thus had to be abandoned when I moved to Canada. Thus, muscle wire and vibro-tactile motors replaced the movements of the meat after much experimentation. This evolution was desirable because the movements are now both more animal-like and robotic-like, depending on a user's interaction.

Figure 6.7. The second iteration of the *MeatBook.*

Instrumentation: Version Two

Software: Processing

Hardware: muscle wire, actuators, micropositioners (servo & stepper motors)

Piezo and Photo cell sensors

Materials

Beef (flank steak)

Pork Uteri (binding)

Honeycomb Tripe (that the *MeatBook lies upon)*

Theremin, speakers

Electronics encasement substance (home brew)

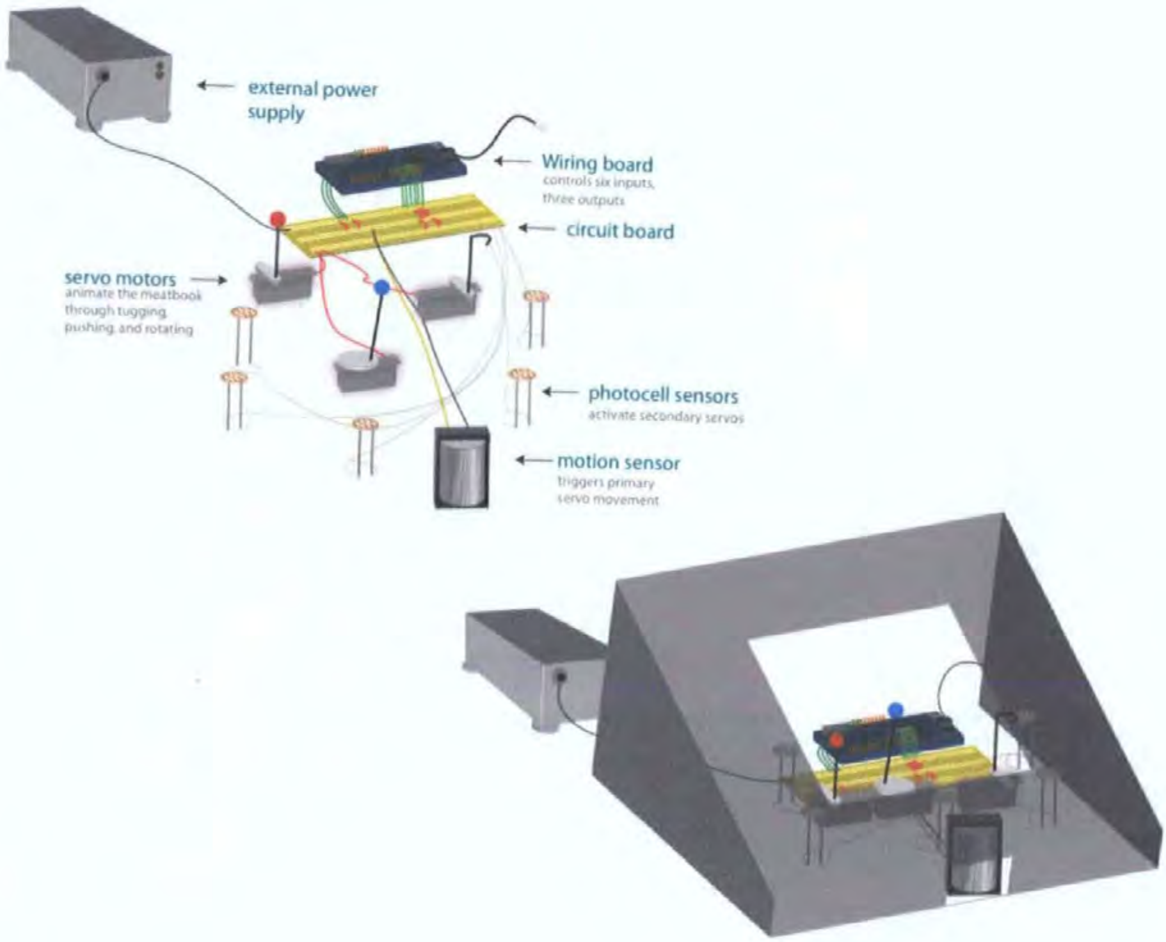


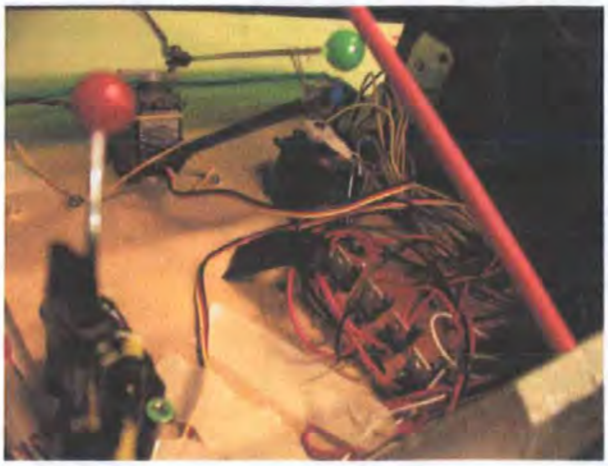
Figure 6.8 Diagram of the technological components of the second iteration of the *MeatBook*.
Illus: Jayme Cochrane.

The electro-mechanical system that drove the interactive components of the *MeatBook* is enclosed within the podium upon which the *MeatBook* sits. The fully assembled *MeatBook* is placed on this podium within a rectangular area designated by wooden slats. The surface between the slats has been removed and the hole covered with a thin plastic sheet that protects the electronics from contamination while it simultaneously provided a flexible surface that permits manipulation of the meat from below. This sheet allows rods attached to motors to push through and impact the surface of the meat, generating a variety of visceral gestures.

Figure 6.9, 6.10: Version 2 of the *MeatBook*

Left: the bookstand with covers off.
Right: Mixing silicone for artificial meat used as a stand-in for real meat. The stand-in silicone "book" was helpful during testing bookbinding methods, technical options and debugging.

There are 3 servomotors inside the podium structure which generate the responsive movements. Each motor runs on 5 volts which are provided by a 3 Amp power supply. A Wiring Board™ microcontroller is used to control the sequencing of the motors. The motors function as part of a larger mechanical system; each is designed to generate a unique kind of movement. The first two motors are coupled with wooden dowels that push up on the meat from below. The first motor has a rod that is pushed forward and backwards, creating a pulsating bulge on the meat's surface, reminiscent of a diaphragm expanding and contracting with breath. The second motor's rod is bent on the end at a 90-degree angle, allowing it to quickly rotate in a semi-circular pattern on the meat. This configuration produces a gesture that is commonly perceived as quivering. The third motor is connected to a rotating arm. In addition, a wire runs from the end of the arm through the plastic sheet and attaches to a hook in the underside of the meat. As the motor turns, it pulls down on the meat, producing both a pulsation and a creasing effect that permeates the entirety of the *Meatbook*.



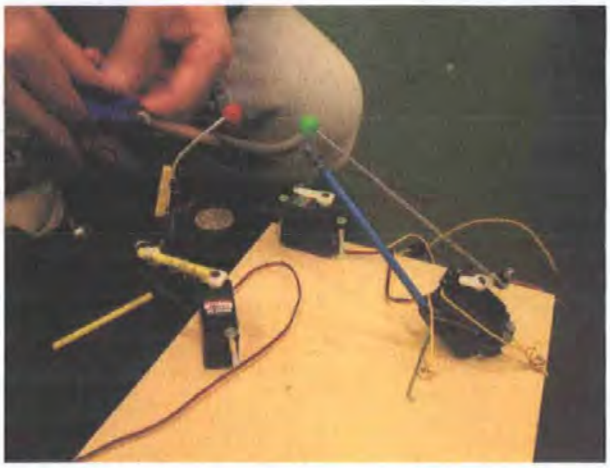


Figure 6.11, 6.12 Version 2 of the *MeatBook*

Left: actuators (green and red balls at the end of armatures) push the meat.
Right: Armatures on their plywood base.

The *MeatBook* interaction is controlled using 5 photo resistors and an IR motion detector. The motion detector has a range of approximately10 feet and is used to detect and lure passers-by. When this sensor is triggered the first motor is activated. The pulsating motion, set to the rhythm of a heartbeat, acts an invitation for people to come and interact with the book. During direct physical interaction with the *Meatbook,* the motion detector is disabled, and the photo resistors act as tracking mechanisms. Each photo resistor is calibrated to trigger the system only if a sufficient amount of light is blocked by the activity of the interactor. A simple, automatic calibration occurs when the system is powered on to adjust to a variety of ambient light levels. This ensures the appropriate level of sensitivity. Using these 5 sensors, the system can determine the approximate location of the interactor's hands. At the early stages of interaction, the system will activate the motor that is closest to the triggered sensors. However, as the duration of the interaction grows longer, the triggering of the individual motors becomes increasingly random. Each motor is also set to run for a preset amount of time before switching off as another motor is activated. Additionally, if multiple sensors are triggered at one time, indicating the likelihood of double-handed interaction, then 2 motors are triggered simultaneously. These rules were designed to prevent a viewer from having a repeat experience on subsequent interactions, to ensure that the interaction is dynamic, and perhaps to indicate that the *MeatBook* itself is simulated with life.

6.10 Findings: Reactions to the *MeatBook:* Version Two

The interactions with the *Meatbook* at the Tangible and Embedded Interactions Conference (TEI '07) were extremely varied, as were the disciplines represented at the conference. The *MeatBook* affords both distant and direct interaction, each which produced different reactions from individual users. The distant interaction, which involved observation of the meat slowly and rhythmically pulsing, tended to invoke visceral responses in viewers, at least as observed by the attendants and graduate students. I call this distant because the exhibitions were set apart by quite a bit of space, and so users were at an approximate distance of 12 feet when they triggered the *MeatBook's* first movements. The level of this response, however, varied considerably. Of those viewers who reacted strongly, some refused to approach the *Meatbook* altogether; most viewers approached tentatively after a brief period of adjustment. Another set of viewers, however, was not at all affected viscerally by the *Meatbook.* Their comments indicated that the *Meatbook* simply resembled uncooked meat which, while out of place at a conference, was not particularly unsettling – despite the movement of the meat. Most viewers, however, fell in-between these two extremes. This middle group seemed viscerally affected by the *Meatbook,* — according to their physical movements and judging by what they said — but was intrigued enough by the movements and the prospect of interaction to move in for a closer look.

The direct interaction was supposed to involve people touching the meat. Unfortunately, because photo resistors were used as the sensing technology, it was possible to activate the system without actually touching the book. This phenomenon was further exacerbated because of the natural lighting an the atrium, which served as the exhibit space. This made it difficult to calibrate the system for optimal performance. Thus, users often discovered that they could elicit reactions from the meat without actually touching it.

In order to encourage users to interact with the *MeatBook* tactilely and directly, we provided surgical gloves for them to wear. Most users took advantage of the availability of these gloves; however, there were three who chose to touch the meat directly with their hands. The users who wore gloves tended to use a single hand and were generally more cautious with their actions. They would lightly stroke the meat, or gently push on the surface. The users who went bare-handed were much more interested in testing the limits of the system. These few users were much more aggressive, using both hands and the weight of their bodies to press on the surface of the book, and had to be intercepted before they damaged the installation. A few users actually laid their hand flat on the book to feel the movement of the motors pushing from beneath. This aspect of the interaction seemed particularly interesting to them, as they "got in sync with its breathing" and thereby created a connection between their own materiality and the materiality of the meat. From their reported subjective standpoint, they "felt" for the rhythm of the "breathing diaphragm," and doubled this perception by "feeling connected to" the *MeatBook*. Reversing their perception, said they felt what the *MeatBook* must have been feeling, with a knowing irony. Obviously, they knew this was a dead piece of flesh, but "went with" its "inescapable" liveness. Although they didn't want to feel that the *MeatBook* was anything but meat and machine, it seemed to coalesce for them into something not quite living and not quite dead, simultaneously. Their reactions seemed to move from a distant to an embodied form of viscerality. According to the two of them, "we weren't just experiencing the meat, we *were* the meat." To re-invoke Merleau-Ponty, these users ere experiencing themselves as subjects, and as objects by so strongly identifying with the meat, which was, for the most part, under their control. Further, in this exhibition, some users commented very strongly that they couldn't figure out where the meat began and where or how their interactions made the *MeatBook* work. Thus, perhaps the programming strategy of cause-and-effect interspersed with a few instances of what was perceived as autonomy by the *MeatBook* was successful.

6.11 Disturbing the Body Schema?

For Merleau-Ponty, the body schema, immediate and affective, acts on two levels: that of the "body at this moment" and of the "customary body" (Merleau-Ponty 1989, p.82). The "body at this moment" is volitional, while the "customary body" is a general mode of being that refers to the "level of tacit abilities which constitute the majority of one's actions, including reaching, grasping, sitting, standing, and walking" (Steeves 2004, p.20) or batting a fly away from our face. This is experienced, for example, when "we spontaneously adjust our posture in a new situation in order to maintain our balance and a sense of control. These experiences seem to occur on a deeper level of experience, beneath the level of consciousness and voluntary action" (ibid.). Merleau-Ponty writes,

> "My organism is a pre-personal clearing to the general form of the world, as an anonymous and general existence, play, beneath my personal life, the part of an inborn complex (Merleau-Ponty 1989, p.84).

The body schema for Merleau-Ponty, unlike some contemporary versions, "is not a conscious image of my body, but a tacit sense of its abilities and of its relation to the world" (Steeves 2004, p.20). Typing, for example, is "the capacity of going beyond created structures in order to create others" (Merleau-Ponty 1963, p.175) not only by developing abstract or complex movements, but also by creating or employing tools and machines to facilitate our goals" (Steeves 2004, p.24).

The body schema is usually experienced, akin to the viscera, as a kind of "absence in the form of a background for a person's activities" (Steeves 2004, p.24). As Merleau-Ponty described it:

> "If I stand in front of my desk and lean on it with both hands, only my hands are stressed and the whole of my body trails behind them like the tail of a comet. It is not that I am unaware of the whereabouts of my shoulders or back, but these are simply swallowed up on the position of my hands, and my whole posture can be read so to speak in the pressure they exert on the table" (Merleau-Ponty , pp.100).

I would argue that at least for the users who were most engaged in the *MeatBook*, their body schema may have been temporarily skewed until they understood how the *MeatBook* worked, and what its limits are. This may be true of any novelty that requires a testing of what is me and what is not me.

6.12 Results

The *Meatbook* is a work of art. Of the suite of projects examined in this thesis, it is the most provocative in terms of the enteric aspect of the visceral. The meat functions not only according to artistic intent, but is also a play on Merleau-Ponty's idea of *flesh*. To reiterate, according to Merleau-Ponty, flesh is neither subject nor world, but a primal 'element' in which both are born in mutual relation. For him, meaning cannot be purely or solely attributed to ideas, but usually precedes them in pre-reflective, bodily experiences. The sense of novelty (or shock, according to some users) of seeing a book made of meat may engender a pre-reflective response that seems to move users to touch the literal flesh of the *MeatBook*. Some of the more squeamish users seem to experience this more intensely, in the spasmodic, alinguistic sense that Massumi suggested (Massumi 2002, pp.112-113). More than a few users said that "I don't have words" or "I can't explain it" when asked to describe their reaction by those who tended to the exhibition. In addition, the laughter engendered by the *MeatBook* could well be an example of Massumi's "alinguistic rupture." What Massumi was getting at though was that the quick shock or spasmodic laughter that resulted from seeing an animated book made of meat was an indication of feeling something — something outside of language, something that occurs in the split second before reflection is possible — immediacy. For Merleau-Ponty, the pre-reflective experience of immediacy, perception, for example, was not a radical idea. For many of the contemporary cultural theorists of our time, however, immediacy is considered to not be possible, as everything is purported to be mediated by language, with the few exceptions of abjection, jouissance, and others.

Figure 6.13: Version 2 of the MeatBook at TEI

The *MeatBook* elicits, in its fresh phase, early in the day, laughter and an enteric/visceral response, as articulated by many users themselves. Late in the day, however, graying and emitting a distinct odor under the warm daylight of the atrium, it also elicits the abject, or a kind of disgust or repulsion. In an exhibition at the Tangible and Embedded Interaction Conference (TEI 2007),[40] at least a third of its users who interacted with it earlier in the day returned to see "how it was doing." Three users returned often. It is only over more time than the usual 1-3 minutes users stop at exhibits can a visceral register give way to a visceral sense. These three users indeed seemed to experience a visceral sense, at least according to their accounts. Some users went so far as to caress and talk to it, as to give comfort to the dying object. This seems to indicate that its animal-like movements, and its organic, fleshy composition spoke to both notions of mortality and empathy, as if the *MeatBook* bore some sort of subjectivity or sentience. A decade after similar reactions to "dying" or "dead" digipets, there is still an apparent desire for some forms of technology to be anthropomorphized, or to fill some sort of need for deeper connections. Just as earlier discourses about the disembodying aspects of technology have mostly given way to discourses of its embodying potential, through creating and exhibiting the

[40] Attendants who staying near the *MeatBook* during the duration of the exhibit and who kept track of their observations were graduate student Aaron Levisohn and Prof. Chris Shaw.

MeatBook as a piece of art, I intend to continue to advance the embodying potential of technology. For, as Merleau-Ponty argued, it is from such experiences that the world springs forth.

6.13 Future Work

Observations, reactions and comments from viewers at TEI '07 provided useful information for improving aspects of the *MeatBook's* construction and interaction. From user feedback it was clear that the *MeatBook* too closely resembled meat products commonly found in grocery stores and butcher shops. In order to create a stronger visceral reaction, more intricate and detailed construction and bookbinding techniques needed to be utilized. The *MeatBook* must resemble a book – with pages and perhaps a cover – in order to achieve the desired effect. (Version Two of the *MeatBook* has already taken this into account by incorporating honeycombed tripe and pig uteri as bookbinding on a multi-page, flank-steak book.)

The direct interaction with the *MeatBook* will also require a complete technical redesign to better encourage contact with the *MeatBook,* and to create more poetic interactions with it, interactions that will afford more interesting interactions. The current technical design was created to be as simple as possible in order to avoid as many technical difficulties as possible onsite at exhibitions. The Photo Resistor sensing system was too difficult to calibrate in changing light situations, and even under ideal circumstances could not reliably disambiguate instances of contact. The behavior of users also indicated that detection of hand location on its own was not sufficiently robust. The new sensor scheme must enable multiple dimensions of interaction, detecting not only location of contact, but the level of pressure being exerted on the book as well. The sensors must be able to detect and withstand pressures varying for soft to extremely forceful. The sensors must also be small enough to fit inside the individual pages of the book so that they can be turned and react both as discrete elements and as a part of a whole.

The generation of movement for the current *MeatBook* was created using servo motors, which was ideal for an instantiation in which the electro-mechanical infrastructure could be hidden inside a podium. Future versions will require completely new designs that enable mechanisms to fit within the pages themselves. Muscle wire, a type of shape memory alloy, has been experimented with and used to a nominal degree in version 2. It is now being considered for more complex use since it can literally be threaded within the pages of the book. By running a current through muscle wire, it can be made to return to a "programmed" shape. Other possibilities such as using an embedded armature or similar articulated framework will be considered as well. This second method may provide a higher degree of force feedback which may be beneficial for certain types of interaction. Likely, multiple methods will be used to generate motion in order create the appearance of organic movement.

Along with improving and upgrading the current implementation, new elements will be added to enhance the overall interactive experience. One important aspect of this will be sound design. The next iteration of the *Meatbook* will use synchronized sound events to enhance the visceral response to the installation.

6.14 Summary

Unlike the *Meditation Chamber* and *BioMorphic Typography,* the *MeatBook* did not rely on biofeedback to better enable a user's awareness of their visceral sense and changes in physiological state. To cite James Steeves, "Each of these aesthetic forms rely on the imagining body to communicate and express new ways of experiencing the sensible world" (Steeves 2004, p.8). Each artwork, in its own way, was created to attend to the issues at hand. With the *MeatBook,* I wanted to develop ways to elicit, provoke or incite a visceral response that was not entirely just another form of the abject. The recognition of seeing what is usually inside *outside* was my initial consideration. However, I wasn't just concerned with eliciting a visceral response as creating an artwork that necessarily concerned the visceral in terms of content, and in creating the artwork in such a way that it could potentially keep the doors to our visceral register open, instead of immediately slamming them shut by creating a piece that elicits disgust and/or horror. In other words, I wanted to see if it was possible to create an artwork that could offer a sense of immediacy over some duration of time. In my opinion, not many artists accomplish this, except in the paintings of Francis Bacon. If users are and critics are to be believed, the *MeatBook* was successful to some degree in this regard.

I took several of Merleau-Ponty's ideas into account in the creation of the *MeatBook,* which I believe accounts for the manner in which it works. Not all of them needed to be experienced, but are examined here in an order that was most common at the exhibitions.

First, one of the ways that users experienced a visceral register of the *MeatBook* was that it was novel. This novelty disrupted what Merleau-Ponty terms our body schema. Such disruptions may be ones we have on a daily basis as we experience novel situations in a myriad of ways. The novelty of the *MeatBook* works on several levels: what we normally consider to be on the inside (meat) is now on the outside — outside of the cow, outside of the grocery store or restaurant. It is an interactive artwork, an object to engage with, but in a way that is different from eating it or preparing it as food. Further, the novelty of the interaction may have disrupted some body schemas, in that it was clearly dead meat that was animated in unexpected ways. When a user first sees the *MeatBook,* for example, she laughs as a way to open her body to a new perception, a new experience. If she considers the *MeatBook* to be abject — that is, disgusting — her body schema will be disrupted, something Kristeva sees as a negative threat. Certainly, this may have been at work for the users who walked away, saying that it was "gross" and "disgusting." However, disrupting our body schemas do not have to be all negative experiences that we avoid. Carnival rides, illusions, sex, being weightless, experiencing medicinal narcotics or learning a new sport or dance would be examples that are positive new perceptions we incorporate into our milieu of what our bodies are capable of doing. We also have experiences of sorts that we aren't even aware of but depend on as part of our body schema, such as driving a car that is speeding inches away from ours. These are the ways that our bodies are fluid, if we incorporate them or not. Thus, in the time it takes to figure out what is me and not me is a time when our body schemas can be reconfigured, reincorporated. Since, according to Merleau-Ponty, this is usually at the tacit level, it makes sense that users did not comment on this aspect.

Next, the *MeatBook* is a book, a repository of knowledge that lives on long after the author. In this case, however, it contains no words, and is as short-lived as a day. Further, books are supposed to be inert, and not act as an animal might. We know that the meat is dead, but that technology animates this book made of meat. Most users were willing to suspend disbelief that the *MeatBook* was not alive, evinced by the way they caressed it and handled it with a gentleness not usually reserved for inert objects.

Though it may seem incongruent that the *MeatBook* could both disrupt a user's body schema *and* resonate with it is not so problematic if we consider it as experiences. What was background — a register or sense of our viscera — is now foreground. Some users resonated either with the meat or with the way they interacted with it. As stated earlier, this phenomenon has been observed by many theorists and scientists (refer to Tale 2.1). Taken together, the *MeatBook* clearly elicited a sense of some of the users' viscera, and this experience is not necessarily one we leave behind if we consider how very plastic and fluid our bodies can be. Phenomenologist, feminist and film theorist Sobchack states, "...the lived body subjectively incorporates and excorporates objective technologies and, in what Scarry calls a 'consensual materialism,' brings into material being both the variety of herself and multiple worlds" (Sobchack 2004, p.132).
It is precisely the work of art to make available for others these multiple worlds, some of which are the felt world opened by the *MeatBook.*

6.15 Computer Code

For the computer code for version 2 of the *MeatBook*, please refer to:

www.sfu.ca/~dgromala/code/meatbook

Chapter Seven: Conclusions

7.1 Introduction

To restate my hypothesis, what was once considered beyond our conscious control, the visceral, is a nexus of the mind/body problem. The visceral can be elicited by specific forms of interactive art. Further, a continuum of conscious awareness must be accounted for, from what I term the *Visceral Register* to the *Visceral Sense.* Where the *Visceral Register* is on the very fringe of barely conscious awareness, the *Visceral Sense* refers to a consciousness of one's viscera. At this end of the continuum, one can learn to control one's viscera consciously. By doing so, the *Visceral Sense* may offer possibilities for transformative experiences, parallel to the so-called "Mindful Awareness" that results from sustained meditative practices. Further, qualities of interactive art, characteristics of the technologies used by interactive artists, and the cultural contexts of the interactive art enable a return back to interest in and a revaluation of mind/body experiences. Finally, although experience is comprised holistically, of enormous and constantly changing variables of mind/body and world, a specific sense, like the visceral, can be brought into awareness and studied. This enhanced awareness, or ontological "lens" can then be brought to bear on the experience of interactive art, possibly enabling users to experience or "attune" themselves to the particular artworks with a greater sense of being.

> "Insofar as, when I reflect on the essence of subjectivity, I find it bound up with that of the body and that of the world, this is because my existence as subjectivity [= consciousness] is merely one with my existence as a body and with the existence of the world, and because the subject that I am, when taken concretely, is inseparable from this body and this world" (Merleau-Ponty 1989, p. 408).

Not only are the subject, body and world inseparable in Merleau-Ponty's terms, they are "not predicated on the prior existence of the subject, *but rather productive of its very phenomenal appearance"* [emphasis mine] (Carman and Hansen 2005, p.20). Carmen and Hansen here refer to Merleau-Ponty's latter drift from subjectivity to ontology. Merleau-Ponty refers to possible worlds: "I call it flesh, nonetheless . . . in order to say that it is a pregnancy of possibilities," (Steeves, 2004, p.150) possibilities that result from the calling forth of body, world and mind in ever-changing contexts.

Why return to Merleau-Ponty now? Why not other, more contemporary theorists who explore the body or perception, of whom are many?

> "What might be gained by a return to Merleau-Ponty now, at least in the context of recent French intellectual history and its American reception, is a

> turn away from the antihumanistic radicalization of ontology and the cultivation of new exploring the ontological correlation of human beings and the world that has been of renewed interest to scholars, for instance the late neuroscientist Francisco Varela, whose work sought to bridge the humanities and the sciences, and feminist scholars like Luce Irigaray and Elizabeth Grosz, who have attempted in different ways to reconceive the connection between woman and body"(Carman and Hansen 2005, p.22).

Though comparatively overlooked in his time, with his ideas and those of his former colleagues conflated in contemporary times,

> "What Merleau-Ponty introduced to philosophy and the human sciences was in effect a new concept of perception and its embodied relation to the world. At the very least, he managed to realign our understanding of perception and the body with the phenomena we are always already familiar with before we fit them into conceptual categories, pose questions about them, and formulate theories"(Carman and Hansen 2005, p.22).

For the purposes of this thesis, Merleau-Ponty, rather than the ancient Greeks, Western philosophers or contemporary theorists seemed the only choice, for his ideas of exploring the visceral, particularly in his insistence that mind, body, are continually intertwining according to all of their distinctive attributes. His work offers a strong contrast to methods of examining the human body safely tucked away in a bell jar, its complexities and movements, aging and metamorphoses mummified in time and in textual metaphor, according to Western intellectual proclivities. Although Merleau-Ponty himself never quite examined the viscera per se, his work with physicians and neuroscientists indicate that he may have, given a longer lifespan.

7.2 Denigrating the Body

The body has been long denigrated, just as the mind was legitimized as a "higher," more important aspect of being human. In the words of Henri Lefebvre,

> "Western philosophy has betrayed the body; it has actively participated in the great process of metaphorization that has abandoned the body; and it has denied the body . . . consequently philosophical concepts fall into the category of the "signs of non-body" (Lefebvre 1991, pp.407).

Nevertheless, the sheer number of books and publications devoted to "the body" indicates that something is afoot. The textual considerations of "the body" are primarily still held in the cage of our most trusted form of knowledge, textual legitimacy. But the publications on "the body" that explore it from a first-person or subjective, felt experience, have some chance of turning the intellectual foci towards meaningful explorations that can and perhaps must exceed textual inscription as "perception" and "experience" suggest. It is here that the work of interactive artists holds promise.

Interactive artists, by taking hold of some of the work that once belonged to critics, by collaborating with the scientists who develop new technologies, in clearing a way for their inclusion in otherwise primarily scientific conferences and publications, and by disseminating their ideas in the vehicles of contemporary culture (if only as newsworthy commodities in television and journals like *Wired*), have an opportunity, however modest, to alter the discourse of what it means to be human in a new technologically-sufficed era. As their forebears did a century or more ago, some of these interactive artists are exploring the subjective experiences of the body through a myriad of technological forms, and are asking questions about meaning and culture (Dourish 2001).

At the same time, scientific "discoveries" of how the body works have helped to open up what was once considered the five senses to others: the proprioceptive, the kinesthetic, the interoceptive and the visceral. By exploring the relatively understudied ideas offered by scientists in relation to the visceral, by examining this bodily mode from multiple fields and by creating artworks that intend to demonstrate what can reside outside of linguistic inscription, I am hopeful that this thesis offers a unique contribution to the field of interactive art.

The visceral, examined throughout this thesis from the existential phenomenological perspective of Merleau-Ponty, is concerned with the common, everyday phenomena of usually pre-reflective perception, building on the bedrock of the body from which all springs forth. This ranges from what is considered the "autonomic" aspects of the visceral system, such as breath, heart rate (and indirectly, GSR), to meat, taken outside of the everyday context of grocery stores, cooking and restaurants and recontextualized as an artistic reminder of that which resonates with our own usually hidden viscera or enteric system. The *MeatBook*, for example, is an organic form that interacts, bleeds and decays. The interaction seems to possibly dispel its aspect of horror-inspiring abjection. In Merleau-Ponty's tradition of existential phenomenology, aspects of the body are observed and described directly — that which comprises the visceral: the respiratory, cardiovascular, and excretory systems — primarily from a first-person perspective, and foregrounded with the notion and experience that mind, body and world are inextricable. That is, this perspective attempts to overcome the dualism of mind and body. Such an ambitious project exceeds the scope of this thesis, and must overcome centuries of thinking and being in specific ways that appear "natural."

In addition, because much of current research in the studies of consciousness is focused primarily if not exclusively on the brain, I have found few scientists or medical methods that were developed to tell us more about the visceral, especially in real-time. Although a subcomponent, the enteric or excretory system is termed the "second brain" because it is the only system that can operate without connections to the brain, and because it colors our affective world by manufacturing an estimated eighty percent of our serotonin and other mood-altering hormones, among many other substances and workings that were once in the exclusive domain of the brain. In addition, the common and unwavering usage of the term "visceral" and "gut response" perhaps provides evidence that we sense its importance and connection to affecting our continuously changing conscious states. Nonetheless, it was discovered that there is far less research devoted to the visceral in any field than one would expect, much of it halting around Pavlov's time. This is surprising considering its importance, and considering the diseases associated with it, from GIRD (gastro-intestinal "reflux" disease), Crohn's disease, irritable bowel syndrome (IBS) and the recent connections to depression. Several communities (so-called "tribes") in existence, particularly in West Africa, put the gut at the center of their world, just as we revere the brain. Nonetheless, little is known about these communities, and there is little indication that studying them is important.[41] Thus, until more is known in scientific and medical terms, studying the visceral appears to be an emerging quest.

Drew Leder, a physician and philosopher extends Merleau-Ponty's work by focusing on the inner, usually invisible and quiescent aspects of our innermost aspect, our viscera. According to Leder, in the dualistic Cartesian split of mind and body, the body "has tended to play the role of secondary or inessential element" (Leder 1990, p.126). Further, the body is understood, still, to be mistrusted, as source of shame, and a harbor for pain, disease or dysfunction that threatens the mind. Above all, the body ultimately threatens us with mortality (Leder 1990, p.138). This experience is reified by cultural practices that serve to continue a divergence of mind and body. In Leder's words,

> "Thus the vectors established by the lived body, and the cultural context in which they unfold, are mutually engendering structures. The human body shapes social practices, and social practices shape our use and understanding of the body. This can lead to what in engineering circles is termed a positive feedback loop" (Leder 1990, p.152).

But the "positive" feedback loop can of course be negative. For when a feedback loop is established, say in the case of a mind/body split,

> "our cultural belief in the disassociation of mind from body leads to an increase in disassociative practices; we are encouraged to abandon sensorimotor awareness for abstracted mathematical or linguistic forms. This in turn intensifies the day-to-day experience of mind as disembodied, confirming the initial cultural practice" (Leder 1990, pp.152-153).

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[41] Based in observing anthropological, medical history and comparative medicine studies of the last four decades and by examining what international grants, such as the Fulbright, are awarded to study.

This continues even further, when, for example, "we have no choice but to remember the body when it screams out in pain, disrupts our projects with fatigue or lust, is wracked by disease, or threatened by death. If positive practices" of multiple awarenesses of our bodies are shunned, "such dysfunctional episodes can become the primary mode of bodily awareness, serving to define corporeality as a whole" (Leder 1990, p.153). This is another result of the feedback loop, one that leads to a mistrust of the body and an awareness of it, in turn skewing "our awareness further toward the negative" (ibid.). Leder continues for pages with examples of how this feedback loop generates more of the same, including our propensity to view other cultures that value bodily forms of knowledge as suspicious and primitive, with an "arrogance" that even "infects. . . our relation to other species" (Leder 1990, p.154). Thus breaking free of this dualist perspective is no small matter, and one that can reasonably only be touched upon within the confines of a thesis and attendant artistic practices (refer to the CD: *Meditation Chamber, BioMorphic Typography,* and the *MeatBook).*

Leder attests to the relative ineffectiveness of criticism of dualistic practices and cultural proclivities. His approach is to instead explain how dualistic thinking arose *from the body,* and why it has had such strong and lasting effects; thus he seeks to deconstruct it from within. His book, therefore, is devoted to showing how the way the body works can indeed itself seem to give rise to tenets such as "disembodiment" by the way it seems to disappear from conscious awareness. More importantly, however, he claims that phenomenology can become "not just a tool for the refutation of previous philosophical positions but for their reinterpretation and reclamation" as well (Leder 1990, p. 155).

6.3 The Importance of the Visceral

What we do know is that the visceral seems an important and compelling area to study, from recent results in fields ranging from medicine, neuroscience and artificial intelligence to philosophy and cultural studies. What has been explored in this thesis is the question: can interactive art elicit or provoke a visceral response? If so, how can we characterize that response? And finally, if or how it may be transformative? I argue that interactive art can indeed elicit a visceral response by referring to academic work, historical and interactive artwork, and through the creation and interaction with my own artworks (refer to the CDROM within).

The *Meditation Chamber,* for example, enables users to become aware of their own visceral workings, primarily in the respiratory and cardiovascular subsystems that comprise the visceral, and primarily in direct ways via a biofeedback device. In homage to Francisco Varela, this work was the first step in a phenomenological quest to understand how Merleau-Ponty's reversibility thesis works, especially since we are using our inward-oriented interoceptive, rather than our more generally utilized exteroceptive senses. The intertwinement of body/mind and world in an inseparable way in the *Meditation Chamber* thus merits several levels or dimensions of exploration. In a longer-term practice of mindful meditation, the transformative aspects of this intertwinement may be easier to understand, as it is a change in worldview, experience and being. Because the *Meditation Chamber* is in use by Virtually Better and twenty of its partners, it is hoped that in some small way, its use can lead at least some of these sufferers of phobias, post-traumatic stress disorder, and other medical conditions to some degree of relief or sense of more control over their minds and bodies. In the *Meditation Chamber*, some users "register" their viscera, transform tacit awareness into recognition and thereby attain some control over their visceral sense.

Mediation is no longer considered to be unacceptable in Western Medicine. In the U.S., for example, "the National Institutes of Health reviewed 30 years of research on the effectiveness of meditation. They concluded that 'meditation and related methods for the enhancement of relaxation are cost-effective ways to improve health and the quality of life'" (Chrisman 2003).

BioMorphic Typography relies on a similar idea and subsystems of the visceral, but in a slightly different phenomenological view promulgated by Merleau-Ponty: by exploring reversibility, the use of language and accessing the so-called "primordial" body. While McLuhan and others spoke of the way that the alphabet led to some senses being dominant, others argued that our bodily knowledges are atrophying. This continues even after two decades or more of the dwindling claim that digital technologies are "disembodying." Evans and Lawlor, for example, claim that "With the information revolution, something extraordinary has happened, something that has reduced the visible world to codes with the genetic code as the prototype of coding generally and, in that sense, as a drying up of sensation" (Evans and Lawlor, 2000, pp.171-172). The *embodying* aspects of new technologies (since 1984) have likewise paralleled the claims of disembodiment.

The *MeatBook,* in contrast to the *Meditation Chamber* and *BioMorphic Typography,* does not rely on biofeedback directly, but elicits a visceral and especially enteric response by use of meat, decontextualized from its familiar venues. From observing users in its exhibitions, it seems to strongly engender an enteric "resonance" in most users, indirectly and directly. Indirectly, it seems to be animated, mostly in non-threatening, interactive ways. Directly, as it rots and emits distinct odors, it incites, inescapably, a visceral response.

Finally, it is related to *BioMorphic Typography* not by questioning how we consider the relations of our bodies to writing, but how we consider *books*. On the one hand, *MeatBook* is a representation of a book, though created from meat. Those familiar with the history of books will recognize its allusions to sheepskins, ink squeezed out of dead squid, cat gut, "bone folders" and a plethora of other uses of animals in the production of books in Europe and the New World. On the other hand, it can be argued that the *MeatBook* is not so much a representation, but is the thing-in-itself—a befuddlement of what is and is not a representation. As the kind of visceral sense, what the *MeatBook* elicits initially is outside of linguistic or representational realms, for the ways the visceral responses seem to intervene between subject and object. A unity-in-being, a form of immediacy, ironically, the disintegrating *MeatBook* interrogates the common meaning of a book as a form of preservation for future generations, outside of presence and beyond the mortality of the author.

According to Brian Massumi, although the visceral[42] "directly, autonomously processes unconscious [sic] perceptual stimuli (that is, not controlled by the brain)" (Massumi 2002, p.112), it can produce or result in conscious effects. "Indirectly it communicates with the brain through peristaltic contractions of the bowel, which are felt proprioceptively, and through hormonal releases, which alter mood." (ibid.) According to Massumi, what he terms viscerality "is a rupture of the stimulus-response paths, a leap in place into a space outside action-reaction circuits until one is jolted back into action-reaction by recognition" (Massumi 2002, p.113). Massumi is a scholar writing in the tradition of the Humanities, and he reads scientific works to ground his work. Few scientists concern themselves with subjectivity or whether or not any human is able to "be" outside of language, but I also draw on their work, particularly on V. Ramachandran, Adam, Gershon and Cameron, to name a few, in order to understand how the visceral systems work. They come to conclusions and provocations that similarly echo Massumi's, but that are ultimately more provocative because of their greater and more intimate knowledge of the viscera.

7.4 Towards a Theory of the Visceral

The artworks developed and explored within this thesis are but a few examples, as a visceral response can be elicited by other interactive artworks, directly or indirectly, whether or not it is the intention of the artists to do so. Some works, as suggested, just touch the realm of our consciousness and are then gone — this is what I term one end of a continuum, the *visceral register*. Other works more strongly elicit a visceral response, enable us to become aware of or

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[42] Massumi uses the term visceral to primarily mean the enteric component of the visceral.

to control aspects of our viscera, in ways that linger in our thoughts and actions. This opposite end of the continuum is what I have termed the *visceral sense.* It is a potentially transformative sensibility that one can learn to control, through meditation or other practices. Either the visceral register or the visceral sense can be affected directly, say, by touching rank meat that acts something like an animal and a robot, and indirectly, by watching a video of Orlan's surgeries, by hearing particular kinds of sounds, or by thinking about the animal tissue that is "home grown." In some cases, this is accomplished by a certain factor of short-term disgust, termed the abject by Julia Kristeva. In other cases that are not threatening or disgusting, particularly those we identify or empathize with, we may resonate with the artwork with both mind and body (refer to fig. 2.1).

Our time seems to be one of world-altering technological development, the effects of which may alter subjective, individual experience, and that touch, at least in ecological terms, our entire planet. It thus appears that the work of artists, whose contributions cover at least over thirty millennia, is as important as ever. Thankfully, the earlier discourses that portray a bodiless world, where one could download one's consciousness, have taken a backseat to the thousands of books and artworks that argue quite the opposite position. Hansen, for instance, argues that media convergence under digitality actually increases the centrality of the body as framer of information: as media lose their specificity, the body takes on a more prominent function as selective processor. . . " (Hansen 2006, p.27). Some of the interactive artists who arguably have intimate knowledge of these emerging technologies, promise to help overcome at least some of our fears of mortality and refusal to acknowledge that we are animals and part of the world. For without more fully experiencing, understanding and valuing our bodies as inextricable with mind and world, we remain an impoverished species indeed.

Merleau-Ponty refers to "that primordial being which is not yet the subject-being nor the object-being and which in every respect baffles reflection. From this primordial being to us, there is no derivation, nor any break; it has neither the tight construction of the mechanism nor the transparency of a whole which precedes its parts" (Merleau-Ponty 1970, pp.65-66). If phenomenology can indeed provide us with new, workable ways of looking at the world and how our minds and bodies are inextricable from that world, it can also help us "to be more attentive to experience," to "uncover phenomena that were concealed" and to "explain what the Cartesian framework renders inexplicable" (ibid.). One of phenomenon that phenomenology and my artworks have underscored is that of attunement with the interactive artwork and world. This attunement is an example of transformations of consciousness, some of which, according to users, can be carried away from the interactive art experience itself as a kind of ontological lens.

My creation of the virtual environments that directly enable burn and cancer patients to become attentive to their bodies, in order to deal with pain. This is possibly one phenomenological vector that in some small way, works to overcome a Cartesian mistrust and devaluing of our bodies in a literal way. The *Meditation Chamber*, in a different way, perhaps serves a similar purpose, but is meant to be used at least several times, (for practice). Like meditation itself, longer term use can perhaps have transformative effects in the way we can carry the experience of meditation into our everyday lives. This transformation can be an awareness or control of our viscera for purposes of health. However, on another front, my creation of artwork such as *BioMorphic Typography* and the *MeatBook* is meant to gently engender an awareness in the former, with more humor and provocation in the latter. Such artistic provocations can, of course, enable the user to just reinforce the ruts that maintain the split of mind and body. However, these experiences may also offer potentials to be transformative, in creating an awareness of our viscera. All of the projects created for this thesis aim to bring our otherwise obscured and "invisible" autonomic/visceral systems into conscious awareness. Further, to learn how to control them is something we rarely do everyday. Nonetheless, these works may be able to evoke some level of transformation, from a more superficial awareness to engagement with those deep, inner visceral systems — the very systems that are responsible for sustaining our exteroceptive senses and life itself. These need not necessarily be vast transformations experienced once, but an accretion of bodily changes that can result from a consciousness of them. Merleau-Ponty was concerned with, for example, "How the body changes natural gestures into elaborate and personal modes of expression. Gesticulations and the simple skills of balance and posture are developed through practice into personal styles of living, and these shape the way that a person feels about herself and interacts with others" (Steeves 2004, p2). Experiences in the virtual environments described in this thesis, as well as experiences that blatantly address the visceral have been shown here to bring into conscious awareness the otherwise quiescent viscera. Becoming conscious of this fluid and ever changing relation with the world, this sometimes volatile background aspect of our bodies, may transform some users' "personal style of living," as demonstrated.

> "The theory of the body image is, implicitly, a theory of perception. We have relearned to feel our body; we have found underneath the objective and detached knowledge of the body that other knowledge which we have of it in virtue of its always being with us and of the fact that we are our body. In the same way we shall need to reawaken our experience of the world as it appears to us in so far as we are in the world through our body, and insofar as we perceive the world with our body. But by thus remaking contact with the body and with the world, we shall also rediscover ourself, since, perceiving as we do with our body, the body is a natural self and, as it were, the subject of perception" (Merleau-Ponty 2004, p.126).

Appendix 1: Publications, Exhibits & Lectures

Note: this is not a cv, but only the publications, exhibitions, lectures, and other activities that were the *direct* result of work on this thesis.

Presentations, Publications and Conferences Attended

Published Books

Gromala, D and Bolter, J 2003, *Windows and Mirrors: Interaction Design, Digital Art, and the Myth of Transparency,* MITPress, Cambridge, MA. Translated into Japanese, 2005. Reprinted 2007.

Published Monographs

Gromala, D 2000, *Ikons on Design: Excretia.* An eight page monograph on *Excretia,* the first interactive font in the BioMorphic Typography family. It responds, in real-time, to a user's continually changing physiological states. Published in 7 languages and distributed throughout Europe and the U.K. Published by Zanders ghmb, a patron of design arts. Part of a group of monographs including Tomato, Zaha Hadid, Ron Arad, Kevin Clarke and Gitte Kath.

Published Books and Parts of Books: Selected Book Chapters & Essays

Seo, J and Gromala, D 2007, 'Touching Light: PostTraditional Immersion in Interactive, Artistic Environments', *Educating Artists for the Future: Learning at the Intersections of Art, Science, Technology, and Culture.* M. Alexenberg, ed. Intellect Books, Bristol,*forthcoming, 2007.*

Gromala, D 2003, Critical essay responses to Stuart Moulthrop's 'From Work to Play' and Bill Seaman's 'Recombinant Poetics - Media-Element Field Explorations' in *First-Person,* Noah Wardrip-Fruin, ed. The MITPress, Cambridge, MA.

Gromala, D 2003, 'The Trouble with Rand', *Paul Rand: Modernist Design. Center for Art and Visual Culture: Issues In Cultural Theory #6,* S Gardner and F Nunoo-Quarco, (eds.) Baltimore: Center for Art and Visual Culture, Distributor Art Publishers (D.A.P.), University of Maryland Baltimore County, pp.95-97.

Gromala, D 2001, 'Learning the Languages of Babel: An Approach to New Media Pedagogy', in *Education of an eDesigner,* S Heller, (ed.), Allworth Press: New York. pp.50-56.

Published Journal Papers: Refereed

Gromala, D and Shaw, C 2005, 'Expressing the Immeasurable: A Methodology for Developing a Visualization Tool for Patients' Assessments of Pain', *Digital Creativity,* vol.15, no.4, pp.253-256.

Published Journal Papers: Refereed Book Reviews

Gromala, D 2003, book review of *Where the Action Is: Foundations of Embodied Interaction,* by Paul Dourish, 2003. Retrieved June 1, 2005, from http://mitpress2.mit.edu/ejournals/Leonardo/reviews/jun2003/Where_Gromola.html

Gromala, D 2001, 'SIGGRAPH's Art Gallery at the Turn of the Millennium', *Leonardo: The Journal of the International Society for the Arts, Sciences and Technology,* vol.34, no.2, pp.136 – 138, MIT Press: Cambridge.

Publications: Invited
Gromala, D and Sharir, Y 2003, 'A Sense of Re-embodiment', *Theologies: Synopsis 2.* Athens, Greece. pp.53–57.

Gromala, D 2000, 'Re-embodiment,' *Riding the Meridian* vol. 2, no. 2: Women and Technology. Retrieved March 14, 2005 from http://www.heelstone.com/meridian/

Publications: Interviews Given
Saether, L 2003, Interviewed regarding the *Meditation Chamber.* Aired numerous times on CNN national television and distributed to hospital networks throughout 2003.

Vigodsky, T 2002, Interviewed regarding about the *Meditation Chamber* by the public radio program called *Science in Your Life.* Aired several times on PBS affiliate radio stations, September – October.

Publications: Reviews by Art & Design Critics and Cultural Theorists
McQuiston, L 2003, 'Diane Gromala', *Graphic Agitation 2: Social and Political Graphics,* (book) Phaidon Press, London, pp.196, 218-219.

Triggs, T 2003, *Type Design: Radical Innovations and Experimentation,* Harper Design International, London, pp.50-53.

Carson, F and Pajaczkowski, C 2001, *Feminist Visual Culture,* Routledge, London, pp.156-157.

Bell, D 2001, *An Introduction to Cyberculture,* Routledge, London, pp.57-63, 145, 157-162.

Invited Conference Presentations: Keynote addresses
Gromala, D 2000, 'Virtual Realities', *Profile Intermedia,* University of Bremen, Germany, November 29.

Gromala, D 1999, 'Virtual Bodies', *Converging Terrains: Gender, Environment, Technology, and the Body,* Southeast Women's Studies Association, North Carolina State University, Raleigh, N.C.

Invited Conference Presentations: Distinguished Lecture
Gromala, D 2003, 'Pain and Remediated Flesh', distinguished speaker, sole representative of the Arts for a U.S. Department of Education FIPSE grant, on *Understanding The Body,* Wayne State University. Invited Lectures

Gromala, D 2003, 'BioMorphic Typography', ICA (Institute of Contemporary Art), London, September.

Gromala, D 2003, 'Enfleshings', Eastern Michigan University, School of Art & Design.

Gromala, D 2003, 'Remediated Flesh, Feral Computing', University of Arizona, School of Art, Tucson, May.

Gromala, D 2003 'A Sense of Flesh: Embodied Digital Art', ETH (Eidgenossische Technische Hochschule) Artificial Intelligence Laboratory, Zurich, June.

Invited Conference Presentations

Gromala, D 2006, 'Pain, from VR to Ubicomp', Royal University, College of Fine Art, Kungl Konsthogskolan, Stockholm, April.

Gromala, D 2003, 'Proprioception and Viscerality', Nomadische Grenzuberschreitungen: Kunst und Forschung (Nomadic Transitions: Art and Research), University of Art and Design, Zurich, April 10.

Gromala, D 2003, Panel: 'Flesh and Embodiment: Physical and Virtual: from CAVES to Wearables', Nomadism in Blurring Boundaries from a First-Person Perspective, Zurich Gallery of Contemporary Art, April 12.

Gromala, D 2002, 'Remediated Flesh: What Pain Might Tell Us About Transformative Remappings of Sensoria in Interactive Art', IAMAS (the Institute of Advanced Media Arts and Sciences), the Center for Media Culture, and SOFTOPIA, Ogaki/Gifu, Japan, October, *Consciousness Reframed 2002.*

Gromala, D 2002, 'Pain and Interactive Art', paper presentation and workshop at the colloquium, *La Conversion et Mediatisation du corps-propre,* University Paul Valery, Montpellier, France, June 20–21.

Gromala, D, 2001, 'Remediated Flesh', *E-naissance: New Configurations of Mind, Body, Space* Galleria Civica d'Arte Moderna E Contemporanea, Turin, Italy, March 28–29.

Gromala, D 2001, 'Ontologies of Remediated Flesh', Vassar College, NY, April.

Gromala, D 2000, 'Remediated Flesh', *l'Art a l'Etre Post-Biologique*, Ecole Nationale Supérieure des Beaux-arts, Paris, December.

Gromala, D 2000, 'Mediating Meat', *Computers and Writing Working Group,* online lectures, University of Florida, October 21–31.

Conference Presentations with Proceedings (refereed)

Gromala, D and Parihar, S 2004, 'Collaborative Agents of Design: The Need for Interdisciplinary Research and Training in Design Education,' *Design Education: Tradition and Modernity* (DETM) National Institute of Design, Ahmedabad, India, March.

Gromala, D, Punekar, RM, and Khandelwal, M 2004, 'Design Visions: Centers of Synergetic and Dynamic Interfaces Between Education Centers and Society', *Design Education: Tradition and Modernity* (DETM) National Institute of Design, Ahmedabad, India, March.

Gromala, D 2003, 'From a Liminal, Gnawing Twinge to Urgent Insistence: Thresholds of the Visceral Sense', *CIBERART Conference,* Bilbao, Spain, April.

Gromala, D 2003, 'Remediated Flesh: What Pain Might Tell Us About Transformative Remappings of Sensoria in Interface Design', *Consciousness Reframed 2002.* London: Intellect Press.

Dolinsky, M, Gromala, D and Sharir, Y 2003, 'The Function of Art in Restructuring Experience in Virtual Environments', *VSMM* (Virtual Systems and Multimedia; Art, Technology and the Human Factor), Montreal, October 15.

Gromala, D 2003, 'A Sense of Flesh: Old Habits and Open Wounds', *The Consciousness Reframed,* The University of Wales, June.

Conference Presentations without Proceedings (refereed)
NSF (National Science Foundation)-sponsored ADVANCE Conference, (NSF initiative to increase the participation of women in the scientific and engineering workforce through the increased representation and advancement of women in academic science and engineering careers.) Invited Conference participant 2002. Design consultant and strategic planner, 2003. (refereed)

Gromala, D 2005, 'Re-enervating Flesh', College Art Association Conference, Atlanta, February (refereed).

Gromala, D, with Seay, F 2002, 'A Tool for Visualizing Pain', at *CHI 2002's Physiological Computing Workshop,* Minneapolis (refereed).

Gromala, D, with Bolter, J 2001, "Theory and Practice in New Media Pedagogy', College Art Association Conference, Chicago, February. (refereed)

Gromala, D with Bolter, J 2000, 'New Media Pedagogies', International Society of Electronic Artists (ISEA) Conference, Paris, December. (refereed)

Invited Conference Session Chairmanships
Gromala, D 2000, 'Performative Design', *Sins of Change: Media Arts in Transition*
Panelists: Scott Bukatman, Matthew Causey, Elizabeth Diller
Walker Art Center, Minneapolis. Major conference marking the twentieth anniversary of the first international Media Arts conference in North America.

Exhibitions & Performances: Invited
Gromala, D 2004, 'BioMorphic Typography', *TypO Exhibition,* Museum of Modern Art, Stockholm, Sweden.

Gromala, D 2002, 'BioMorphic Typography', *TechnoPoetry Festival,* Georgia Institute of Technology, April 1-2.

Gromala, D 2000, 'Eating Eye,', University of Bremen, Messe Centrum, Germany.

Exhibitions & Performances: Refereed
Levisohn, A, Cochrane, J, Gromala, D and Seo, J 2007, 'The MeatBook', at Tangible and Embedded Interaction (TEI 2007), Baton Rouge, Louisiana, USA, February 15-17.

Gromala, D and Quennesson, K 2005, 'Conscious Camera', SIGGRAPH 2005 Emerging Technologies, Los Angeles, July 31 – August 4.

Gromala, D 2003, 'BioMorphic Typography', *TypO Exhibition,* FACT (Foundation for Art & Creative Technology), Liverpool, England.

Gromala, D, Hodges, L, Shaw, C and Seay, F 2001. Interactive exhibit, 'The Meditation Chamber', SIGGRAPH, Los Angeles. Selected after rigorous adjudication for technological innovation in SIGGRAPH's Emerging Technologies venue. This work combines an immersive virtual environment with a biofeedback device. It blurs the boundaries among an artwork, an innovative use of technology, and an experimental, therapeutic modality for users with stress-related illnesses. August 12-17.

Gromala, D 2000, 'Excretia', Exhibition of proof-of-concept for "biomorphic typography," a major work-in-progress. The visual character of biomorphic typography responds in real-time to a user's changing physical states. ISEA (International Society for Electronic Arts), Paris, December 7-10.

Selected Exhibitions & Performances: Refereed Posters with Publications

Terry, M, Brostow, GJ, Ou, G, Tyman, J and Gromala, D 2004, 'Making Space for Time in Time-Lapse Photography', at *SIGGRAPH Technical Sketches.*

Gromala, D and Shaw, C 2004, 'Expressing the Immeasurable: A Methodology for Developing a Visualization Tool for Patients' Assessments of Pain', at *CHI 2004 Workshop: Cross-dressing and Border Crossing: Exploring Experience Methods Across Disciplines,* Vienna, April.

Jafariniami, N and Gromala, D 2003 'Meaningful Traces: Augmenting Children's Drawings with Digital Media', at *UbiComp 2003,* Seattle, October.

White, D, Abowd, G and Gromala, D 2003, 'Mobile Capture and Access for Children with Autism', at *UbiComp 2003,* Seattle.

Shaw, C, Hong, JY, Ribarsky, W, Gromala, D, Zhulin, I and Borodovsky, M 2002, 'Interactive Bioinformatics Browser', at *Applying Bioinformatics: From Genes to Systems,* Georgia State University, Oct 3-4.

(Gromala's) Works Reviewed and Discussed by Art Historians, Critics and Theorists

Dixon, S with Smith, B 2007, *Digital Performance: A History of New Media in Theatre, Dance, Performance Art, and Installation.* MIT Press, Cambridge, MA, pp.16, 138, 215-216, 365, 376-378, 393, 435, 560, 580, 590-591, 598, 662.

Koski, K 2007, *Augmenting Theatre: Engaging with the Content of Performances and Installations on Intermedial Stages,* Enschede: PrintPartners Ipskamp. p.164.

Rush, M 2005, *New Media in Art,* Thames and Hudson, London, p.235.

Hansen, M 2004, *New Philosophy for New Media,* MIT Press, Cambridge, MA, pp.178, 180, 182.

Triggs, T 2003, *Type Design: Radical Innovations and Experimentation.* Harper Design International, New York: pp.50-53.

Carson, F, and Pajaczkowski, C 2001, *Feminist Visual Culture,* Routledge, London, pp.156-157.

Bell, D 2001, *An Introduction to Cyberculture,* Routledge, London.

Shaviro, S 1999, 'Virtual Pleasure, Virtual Pain', *Art Byte,* vol.2, no.1, pp.20-21.

Morgan Spalter, A 1999, *The Computer in the Visual Arts*, Addison Wesley, Reading, MA, p.107–108.

Research Work included in Permanent Collections
San Francisco Museum of Modern Art, Trinity College (Dublin), University of Arizona, University of Bremen (Germany), University of California, Los Angeles, University of Texas, Vassar College, Walker Art Center, Wexner Center.

Program Reviewer
Consultant, advisor, and external evaluator for curriculum development involving new technologies. This enabled me to obtain greater insight into some of the views expressed in this thesis.

National Science Foundation, IGERT (interdisciplinary graduate program grants), 2004
Interdisciplinary Graduate Programs at the Massachusetts Institute of Technology, 2004
The University of Arizona, 2000
The University of Maryland, Graduate Program Review, 2000, 2003
Wanganui Polytechnic, New Zealand, 1999

Honors and Awards: Nominations for Technological Innovation
Frank Annunzio Award, nominated, 2000
Nominated for the $50,000. Frank Annunzio Award, designed to honor a living American who is improving the world through ingenuity and innovation, and to provide incentive for continuing research. Nomination was based on my work, which concerns the therapeutic aspects of immersive virtual reality, including the *Meditation Chamber.* Past winners were: Maya Lin (artist, Vietnam War memorial), Michael Graves (architect), John W. Wild (pioneer of ultrasound), Charles Towne (invention of laser), Robert Gallo (medicine), Ray Wu (first method of sequencing DNA), and Millard Fuller (founder, Habitat for Humanity). 4 artists were nominated.

Discover Award semi-finalist, 2002
"A Living Book of Senses," (later reworked as the *MeatBook*) was selected as a semifinalist for *Discover* Magazine's Award for Technological Innovation. The $100,000. award is sponsored by the Christopher Columbus Foundation, an independent federal agency established by the U.S. Congress in 1992. The foundation's mission is to encourage and support research that produces new discoveries that have the potential to influence everyday life. Fifteen (15) semi-finalists were selected from among four hundred (400) candidates.

Appendix 2: *Meditation Chamber* User Studies

User studies involving the participation of 411 users were conduction during SIGGRAPH 2001, in Los Angeles, 12-17 August. Because of strict Human Subjects Approval, the user studies must be accessed within the URL www.sfu.ca/~dgromala/thesis. The login is <feral> and the password <computing>.

Since the *Meditation Chamber* was designed to be used for therapeutic uses at the Virtually Better clinic in Atlanta, user studies were a necessity. The *Meditation Chamber* is currently in use at Virtually Better, and 20 of its clinical partners.

Appendix 3: *BioMorphic Typography:* Questionnaires

This appendix includes transcriptions of questionnaires handed out at the first exhibition of *BioMorphic Typography,* at the *TechnoPoetry* Conference at the Georgia Institute of Technology. Thirty participants filled in the questionnaire. Observations of approximately 87 other users were observed by graduate students and the author, who attended to hooking users up to the biofeedback device and starting the program. While this is a work of art, questionnaires and user studies provide only limited usefulness.

Appendix 4: The *MeatBook:* Phenomenological Impressions

These were phenomenological impressions gathered from 19 graduate students during testing of the second iteration of the MeatBook. Observations of its first, second, and third exhibitions proved far more useful, especially because they were comparative and because they were attended by many more people.

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Abrams, J 'Muriel Cooper's Visible Wisdom', *American Institute of Graphic Arts (AIGA): Inspiration, Medalists,* Retrieved July 1, 2007, from http://www.aiga.org/content.cfm/medalist-murielcooper/

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Barnes, V, Schneider, R, Alexander, C, Staggers, F 1997, 'Stress, Stress reduction, and Hypertension in African Americans: An Updated Review', *Journal of the National Medical Association,* vol.89, no.7, pp.464-476.

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Blokland, EV and Rossum, JV 1990, *Beowulf,* Font, LettError, Netherlands. Retrieved September 10, 2006, from http://www.findarticles.com/p/articles/mi_qa3982/is_200501/ai_n13507284/

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Bodker, K, Kensing, F, Simonsen, J 2004, *Participatory IT Design: Designing for Business and Workplace Realities*, MIT Press, Cambridge, MA.

Bolter, J and Gromala, D 2003, *Windows and Mirrors: Interaction Design, Digital Art, and the Myth of Transparency*, MIT Press, Cambridge, MA.

Bolter, J and Grusin, R 2000, *Remediation: Understanding New Media*, MIT Press, Cambridge, MA.

Brodwin, P 2001, *Biotechnology and Culture: Bodies, Anxieties, Ethics* (Theories of Contemporary Culture). Indiana University Press: Bloomington.

Bruce, H and Davis, B 2000, 'Hip-Hop Meets Poetry — A Strategy for Violence Intervention', *English Journal*, vol.89, no.5, pp.119-127.

Bruguera, T 1998, *Body of Silence*, Performance, Medium: Lamb meat, book, Rhona Hoffman Gallery, Chicago.

Buck-Morss, S 1991, *The Dialectics of Seeing: Walter Benjamin and the Arcades Project* (Studies in Contemporary German Social Thought), MIT Press, Cambridge, MA.

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Buytendijk, FJJ 1974, *Prolegomena to an Anthropological Physiology*, Duquesne University Press, Pittsburgh, PA.

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Canadian Mental Health Association (CMHA) 2007, 'The Connection between Mental and Physical Health', retrieved March 1, 2007, from http://www.ontario.cmha.ca/content/about_mental_illness/mental_health.asp?cID=3963

Cardiff, J 2005, *Her Long Black Hair*, Performance, Medium: Binaural headphones, CD player, packet of photographs, 35-minutes. Performed Central Park, New York, NY, July 16 – September 11.

Carey, J 2006, *What Good Are the Arts?*, Oxford University Press, Oxford.

Carman, T and Hansen, M 2005, *The Cambridge Companion to Merleau-Ponty*, Cambridge University Press, Cambridge, England.

Cartwright, L 1995, *Screening the Body: Tracing Medicine's Visual Culture*, University of Minnesota Press, Minneapolis.

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Windows and Mirrors

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Windows and Mirrors

INTERACTION DESIGN, DIGITAL ART, AND THE MYTH OF TRANSPARENCY

Jay David Bolter and Diane Gromala

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Contents

Series Foreword

The relationship of digital art to innovation in the practice of design is the subject of *Windows and Mirrors: Interaction Design, Digital Art, and the Myth of Transparency* by Jay David Bolter and Diane Gromala. Centered on a conception of art practice that emphasizes the function of experimental forms, Gromala and Bolter postulate that digital art can directly inform the trajectory of interaction design. By shaping a discourse around issues of artistic practice, *Windows and Mirrors* is an analysis of the material engagement and desire to define the computer as media.

According to their analysis, a conception of the computer as media runs in direct contradiction to structuralist orientations offered forth by engineers for whom the objective of digital transparency defines the interactive experience. In contrast Gromala and Bolter's analysis points to a continuously emerging media that attempts to define itself and is therefore visible and reflective of the user. The focus of *Windows and Mirrors* is the SIGGRAPH 2000 Art Show. ACM SIGGRAPH Conferences began in 1974 to enable presentation and discussion of the latest research advancements in computer graphics and interactive techniques. The conference and accompanying trade show quickly grew into one of the world's most prestigious venues dedicated to envisioning the future of digital imaging. Conference organizers recognizing the need to address the human element expanded their program to include the arts and hosted the first Art Show in 1981. Over the next two decades hundreds of artists participated in this unique event in which artworks, research and technology innovation create a framework for envisioning the future. Gromala and Bolter's selection of the SIGGRAPH 2000 Art Show draws attention to a specific moment of transition as we entered a new millennium. Theirs is a unique collaboration. As Chair of the SIGGRAPH 2000 Art Committee, Diane Gromala offers important curatorial insight while Jay David Bolter, a historian and theorist of digital technology, provides an outside perspective, examining the implications of the selected artworks on the field of interaction design.

The Leonardo Book Series is proud to include *Windows and Mirrors: Interaction Design, Digital Art, and the Myth of Transparency.*

Joel Slayton

Acknowledgments

The "we" of this book (the coauthors) represents two perspectives on the SIGGRAPH Gallery. One of us was involved in every step of the design and execution of the gallery; the other was an engaged outsider. Diane Gromala was the chair of the SIGGRAPH 2000 Art Committee and therefore had primarily curatorial responsibility for the gallery. (David Okula also made important contributions to the design of the gallery.) Jay David Bolter, meanwhile, witnessed the evolution of the gallery as he worked with Gromala in the Wesley Center for New Media at the Georgia Institute of Technology.

Our backgrounds have proved to be complementary (or perhaps contradictory) in productive ways. Gromala had had long experience as a digital artist and designer, to which she added a knowledge of media and critical theory. Bolter had been a historian and theorist of digital technology, whose work in hypermedia had led him to a growing appreciation of the computer as a new expressive medium. We have subsequently cotaught courses on digital, visual design in the graduate program at Georgia Tech, in which we combine productive theory with critical practice.

For each of us, the gallery was a reflective experience, but in different ways. Gromala knew each exhibit so well that she was able to reflect on their effects as she forged her vision of the whole gallery as a collective experience. Bolter was able to consider each of the pieces in turn and the gallery as a whole, when he visited the working gallery in July 2000. This visit helped him to reflect on the relationship of digital art to the larger design and human-computer interaction communities.

The Art Gallery Committee, who worked with Diane to plan and stage the exhibit, included Deena Elisabeth Eber (Bowling Green State University), Mirtha Ferrer (Georgia Institute of Technology), Ian Gwilt (Wanganui Polytechnic), Saoirse Higgins (ArtHouse Multimedia Centre), David Okula (Space Guru), Lily Shirvanee (MIT Media Lab), and Noah Wardrip-Fruin (New York University). The committee was assisted by the jury, including Steven Dietz (Walker Art Center), Thecla Schiphorst (Simon Frazer University), Andrew Glassner (consultant), and Marla Schweppe (Rochester Institute of Technology).

In addition to the committee, we have many people to thank for helping to make this book possible: Frances Hamilton, Lauren Keating, and Lily Shirvanee. We thank those who read and critiqued portions of the manuscript, including John Bowes, Amy Bruckman, Christine Golus, Blair MacIntyre, Gretchen Schiller, Tom Rieke, Chris Shaw, and Teal Triggs. Their comments were extremely helpful, even when we weren't wise enough to follow all their advice. Thanks to the talent, help, and support of The MIT Press, especially Douglas Sery, Katherine Innis, Sandra Minkkinen, Beverly H. Miller, Erica Schultz, and Yasuyo Iguchi.

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We are grateful to the following artists, designers, scholars, and friends for their kind permission to reprint graphics: figures 1.1–1.6 (Camille Utterback and Romy Architùv); figure 1.8 (Lubalin family); figures 2.1 and 2.2 (Daniel Rozen); figure 2.10 (Zuzana Licko); figures 3.1–3.4 (Tiffany Holmes); figure 3.5 (Wolfgang Weingart); figures 4.1–4.4 (Mark Billinghurst, Rob Blanding, Winyu Chinthammit, Tom Furness III, Nick Hedley, Hirokazu Kato, Lori Postner, Ivan Poupyrev, and Lily Shirvanee); figure 4.5 (Kathleen Brandt); figure 4.6 (Cameron McNall, Shane Aker, Doren Garcia, Jim Gayed, David Hutchins, Gareth Smith, and Jackie Stewart); figure 5.1 (Jeff Gomperz, Prema Murthy, and Eugene Thacker); figure 5.2 (Michael Hart); figure 5.3 (Elliott Peter Earls); figure 5.4 (Ranio Ho); figure 6.1 (Sponge: Sha Xin Wei, Chris Salter, Laura Farabough, Maja Kuzmanovic, Evelina Kusaite, Cynthia Bohner-Vloet, Sam Auinger, Joel Ryan, Ozan Cakmakci, Kristof Van Laerhoven, Els Fonteyne, Walter van de Velde, Adam Lindsay, and David Tonnessen); figures 6.2–6.5 (Larry Hodges); figures 6.6–6.7 (Blair MacIntyre); and figures 7.1–7.5 (Michael Mateas, Steffe Domike, and Paul Vanouse).

Unless otherwise indicated, all the sites referenced in this book were visited and working on or about July 1, 2002.

Finally, we acknowledge the work of the following critics and theorists. Readers (and especially reviewers of our book) all have their favorites and are likely to complain that we are ignorant of this or that key idea. We are no doubt ignorant of many important ideas, but we are acquainted with the contributions of the theorists and theories listed below. We choose not to discuss them, because this is a book about the craft of and the material engagement with digital art and design, and we believe that the theoretical literature often strays too far from practice to be useful for our purposes:

Richard Dawkins and memes
Deleuze and Guattari and rhizomes
Donna Haraway and cyborgs
Heidegger and enframing
The Frankfurt School and the culture industry
Lacan and the mirror stage
Baudrillard and simulacra

Windows and Mirrors

Introduction (but really, you should read this)

In 1998 in *The Invisible Computer,* Donald Norman told us that computers as we know them are going to disappear. We'll continue to use computers, of course, but they will disappear from view as they are absorbed inside "information appliances." Norman drew an analogy to electric motors in the early twentieth century. When the technology was first marketed, consumers bought a very visible electric motor with attachments to accomplish various tasks—for example, to power a vacuum cleaner. But soon the motors were built into the appliances. No one any longer thought of the machine as an electric motor with an attachment to clean floors; instead, they thought of it as a vacuum cleaner, which contained a motor as a component. Norman believes that computers will evolve in this same way into information appliances, such as electronic calendars, cell phones, and portable e-mail readers. We won't care much that there is a digital processor inside these appliances; we *will* care that each appliance accomplishes a task for us. Norman's argument seems convincing when we look around at all the devices, from personal digital assistants (PDAs) to automobiles, that depend on computer chips. Still, Norman is telling only half the story. Our book is meant to tell the other half.

This is a book specifically about digital art, but it is written for digital designers and technologists in general: Web designers, educational technologists, graphic designers working with and in digital forms, interface designers, human-computer interaction (HCI) experts, those who are laying out the future of digital media for business and entertainment, and anyone interested in the cultural implications of the digital revolution. We describe in this book what digital art has to offer to this vast community.

Digital art shows that the computer is not becoming invisible in our culture, as the electric motor did. We don't want computers to disappear. Although processors are being buried in all sorts of devices, computers continue to fascinate us. We continue to be exhilarated by and sometimes frightened of what digital technology is doing, and we are tantalized by the prospect of what it might do in the future. It is the task of digital art to fascinate, exhilarate, and sometimes provoke us. Appliances, on the other hand, don't fascinate us; they brown our toast.

We are talking about two competing visions of digital technology: the pragmatic vision offered by Norman and other HCI experts, for whom computers *are* information appliances, and the vision offered by digital artists and interaction designers. They are competing in the sense that each vision is an attempt to convince our culture at large. The differences in these visions emerge quite clearly when we look at the most popular, the most exciting, and in some ways the most disappointing contemporary manifestation of digital technology: the World Wide Web. Let's start with a parable.

The Structuralists and the Designers

The Internet once belonged exclusively to the Structuralists, a community composed mostly of graduate students and professors in computer science, who seldom ventured outside their cubicles. This closely-knit community had its own ethics and languages (such as C). Their culture was highly developed in mathematics but not in art.

Around 1990, one of these Structuralists, Tim Berners-Lee, had an idea for a new service that would run on the Internet, a global hypertext system he called the World Wide Web. There had been other hypertext systems before this, most of which had worked only on stand-alone computers. Berners-Lee's brilliant idea was that the links of one hypertext could point to information stored on other servers connected to the Internet. But his hypertext system was limited largely to verbal representation: each page could display only ASCII text along with links. This was adequate for the uses that Berners-Lee foresaw, because he wanted a system that would help scientists share drafts of their papers and other information. The World Wide Web grew slowly in its first years, precisely because it served this limited audience.

In 1993, another Structuralist, Mark Andreessen, and a colleague produced Mosaic, the first graphical browser for the Web. At the same time, he introduced a new tag—the in-line image tag—which allowed static images to be integrated into the text of the Web page. This apparently small improvement had enormous consequences, because people outside the Structuralist community began to see how the Web might be used to provide information and entertainment to a vast audience beyond the scientific world. They began to imagine what we now call e-commerce.

That's when the Designers started to invade the Internet. Although this tribe was less homogeneous than the Structuralists, many of them were trained as graphic designers for print, and they brought the skills and assumptions of graphic design to the Web. They knew how to weave together words and images in order to communicate in the two-dimensional space of the printed page. They assumed that a Web site could function like a newspaper or magazine as a form of visual communication. Some Designers came to Web design because they were attracted by the potential of this new form. Others invaded the territory of the Structuralists as mercenaries, paid by clients who wanted to colonize this new realm for advertising.

The Designers soon mastered the Structuralist language, html. They considered this language primitive, however, because it did not provide enough control over the look of the Web page. The reason was that, in keeping with their view of how information should be organized, the Structuralists had designed html to describe the structure (paragraphs, lists, links) but not the appearance of the page. The appearance—the Structuralists believed, according to their ethic of technological democracy—should be determined by each user.

This was the great, almost religious difference between the Structuralists and the Designers. The Structuralists were separatists, believing that form and content could and should be separated. For them, a Web site is a pipe through which content flows to the user. They opposed elaborate visual design, which they thought impeded the flow of information. The Designers, on the other hand, were unitarians, who believed that form and content could not be separated: that a Web page communicates its message through the careful interplay of words and images. For the Designers, a Web page is an experience, and they wanted complete control over it, just as they had enjoyed (more or less) complete control in print. So the Designers kept pressing for more html tags that would give them that control.

The struggle to define the Web continued throughout the 1990s. For example, the Designer David Siegel (from whom we have taken the term *structuralist*) wrote in his influential book *Creating Killer Web Sites* (1997), "I believe design drives the user's experience. . . . Who cares how great your content is if people aren't attracted to it or don't find it pleasurable to read?" (8).

As late as 2000, HCI expert and Structuralist Jakob Nielsen wrote in *Designing Web Usability*, "Ultimately users visit your website for its content. Everything else is just the backdrop. The design is there to allow people access to the content. The old analogy is somebody who goes to see a theatre performance: When they leave the theatre, you want them to be discussing how great the *play* was and not how great the costumes were" (99). Nielsen has become the champion of what might be called the Structuralist Reformation, pursuing with a puritanical zeal what he regards as the exuberance of the Designers.

Nielsen believes that the Web is for business, not pleasure: it should be a transparent channel for information transfer. He is literally an iconoclast, arguing that graphics are greatly overused on the Web (they slow download time). He would bar the use of Flash from Web sites. For Nielsen, the most efficient design is one that becomes invisible and leaves the user alone with the information content, and clearly that content is typically text rather than an image. Designers like Siegel believe that Web pages are visual (and potentially auditory) experiences. Static and now moving images are not "window dressing" that slow download time; rather, they are essential to the communicative experience.

Nielsen's book and articles are widely read and discussed. For better or worse, however, the Designers seem to be winning the battle in cyberspace itself. Nielsen himself admits that the vast majority of Web sites are badly designed—that is, they don't follow his prescriptions. There are more images, more digitized video and audio, more animation on the Web every day. Designers like Siegel would agree that sites are often (usually?) poorly designed. For them, the problem is not that the sites use too many images, but rather that they use these images poorly and so fail to provide a compelling experience for their users.

The visible computer

The debate between the Structuralists and Designers over the World Wide Web is part of a struggle to define new media design and, in a larger sense, the significance of digital technology for our culture. While Jacob Nielsen and Don Norman might (or might not) object to the name, they represent the Structuralist position with authority. Nielsen tells us that Web pages should be transparent vehicles of information delivery. Norman tells us that the computer will be absorbed into a series of smart information appliances. They are not altogether wrong. Sometimes we do want our Web pages to provide the quickest route to a specific fact, and we are already surrounded by information appliances, especially cell phones.

For our current culture, however, the term *appliance* doesn't describe computers very well. Computers don't feel like toasters; they feel much more like books, photograph albums, or television sets. For us today—and it's a realization that our culture has made gradually over the past thirty years—the computer feels like a medium. It is providing us with a set of new media forms and genres, just as printing, the cinema, radio, and television have done before. These digital media forms stage experiences for us.

As producers and as users of digital technology, we don't want our computers to disappear, any more than we want books, films, or paintings to disappear. As producers and as users, we often want to be aware of the medium in order to understand the experience that it is staging for us. For that reason, this book could be subtitled *The Visible Computer.* As producers, we must master techniques to render digital media transparent to the user, but we must also render the media visible to and reflective of the user. Making digital artifacts requires both perspectives. As we show in the following chapters, every digital artifact oscillates between being transparent and reflective. The mistake that Nielsen and Norman make is to assume that the single goal of all design is to make the interface transparent, when in fact the goal is to establish an appropriate rhythm between being transparent and reflective. This is a common error in mainstream interface design and HCI today. Despite evidence of the popularity of experiential Web sites, computer designers and HCI experts still suppose that the best interface is always "clear," "simple," and "natural." As we shall see, all of these are variations on the theme of the disappearing computer.

Every digital artifact oscillates between being transparent and reflective.

How to read our parable, or what we are *not* saying

This book will be misunderstood. In a vain effort to prevent misunderstanding, we would like state at the outset: we are NOT saying that the computer and information scientists, who, after all, built the Internet and created the World Wide Web, are foolish or naive. And we are not claiming that visual designers are innately superior. The Structuralists represent an important vision of the world as information to be organized and presented to users in the most efficient way possible. Their vision is not wrong, but it is incomplete. (In fact, some of the Structuralists themselves are beginning to acknowledge the need for a broader vision. Norman is now studying the importance of aesthetics for design, as he indicates in "Emotion and Design," published in *Interactions,* 2002.)

Furthermore, we are not denying that there is a difference between art and more pragmatic forms of design. The distinction between visual art and graphic design, for example, is a century old. We believe, however, that in one sense, digital art can be understood as a form of interface design.

The significance of digital art

The assumption that the computer should disappear needs a strong corrective, and in this book, we look to digital art to provide that corrective. We will examine some compelling recent works, taken from the art gallery at the SIGGRAPH conference at the turn of the millennium. These works cannot be dismissed as eccentric reactions to digital technology or as "personal expressions." We should instead think of them as radical experiments in digital design—experiments by people with a wide variety of backgrounds in art and technology who have thought deeply about the relationship between digital technology and the user. Such digital art can be the purest form of experimental design.

Digital art is relevant for information architects, creative managers who are building Web sites, usability specialists testing productivity software, computer scientists imagining new applications in mixed reality and ubiquitous computing, and those seeking to create new forms of digital entertainment. That relevance is proved by the fact that one of the most prestigious computer conferences welcomes this art into its midst. These works are not meant to deliver some benign information content and then disappear from our consciousness. Instead, they engage us in interactive experiences in which it is meaningless to try to separate form and context. Rather than castigate the Structuralists, we want to convince them that digital art can help all information technologists achieve their goal of effective design.

Chapter 1. TEXT RAIN

THE DIGITAL EXPERIENCE

To design a digital artifact
is to choreograph
the experience that the
user will have.

If we only look *through* the interface,

we cannot appreciate the ways in which

the interface itself shapes our experience.

The Art Gallery of SIGGRAPH 2000

SIGGRAPH 2000 was a carnival for the twenty-first century. Its distant predecessors were the medieval and Renaissance trade fairs of Europe, where people crowded into a muddy town marketplace to gawk at tables of exotic goods (cinnamon and silk), to be entertained by singers, jugglers, players, and animal acts. The delights of SIGGRAPH 2000 were more high tech; there were no dancing bears. For the conferees of SIGGRAPH 2000, technology itself was the attraction: the latest releases of Photoshop and OpenGL; the fastest new texture-mapping hardware from SGI; the newest games for the Sony Playstation 2. All these attractions were collected in a maze of booths in the enormous, refrigerated halls of the Morial Convention Center in New Orleans.

The conferees came not only to see the newest technological toys but also to discuss the future. For, unlike Comdex, the Las Vegas extravaganza of electronic consumerism, SIGGRAPH is an academic conference as well as a trade show. In the technical sessions, conferees considered technologies yet to be released. Academic computer specialists and industry researchers met to review work on subjects like the psycho-physiological models of shading and lighting, the modeling of snow, the animation of clouds, and non-photorealistic virtual reality. Unlike other academic conferences, SIGGRAPH has long recognized that digital art can contribute to this discussion—that digital art too is technology yet to be released. The Art Gallery has been a part of SIGGRAPH since the 1980s, and the

Figure 1.1
The Art Gallery of SIGGRAPH 2000.

gallery at SIGGRAPH 2000 was the largest and most varied in the history of the conference, exhibiting the work of sixty leading digital artists.

Hall D, which alone seemed large enough to assemble the space shuttle in, housed the Art Gallery (figure 1.1) as well as the Emerging Technologies exhibit. You might have found it difficult to decide where the art ended and the emerging technologies began. Like the digital art, many of the Emerging Technologies exhibits provided visitors with interactive experiences. Like the Emerging Technologies exhibits, installations in the Art Gallery were experiments in design. The most visible, and in some ways the most important, part of any digital application is its interface—the face that the application presents to its users. And digital art is all interface, defined entirely by the experience of its viewing or use. That is why digital art can provide such a clear test of the possibilities and constraints of digital design: it fails or succeeds unequivocally on the strength of its interface.

Digital art can provide the clearest test of the possibilities and constraints of digital design.

In the following chapters we tour the Art Gallery of SIGGRAPH 2000, stopping to examine a few pieces closely, because this tour has a specific purpose. We want to ask of each piece: What does this work have to offer to the digital design community in general? What lessons can we carry from this work over into other applications, other domains of digital design? Because each piece is a realization, an embodiment of radical design, it will embody the following three points:

1. The computer has become a new medium (a new set of media forms).

2. To design a digital artifact is to design an experience.

3. Digital design should not try to be invisible.

Since the 1970s, it has become increasingly clear in our culture that the computer and related digital technologies are media technologies and support a range of new media forms. Media forms are not just channels for information, they also provide experiences. Furthermore, in every digital artifact, from spreadsheet to video game, the physical shape, the interface, the look and feel are part of the user's experience. Every digital artifact needs at times to be visible to its user; it needs to be both a window and a mirror.

TEXT RAIN

It's July 25, 2000, and the gallery is crowded with visitors. An installation that everyone visits sooner rather than later is *TEXT RAIN,* created by Camille Utterback and Romy Achituv. *TEXT RAIN* consists of two large parallel screens; one features projected video, while the other serves as a backdrop. These two screens form a corridor about ten feet wide within the gallery, and no one passes through that corridor without glancing up at the screen, slowing, and then stopping, at least briefly, to take part in the show. As the visitor immediately discovers, she herself becomes the show, when her face and figure are caught by the video camera and projected on the screen in black and white. At the same time, a rain of colored letters falls steadily from the top of the screen. Wherever the letters come in contact with the viewer's image, they cease to fall. Whenever the viewer moves, the letters that had collected resume their fall. Visitors instantly want to play, making visual and verbal patterns by holding the letters in their hands or along their arms (figures 1.2 and 1.3). They hold up boards or sheets in order to catch the letters and even make them rebound (figures 1.4 and 1.5).

Figure 1.2
Camille Utterback and Romy Achituv, TEXT RAIN: *Catching the falling letters.*

Figure 1.3
TEXT RAIN: *A dancer channels the letters with her body.*

TEXT RAIN is not simply an expression of the artist's personality. (That romantic notion doesn't fit digital art well.) Rather, the experience of this piece comes from the interaction of the viewers with the creators' design. *TEXT RAIN* is as much an expression of its viewers as of its creators; it is what the viewers make of it. Without them, the piece is incomplete, for there is nothing on the screen but the falling letters. In fact, *viewers* is not an entirely adequate term; they are participants or users at the same time. *TEXT RAIN* is a text that its viewer-users help to create, a text that they write in the process of reading. Like the other digital installations in the gallery, *TEXT RAIN* is about the process of its own making.

The letters of the text come from the poem "Talk, You" by Evan Zimroth (1993). If you cup your hands, you sometimes manage to capture a whole word or a short phrase. The word or phrase belongs to the original poem, if the letters manage to stay together during

Figure 1.4
TEXT RAIN: *Using a sheet to catch . . .*

Figure 1.5
TEXT RAIN: *. . . and toss the letters.*

Figure 1.6
TEXT RAIN: *Making a kinetic poem.*

their fall. When one or more letters are lost or the letters of another word intervene, *TEXT RAIN* becomes a kinetic poem—one that re-forms itself before your eyes. *Turning* could become *tuning*; *limb*, *limbo*. Often, the letters that rain down offer only nonsense, but sometimes they make just enough sense to encourage the viewers to find meaning. "TuninGear und too" or "ym for limbs" or "Im faces" could be phrases from James Joyce (Figure 1.6).

In this way *TEXT RAIN* comes to mean what the viewer-user wills it to mean. Digital works like *TEXT RAIN* make us playfully aware of our relationship to our technology, and they suggest that we can assert some degree of control over the relationship.

TEXT RAIN not only invites its participants to make meaning; it puts them on video as they do so. Other visitors to the gallery can see them holding up their arms and smiling, and they can see the images on the screen, which explain the participants' funny gestures. The behavior of the participants brings other visitors over, who then become participants themselves. *TEXT RAIN* is a poem and a video program at the same time. As an experiment in the future of digital technology, it suggests that that future belongs to presentation and representation.

In our digital culture, we are indeed coming to value computers for their capacity to present and represent. We have known for decades that computers can represent numbers and texts, but now we know that they can also present images and sounds. Using a computer has become a multimedia experience—an experience so compelling that we in the industrialized world now surround ourselves with digital devices. In the past, we were reluctant to acknowledge that computers offered us such experiences. Only teenage boys and geeks were allowed to admit that digital technology could be fun or exciting. For the rest of us, computers were supposed to be "good for something." However, just like films, CDs, and books, what digital artifacts are often good for is to stage experiences for their users.

HCI expert and cognitive scientist Donald Norman tells us that as computers become smaller and more portable, they are morphing into information appliances. Although it is certainly true that digital technologies are conveyors of information, the term *appliance* is too limiting. We do not call books, still cameras, or movie cameras "appliances." We do not simply apply computers to tasks of information storage and retrieval, any more than we use books or television strictly for that purpose. Books, televisions, and computers stake out a cultural territory that is more varied and more mysterious than refrigerators. That's the territory that *TEXT RAIN* and the other installations of SIGGRAPH 2000 are exploring. Each installation calls its participants into an active relationship, asking them to perform rather than merely to view.

Brenda Laurel understood the performative and representational power of the computer when she wrote *Computers as Theatre* (1991). She argued that we should design computer applications not only to be used, but to be performed and experienced. But Laurel put too much emphasis on one rather specialized media form, the theater. In fact, the computer is not only a new stage for theatrical performance; it can also be a new cinema, a new television, and a new kind of book. The computer does not fuse all its representations into a single form, but presents them in great variety. If there was ever a technology that did not have a single essence, it is the digital computer.

In its fifty-year history, the computer so far has been a calculating machine, an electronic brain, a filing cabinet, a clerk, and a secretary. If we trace that history briefly, we can see how the computer has now become a medium, or rather a growing set of media forms.

The computer becomes a medium (a new set of media forms)

It's 1949. Depending on your definition of a computer, there are three or four such machines in the world, whose names sound like villains in Superman comic books: ENIAC, EDSAC, BINAC. These machines are used almost exclusively to do complex calculation for military and civilian scientists and engineers. Computer pioneer Howard Aiken is reported to have told the U.S. Bureau of Standards that the world would only ever need five or six computers like the ENIAC.

The computer did not start out as a medium. In the 1940s, when the brilliant and elegant John von Neumann, the brilliant and eccentric Alan Turing, and many others were designing the first programmable computers, they were *not* defining a new medium. They were building super-fast calculating engines to solve problems in science and engineering. Their work was funded by the U.S. and British governments as part of the effort to win World War II and then to ensure the advance of technology after the war. Even at that time, however, von Neumann and Turing understood their machines as something more—as "symbol manipulators." It didn't matter whether the symbols were numbers, words, or the elements of any logical calculus. The computer could take these inputs, apply the rules of logic, and produce new patterns as output.

In the late 1940s, when he was working at Manchester University and musing on the significance of the first computers, Alan Turing came to believe that the essence of human thought is symbol manipulation. Turing was in many ways a stereotype of the British mathematical genius, lost in thought and unconcerned with appearances: he bit his nails, went out without his tie, and rode a bicycle whose chain derailed with mathematical regularity (Hodges 1983). During World War II, Turing had helped to build and use the mechanical Bombe and the electronic Colossus to decrypt messages from the Germans' Enigma coding machines, so he knew that a computer could function as a technology for transforming and transferring messages—that is, as a medium. But he went in another direction, appropriate for an introverted genius, and became convinced that the digital computer was not a medium but a mind. For Turing and others who followed him, the computer should not just be a channel for human messages; it should be a thinking machine, capable of producing its own messages.

It's 1954. The U.S. economy is already spending $10 million a year on computer hardware (Cortada 1997, 32). The machines are beginning to be used not only for military and scientific research, but also for large-scale bureaucratic tabulation and business data processing. On election night in November two years earlier, the UNIVAC computer had predicted a landslide win for Dwight Eisenhower, suggesting that computers can manifest greater political savvy than the pollsters, who were predicting a close race.

Turing became the patron saint of the artificial intelligence (AI) movement. Following Turing, AI specialists, including John McCarthy and Marvin Minsky, argued that computers could make that ultimate leap over the wall that the French philosopher Descartes had erected between the mind and the body. They believed that computers were physical machines that could exhibit mind, the very idea that Descartes had thought impossible. These enthusiasts proceeded to frighten and fascinate us with this vision for almost half a century, although even today, no machine can come close to passing the Turing test. Sadly for AI enthusiasts, 2001 has come and gone, and there is no HAL. Yet the idea of the computer as a symbol manipulator was and remains powerful. All the scientific and engineering uses of the computer, the business information systems, the databases and text archives, and more recently the spreadsheets and word processors in personal computers, are expressions of the computer as symbol manipulator. Throughout the last half of the twentieth century, the enthusiasts kept insisting that the essence of both human and machine intelligence was symbol manipulation—that there was, in fact, no essential difference between human beings and computers. And because of the way we used the computer in these decades, they made some sense. It was easier to think of the computer as an ersatz human being than as a medium like print, radio, film, or television.

It's 1962. There are 10,959 computers in the world (Cortada 1996, 70). In the following decade, the first time-shared computer systems will allow some lucky programmers at MIT and elsewhere to input their programs "interactively"—by typing them into a text editor. Nevertheless, many still fail to see the computer's potential to store and transmit even textual information.

A few voices were suggesting that the computer was a medium, but it took us decades to hear them over the noisy claims of the AI enthusiasts. No one listened in the early 1960s, when a young humanist, Ted Nelson, began to argue that the computer made possible a new kind of reading and writing that he called "hypertext." Douglas Engelbart got a much better reception in 1968 when he gave a masterful demonstration of his NLS (oNLine System), which included collaborative word processing, data file sharing, teleconferencing, and hypertextual linking. His audience of a thousand computer professionals was overwhelmed. J. C. R. Licklider and Robert Taylor were moved by NLS to write, "In a few years, men will be able to communicate more effectively through a machine than face to face" (Licklider and Taylor 1999). Their article, "The Computer as a Communications Device," written in 1968, was one of the first to label the computer as a medium. Licklider and Taylor had seen a very early version of the future, however; Engelbart was still years ahead of his time. In order to make the computer a communications medium for our culture as a whole, two technologies had to be developed and put into widespread use: electronic networks and the personal computer.

It's 1979. The number of personal computers in the United States already exceeds 500,000 (Cortada 1997, 33). Two college dropouts are building and marketing a microcomputer they call the Apple. The networking of universities and corporate research centers, which began around 1970 as the ARPANET, continues. College students at Duke and the University of North Carolina are devising a protocol called Usenet to allow people to subscribe and contribute messages to newsgroups.

Licklider at the Advanced Research Projects Agency in the Defense Department supported the development of the wide-area network, the ARPANET, which eventually led to the NSFNet and the contemporary Internet. Robert Metcalfe and others at Xerox Palo Alto Research Center (PARC) in the 1970s created the software and hardware for local-area networking, called Ethernet. Meanwhile, Alan Kay and his team at Xerox PARC were inventing the personal computer, which Kay called the Dynabook, or "personal dynamic medium" (Hiltzik 1999). Kay had no doubt what the computer was when he wrote, "Although digital computers were originally designed to do arithmetic computation, the ability to simulate the details of any descriptive model, means that the computer, viewed as a medium itself, can be *all other media* if the embedding and viewing methods are sufficiently well provided" (Kay and Goldberg 1999). Kay was claiming that the computer was the ultimate medium and could make all other media obsolete. Using his Dynabook, we could create, edit, and store texts; we could draw and paint; we could even to compose and score music.

What Kay and his colleagues actually produced was the Alto (figure 1.7), an "interim" Dynabook that could perform all these wonders in some form. But the Alto was a research machine, which only the workers at Xerox PARC and some lucky students at the Jordan Road Middle School in Palo Alto ever got to use. In order to convince the rest of us, the Dynabook had to come into the hands of millions of users, and Steve Jobs added that necessary element when he marketed

Figure 1.7
The Alto computer, a "personal dynamic medium" of the mid-1970s. Courtesy of Xerox Palo Alto Research Center.


U&lc.

A Proposition for Education in Letterforms & Handwriting

Lettering and Society

The Inter-dependence of Technique and Typography

Technical Training for Technicians and Typographers

Type in Our Environment

Education and Training in Letterforms

The Rules of the Game

Figure 1.8
Herb Lubalin, computer-controlled graphic design from the 1970s.

the Macintosh computer. The graphics and sound capabilities of the Macintosh were the key to convincing us that the computer was a medium. At that time when someone said the word "medium," we thought first of television, film, and radio. Now, as the computer screen began to look and act like a television screen and as its speakers began to play music or even speak words, we saw the computer itself in a new way.

Computer specialists had been exploring the power of the computer to display, manipulate, and animate images since the 1960s, but a popular audience for their electronic images developed only later. American culture first came to appreciate computer graphics in such movies as *Star Wars* (1977) and then on television. Meanwhile, graphic designers began to use computer-controlled photocomposition to create layouts in magazines and newspapers (figure 1.8).

It's 1989. There are almost 14 million computers in American homes; 75 million Americans use a computer at home, at school, or at work (Cortada 1997, 33). Now eight years old, the IBM PC has established the word processor and the spreadsheet as indispensable business tools. (And as a result, typewriter sales are declining for the first time in a hundred years.) For millions of business users, the computer is now unquestionably a medium for words and numbers. For a smaller group of designers and educators, Apple is offering the first computer that is both a tool for visual design and an artifact of visual design.

With the Apple Macintosh computer, users had at first primitive and then increasingly sophisticated tools with which to create their own graphics. The computer became a medium when these tools and practices became widespread and the rhetoric of their enthusiasts became plausible. That rhetoric moved from articles in journals to advertisements in newspapers and on television, as communications and computer corporations began to announce (prematurely) that the computer was replacing the printing press. (It is amazing how seductive the rhetoric of prediction is. As recently as 2000, in *Designing Web Usability,* Jakob Nielsen was predicting that computers would replace printed books by 2007.)

It's 1993. With its Windows operating system, Microsoft ensures the success of the graphical interface that Xerox and Apple pioneered. The supporters of the DOS interface are left to join the Society for Creative Anachronism. Meanwhile, when Marc Andreessen shows the "inline image" tag to Tim Berners-Lee, the World Wide Web becomes a medium of visual design that will soon rival magazines and books.

The World Wide Web was the final element, creating in the 1990s an audience of millions of viewer-users for the digital experiences that networked computers had to offer. The creator of the Web, Tim Berners-Lee, had originally conceived of it as a textual medium, a global hypertext of words. But a few years later, Mark Andreessen and his colleagues devised the graphical Web browser and placed images and text together on a Web page for the first time. Within a few more years, it had become apparent that the computer could reconfigure and re-present much of the information and experience that our culture had previously located in books, newspapers, and magazines, in radio, in films, and on television. The computer was now unquestionably a medium, and it seemed hard to think of it as anything else.

At that point, our fears and fantasies changed too. For decades, AI specialists had fascinated us with the notion that the computer would change what it means to be human. (In 1984, Sherry Turkle summed up their vision in her book *The Second Self.*) If the essence of human thought was symbol manipulation, then it seemed inevitable that computers would eventually outthink us. In the 1960s, 1970s, and 1980s, philosophers, psychologists, and computer scientists argued furiously over what computers could or could not do—whether there was some human essence that computers could not duplicate. The argument was never settled, though, because it was a debate over cultural constructions. Collectively as a culture, we decide how computers are going to be used—whether as aids to human intelligence (calculators and word processors), replacements for human intelligence (AI applications), or expressive

Figure 1.9
Virtual reality headset (photograph: Ted Esser).

media. What happened was that we lost interest in the AI question as we changed our idea of what computers are for.

Computer graphics became more compelling to us than numerical analysis and logic programming. Although computers were still used to perform physics calculations, tend databases, write memos and letters, and control industrial processes, these applications had become routine. What caught our imagination now was the computer as a perceptual manipulator—as a graphics engine to make images move and as a MIDI (Musical Instrument Digital Interface) controller for sound. Virtual reality (VR) replaced AI in our digital dreams and nightmares, and in VR the old debate about technology and humanity was again redefined. The supporters of AI had insisted that human beings, like computer programs, were information processors. The VR enthusiasts now offered a different definition of human identity that emphasized the senses rather than abstract information processing. They suggested that to be human was to be a bundle of perceptions, a moving and malleable point of view, just what we feel when we are wearing a VR headset. The most compelling computer experience changed. It was no longer playing chess against an AI program like Deep Thought; instead, it was the experience of being immersed in a virtual world (figure 1.9).

The Internet was the other technology that changed our view of computers. The Internet realized the vision of Nelson, Engelbart, and Licklider for the computer as a node in a (potentially) global network. With the coming of e-mail and the World Wide Web, a standalone computer, one without a network address, now seemed incomplete. Digital devices, from desktop computers to palmtops, became portals to connect us with other people and devices. The texts we typed into our word processors no longer had to be printed out and delivered to readers in the traditional form of ink on paper. Now the computer itself was a medium of both creation and almost instantaneous publication. Now there were chatrooms, MOOs, and applications for instant messaging, which carried with them the excitement and potential danger of communicating with people around the industrialized world—people whom we might never meet and yet with whom we might have long, even intimate, conversations.

If we put these two defining digital technologies, graphics and networking, together, then we get global hypermedia on the World Wide Web—or we get a more poetic vision: novelist William Gibson's cyberspace, a globally networked virtual reality. In either case, digital technology today offers an experience that is more vivid than the phrase *information processing* can convey.

To design a digital artifact is to design an experience

We live in a media-saturated environment, in which many different forms and technologies compete for our attention. The traditional media (television, radio, film, and magazines and newspapers) are far from dead, and new digital forms, from video games to Web pages, must compete with them and with each other. The design of even the most business-like computer applications must take this competition into account. Computer applications can no longer afford to be (if they ever were) simple channels for the delivery of information, as if that were the same thing as delivering milk or cat food. Every application must be an experience.

In fact, interacting with a computer was an experience even before the computer was a medium, even in the era of plugboards, magnetic tapes, and punch cards. Talk to the veterans of the days before computers had interfaces, and they will tell you about the laborious process of inscribing programs on decks of punch cards. In the 1940s, 1950s, and 1960s, to use a computer meant to operate a machine. Yet even batch programming by punch card had its own rhythms and even pleasures. Anyone who really disliked the required precision and repetition presumably went into some other line of work.

Today, we do not operate computers; rather, we interact with them, and successful digital artifacts are designed to be experienced, not simply used. The term *user* is unfortunate (but now unavoidable), as if we were habituated or addicted to the artifact. Good digital designs do not addict; they invite us to participate, to act and react. To design a digital artifact is to choreograph the experience that the user will have. If the design is too restrictive, the choreography too heavy-handed, the experience may alienate the user. (The whole genre of computer-based training is heavy-handed in this sense.) If the design is ill defined, however, we cannot figure out what genre we are in. A new application can fail precisely because the user does not know what it is for.

To design a digital artifact is to choreograph the experience that the user will have.

Hypertext itself almost failed in this sense because people couldn't grasp what it was for. Ted Nelson, who coined the term, wandered through the computer world for more than twenty years talking to anyone who would listen about his vision for a global hypertext system he called Xanadu. A combination of the McDonald's franchise and an electronic Library of Congress, Xanadu would have linked together much (and eventually all) of the world's texts. In 1984, Nelson wrote that by the year 2020, "there will be hundreds of thousands of file servers—machines storing and dishing out materials. And there will be hundreds of millions of simultaneous users, able to read from billions of stored documents, with trillions of links among them" (Nelson 1984, p. 0/12). For Nelson, the Xanadu system had to be perfect, however—no compromises in architecture or coverage. He was waiting for this perfect system in order to organize and incorporate all of his own ideas and writings. The legend is that the rooms of Nelson's house were filled with slips of notepaper waiting to be fed into Xanadu and "intertwingled." Xanadu was never built, except in ephemeral prototypes, and almost no one else could see why hyperlinked texts were necessary at all. Tim Berners-Lee and then Mark Andreessen finally came up with the right package in the form of the World Wide Web. Here was a media form that people could understand—a combination of electronic text and images that recalled all the uses of graphic design for print and ultimately promised global multimedia. It could be a digital library for scholars and scientists, but it could also be a new kind of shopping mall for consumers. It could entertain surfers with everything from pornography to the virtual Louvre. The Web finally presented hypertext as a convincing digital experience.

Such a digital experience does not simply enhance the delivery of information. The information itself becomes an experience. Even word processing programs and spreadsheets provide experiences. Using a word processor may be frustrating, as it is with Microsoft's animated paperclip (the software agent from hell) that insists on advising you how to write a letter when you are not writing a letter. Nevertheless, it is an experience. Listen to your friends and colleagues complaining about the Microsoft paperclip; it annoys them in a way that they want to share with you, just as they want to share the experience of having their flight cancelled or being caught in a two-hour traffic jam.

In a similar fashion, people like to share their adventures on the Web. William Gibson's often quoted description of cyberspace in *Neuromancer* (2000) really does seem to fit the Web: "a consensual hallucination experienced daily by billions of [human beings]" (51). The Web may still have only millions of participants, but it is an experience of enormous power. Pragmatists like Jakob Nielsen, who tell us that the Web is about gleaning information as rapidly as possible from transparent pages of words and images, do not seem to understand why this technology is extraordinarily popular. They tell us how bad most Web sites are at conveying information. Yet if the Web is so bad at doing what it is supposed to do, why do millions of people choose to share the "hallucination"? The Web is a multimedia experience in which users are prepared to indulge for five, ten, or twenty hours a week, and the visual design of Web pages is not "window dressing" for the content. The form and content of Web pages are inseparable. Pragmatic explanations of the Web as an information system are not wrong, but they are insufficient. The same pragmatic explanation fails to account for the influence throughout the twentieth century of visual design in posters and magazines and on television. It fails to explain why successful corporations have been willing to pay millions of dollars on branding and design programs for stationery and physical products and why they continue to do so on the Web.

In the past decade, some digital designers have come to speak of their task as "interaction design," understanding an interface or application not as a series of static screens, but rather as a process of give and take between computer and user. Interaction designers must keep in mind a world of if-then scenarios. In a sense, they must think like scriptwriters preparing the dialogue for a film or play, but with a key difference: in a film or play, the dialogue is fixed, while in a digital interface, the possibilities multiply as the user's choices call forth different visual or textual responses from the computer. A digital artifact can be designed to unfold in multiple ways. The best digital art can help us see how to design for multiplicity, because such art adapts itself to the user rather than forcing the user to follow a rigid script. Works of digital art are experiments in interaction design. They can afford to be radical experiments because they do not have to meet the (often contradictory) demands of a client. As pure interfaces, they demonstrate that content and form are inseparable. A work of digital art can isolate and explore with clarity the relationship between itself and the user.

Works of digital art are experiments in interaction design.

As Nathan Shedroff (2002) puts it, "The emphasis in Interaction Design is on the creation of compelling experiences," and for that reason he also calls his approach "experience design." Shedroff is one of a number of innovators (including Clement Mok, Richard Saul Wurman, David Kelly, Shelley Evanson, and Hugh Dubberley) who are bringing graphic and

Figure 1.10
Workers at SIGGRAPH 2000, playing in the TEXT RAIN.

visual design together with information design in the digital realm (Winograd 1996; Wurman and Bradford 1996). Their goal is a digital experience that is carefully structured yet both visually compelling and open to creative interaction with the user. The interaction between designer and user *through* the technology is what gives the experience its meaning. Experience design is also contextual, in the sense that designs must both respond to and shape the many contexts (personal, physical, and cultural) in which they function.

Digital art is an expression of this new design philosophy. When we walk into the SIGGRAPH Gallery, we expect to have an experience that we would not have in everyday life. We are prepared to let the artist-designer choreograph our experience. If the design is successful, however, the experience can seem both inevitable and surprising.

To set up SIGGRAPH in the enormous bays in the Morial Convention Center, construction workers with forklifts and scaffolds were needed. As these workers assembled the Art Gallery, they too began to play with *TEXT RAIN.* They caught the letters on the railings of their forklifts (Figure 1.10). Instantly and effortlessly, *TEXT RAIN* became part of their working world. *TEXT RAIN* is not an elite piece of art, but an experience to be appreciated by both construction workers and Ph.D.s in computer science. It manages to be immediately accessible to a broad audience.

Digital applications offer an experience like that offered by books, films, and photographs: a media experience that is also an "immediate" experience. The essence of digital design is to work on two levels at once—to be both mediated and immediate. Digital applications cannot deny that they are media forms, depending on highly sophisticated, electronic technology. At the same time, in crafting digital applications, designers must try to make their work easy to grasp and accessible for their users. Digital art, like the work at SIGGRAPH 2000, contributes to digital design by showing us how media forms can also be immediate.

TEXT RAIN, for example, combines forms of print and video to give us a new kind of reading and writing. A poem and a television show at the same time, *TEXT RAIN* is both visible and invisible as a media form. The participants find the interface so easy to use, so natural, that they need no instruction at all. They understand instantly how to project their images on the screen and interact with the falling letters. The space of *TEXT RAIN* is an image of the physical world and at the same time an interface, a space for the manipulation of texts.

Digital art, like other digital applications, often opens a window for us, as we look through the computer screen to see the images or information located "on the other side." But *TEXT RAIN* is also a mirror, reflecting us as we manipulate the letters. It is as if we have passed through the screen and find ourselves inside some malfunctioning word processor that is raining letters down on us. *TEXT RAIN* surprises and pleases us by being simultaneously a mirror and a window. If there is one reason that digital art is important for digital design, it is this: digital art reminds us that every interface is a mirror as well as a window.

Digital design should not try to be invisible

Think of the computer screen as a window, opening up onto a visual world that seems to be behind or beyond it. This is the world of information that the computer offers: texts, graphics, digitized images, and sound. Concentrating on the text or images, the user forgets about the interface (menus, icons, cursor), and the interface becomes transparent. HCI specialists and some designers speak as if that were the only goal of interface design: to fashion a transparent window onto a world of information.

There are times, however, when the user should be looking at the interface, not through it, in order to make it function: to activate icons or to choose menu items, for example. At such moments, the interface is no longer a window, but a mirror, reflecting the user and her relationship to the computer. The interface is saying in effect, "I am a computer application, and you are the user of that application." No interface can be or should be perfectly transparent, because the interface will break at some time, and the user will have to diagnose the problem. Furthermore, even when the interface is working, we should not allow it to take us in completely. If we only look *through* the interface, we cannot appreciate the ways in which it shapes our experience. We should be able to enjoy the illusion of the interface as it presents us with a digital world. But if we cannot also step back and see the interface as a technical creation, then we are missing half of the experience that new digital media can offer.

If we only look *through* the interface, we cannot appreciate the ways in which it shapes our experience.

The same would be true if we treated any other medium as exclusively transparent. When we watch a film, we can sometimes get so absorbed in the story that we may temporarily forget about everything else, even that we are watching a film at all. The film as an interface has become transparent for us. Sometimes, however, we want to step back and appreciate how the film was made. This awareness enriches the experience of the film, and not only for a small group of film scholars. Many viewers of this popular medium are eager to learn more about how films are made, and they can. If we buy the DVD version of *The Sixth Sense,* for example, the disk includes scenes left out of the final cut, an interview with the director, M. Night Shyamalan, and descriptions of the special effects. These segments ask us to reflect on how the film succeeds in scaring and fooling us. Popular interest in the process of making films, television shows, and music has increased in recent decades, so that we enjoy all of these media forms as mirrors as well as windows. The same is true of the computer, itself now a medium. Every digital design functions as both a window and a mirror.

When we look in a mirror, we see ourselves, and we see the room behind and around us—that is, ourselves in context. Digital interfaces are like mirrors in the sense that they reflect the user in context, including her physical surroundings, her immediate working or home environment, and the larger environment defined by her language and culture. They do this work of reflecting whether or not the designers consciously intend it. Because the user brings all of these contexts to her interaction with any digital interface, the design cannot help but reflect them. The success of an interface, however, depends on the ways in which it can adapt to these contexts. The most compelling interfaces will make the user aware of her contexts and, in the process, redefine the contexts in which she and the interface together operate. This is where digital art can make a special contribution, because digital art is precisely the kind of interface that both reflects and redefines contexts.

Like other digital artists in the past two decades, those at SIGGRAPH 2000 want us to be aware of the contexts in which their individual works in particular and digital technology in general function. For that reason, there are more mirrors than windows among their exhibits. *TEXT RAIN* is a mirror that reflects its users, for as passers-by are caught by the camera, they find themselves projected on the screen in a rain of falling letters. The exhibit we visit in chapter 2, called *Wooden Mirror*, combines mechanical and electronic technology to produce a beautifully textured image of its visitors. In chapter 3, we visit *Nosce te ipsum* ("know yourself"), a digital collage that contains at its center a captured video image of the visitor. Other pieces in the gallery are mirrors in a metaphoric sense, reflecting the layers of media and culture in which we find ourselves situated today. *Magic Book* and the *Fakeshop* Web site remind us of the variety of media forms that surround us in our media-saturated culture. *T-Garden* concentrates on the spatial context in which we as embodied creatures operate, and *Terminal Time* reminds us playfully of the ideological lenses through which we understand history. None of these pieces is content just to reflect us; they all invite us to reimagine and redefine our contexts.

Taken together, all of these pieces from SIGGRAPH 2000 demonstrate the value of digital art for the larger fields of digital design and HCI. Works of digital art have a critical function: they critique the art of design itself. They make us aware of the assumptions that are built into the practices of designers and computer specialists. Because computer designers so often assume that the interface should be a window, digital art insists that the interface can also be a mirror. And in the process, it demonstrates the other great strategy of digital design. Those who understand and master both strategies will be more effective designers.

Chapter 2. Wooden Mirror

THE MYTH OF TRANSPARENCY

The desire for transparency
is a cultural choice.

It is important for designers and

builders of computer applications

to understand the history of transparency,

so that they can understand that they have a choice.

Wooden Mirror

As you approach *Wooden Mirror* in the gallery, you see what appears to be an old-fashioned, octagonal picture frame. Within the frame, there seems at first to be no picture at all, just the even texture of rows of polished wooden tiles, which look like the tiles from the game of Scrabble. But as you come closer, the tiles begin to move. With a pleasant clicking, some tiles come to a different angle and change color. They continue to move in rippling domino patterns as you move. When you stop, the tiles stop too, and you realize that they have formed a coarse image of you. The mechanism is a digital mirror that reflects the person who stands or sits in front of it (figure 2.1).

A concealed video camera captures your image when you step in front of the mirror. The data are digitized and fed into a computer, which sends signals to control tiny relays behind each tile. As the artist, Daniel Rozin, explains, "The non-reflective surfaces of the wood are able to reflect an image because the computer manipulates them to cast back different amounts of light as they tilt toward or away from the light source" (*SIGGRAPH 2000*, p. 68).

We are used to seeing our image captured by video cameras and displayed on monitors, and this mirror should seem low tech in comparison to a conventional video, as its grained tiles click into place to define our reflection. But the blend of digital technology and wooden material is so unusual that it seems less "natural" and at the same time more engaging

Figure 2.1
Daniel Rozin, Wooden Mirror:
Reflecting a seated figure.

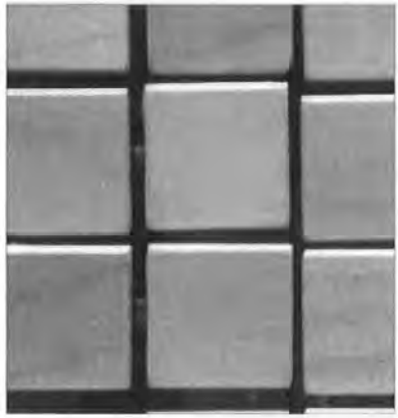


Figure 2.2
Wooden Mirror: *Analog (wooden) tiles in a digital design.*

than a video display. In using wood to create a digital image, *Wooden Mirror* blurs the line between the analog and the digital (Figure 2.2). It also shows that digital artifacts do not have to disappear into the ether of cyberspace; they do not have to be disembodied and immaterial.

Like *TEXT RAIN, Wooden Mirror* invites us to create our own image; it also invites us to watch others as they create theirs. At any time, there may be one or a few active participants surrounded by a larger audience of onlookers, who then become participants themselves. The exhibit is open to the space of the gallery. We can approach from anywhere within the field of view of the camera, so that the transition from onlooker to participant is easy and spontaneous.

The measured responsiveness of this mirror fascinates us as participants or as observers. It seems like telekinesis that we can move our arm or nod our head, and the tiles slide into place. People experiment playfully to see how their actions will affect the image.

Two women discover that if they stand very still and then blink their eyes, a few of the tiles mirror their blinking.

Looking into a silvered mirror is an experience of looking at and looking through at the same time. A mirror seems to be transparent and to reveal a world parallel to our own, an idea that has always had a sense of menace as well as fascination. How many authors, like Lewis Carroll, have imagined characters stepping through the looking glass? How many have imagined characters stepping out of the mirror to trouble us in this world? And yet the image offered by a mirror is what optics calls "virtual," not "real." The rays of lights only appear to come from beyond the glass. We are really looking at the surface of the mirror, and what we are seeing is a reflection of ourselves and the world around us.

So as its name suggests, *Wooden Mirror* is a paradox. It is a mirror made of the unlikely material of wood. It is opaque, and yet it reflects. It is a digital artifact, and yet it forms its image through a complex and delicate mechanism. *Wooden Mirror* is also a playful reminder that a mirror is a surface and not a window onto a different world. It is a strangely truthful kind of mirror that doesn't deliver on its promise of transparency, in part because the wooden tiles have a pleasing texture that makes us aware of the surface. The piece just manages to fulfill its duty as a mirror. As Rozin says, "The image reflected in the mirror is a very minimal one. It is, I believe, the least amount of information that is required to convey a picture. . . . It is amazing how little information this is for a computer and yet how much character it can have (and what an endeavor it is to create it in the physical world)" (*SIGGRAPH 2000*, 68). *Wooden Mirror* also demands some effort on the part of its viewers: to impress exactly the image they want on the mirror and to find themselves outlined in the wooden tiles.

Wooden Mirror isn't just about the silvered mirror, which is a technology that dates back to Roman times. It is also a comment on digital artifacts and interfaces—a comment on how computer applications reveal information and reflect their users and the process of production. The textured surface of *Wooden Mirror*, which responds so playfully to our movements, helps us to understand the conventional computer screen as both a window and a mirror.

The history of disappearing

Here's a parable about two contemporary interface designers. (We've changed the names and set the story in ancient Greece to protect our royalties.)

Two great painters, named Parrhasius and Zeuxis, entered into a competition to see who could create the most lifelike painting. Zeuxis offered for his entry a painting of grapes on a theater wall that was so successful that birds were deceived and flew down to eat them. Parrhasius offered as his entry the painting of a linen curtain on the same wall. When Zeuxis saw it, he thought it was a real curtain and proudly ordered it lifted so that his painting of grapes could be revealed. When he realized his error, Zeuxis conceded the victory to Parrhasius on the grounds that he (Zeuxis) had fooled some birds, but Parrhasius had deceived Zeuxis himself, a fellow artist.

In the story, Zeuxis is great because he could make his technique disappear—make the viewer unaware that the grapes were really smudges of paint on a wall. His technique becomes transparent, and the viewer sees grapes instead of paint. The fact that the "viewers" are birds suggests that Zeuxis could deceive nature itself. But his rival, Parrhasius, is even better, because his painted curtain becomes transparent even to Zeuxis himself.

It isn't really our story. When the Roman author Pliny the Elder told it in the first century A.D. (in his *Natural Histories,* Book 35, Chapter 65), it expressed the almost universal attitude toward art among the ancient Greeks and Romans. But it is striking that the story could still apply to information designers today. Although such designers today are not (often) creating pictures of grapes—they are making textual and visual information available through their interfaces—they still believe that the medium should disappear. For them, the ideal interface is a transparent window onto a world of data. The user is not supposed to notice the interface any more than the viewers of Zeuxis and Parrhasius noticed the paint on the wall. The user should look through the interface, just as the crows looked through and saw the grapes.

It does not have to be this way, however. Painters do not have to aim for transparency, and neither do digital designers. The desire for transparency is a cultural and historical choice. In the history of Western painting and design, it is true, transparency has been the goal of most artists or designers, but some artists in other periods have had other goals. If those who design contemporary computer applications understand the history of transparency, they will realize that they too have choices in today's media environment.

If designers of computer applications understand the history of transparency, they will realize that they have choices.

The desire for transparency, strong in ancient Greece and Rome, grew even stronger in the centuries after the Renaissance. This desire led to the development of the technique of linear perspective, ascribed to the fifteenth-century painter Brunelleschi, who began a tradition of perspective painting that continued into the nineteenth century. Paintings, like digital applications, offer an experience, and perspective painting offered the same experience as the one now promised by virtual reality—the experience of "being there." As the viewer, you were supposed to be able to reproduce the experience of the artist as he looked on the scene (or the imagined experience as he constructed an imaginary scene).

The word *perspective* comes from the Latin word for "seeing-through," and that's what you as a viewer were supposed to do. If you stood at a predetermined place in front of the picture, you could look "through" it to the objects represented. The surface of the picture (the framed canvas or the painted wall) became your window onto a depicted world. In his treatise *On Painting,* the painter and writer Alberti used exactly that metaphor: "On the surface on which I am going to paint, I draw a rectangle of whatever size I want, which I regard as an open window through which the subject to be painted is seen" (Alberti 1972, 55).

For four hundred years, most Western painters were using linear perspective and foreshortening to create the illusion of such a window. Furthermore, when the photographic camera was invented in the nineteenth century, it seemed to create linear perspective automatically, or "naturally." One of the pioneers of photography, the Englishman William Henry Fox Talbot, called the camera "the pencil of nature" and so helped to initiate a century of debate about art and photography. Did the camera render painting obsolete? Was the photographer an artist or simply a technician? The camera did its job so well that painters were compelled to reevaluate their goals, and eventually many abandoned the techniques of perspective painting. Yet photographers and, later, filmmakers and television producers continued to pursue and perfect the techniques of visual illusion and transparency. We still usually regard photographs, movies, and television programs as transparent windows onto a real or imagined world.

Transparency in painting meant creating an image that fools us—makes us think we are looking at the physical world; it meant what computer graphics experts now call photorealism. The desire for transparency carried over to the other arts and other forms of representation, even to the art of displaying words rather than images. The demand for clarity and simplicity is another version of the desire for transparency, and in this sense, transparency has also been the goal of typography. For hundreds of years, printed books have been designed so that we as readers look through the pages, not at them.

As readers, we are supposed to focus on the meaning of the words in a book, and the typeface should convey the words to us without our noticing the style of type. Although typefaces since the fifteenth century have varied in all sorts of subtle and beautiful ways, these variations were meant to be appreciated within the guild of typographers themselves, not by us as readers. We were not supposed to notice the harmony of the letterforms of an Old Style typeface such as Bembo (figure 2.3).

That tradition remains powerful today. Unless you are an experienced graphic designer, you probably do not know the name or even the style of the typeface that you see on this page and throughout this book. (It's Adobe Garamond, by the way, which is based on an Old Style typeface.)

The typographers did their work so well that, even in the twentieth century, font designers had difficulty obtaining patents for new fonts because judges and lawyers could not see the changes as significantly new. (To get a patent, you have to show that your invention is a significant change over the "prior art.")

What was true of typography was true of graphic design in general. The early twentieth century witnessed a revolution in visual design that was the counterpart to the revolution in visual art. Just when artists apparently ceased to care whether their paintings looked like things in the world—when Picasso started painting women with two eyes on one side of their head—graphic designers and visual poets started to scatter words and images around on the page in ways that would have scandalized earlier typographers. But in fact, even the modernists—especially modernists of the Bauhaus, de Stijl, and later the International Style—were seeking the same goal of transparency through new means. The hallmarks of their design, asymmetric arrangement and sans serif type, were not meant to obscure the text, but rather to ensure that the design would be immediately readable.

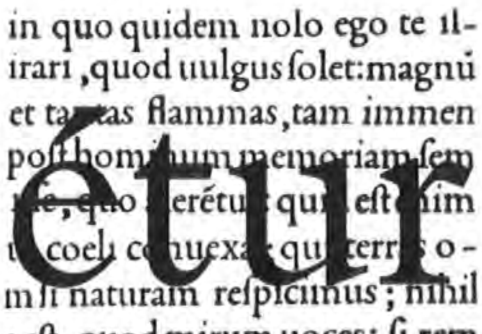


Figure 2.3
Bembo, an Old Style typeface.

Figure 2.4
Jan Tschichold, The New Typography, *1928: Modernist clarity in typographic design.*

The leading figures of this revolution, such as the typographer Jan Tschichold, believed that they were clarifying design by removing the obscure ornamentation that had accrued like rust in the previous decades and centuries (figure 2.4). They sought clarity and transparency above all. In 1928, Tschichold wrote exactly this in his *New Typography:* "The essence of the New Typography is clarity. . . . This utmost clarity is necessary today because of the manifold claims for our attention made by the extraordinary amount of print, which demands the greatest economy of expression." And again: "It is essential to give pure and direct expression to the contents of whatever is printed" (1998, 66–67).

This could be Jakob Nielsen speaking about the Web today. The desire for transparency has also taken hold among HCI and computer graphics specialists, so that the goals of contemporary interface design are ironically the same as the goals of the modernist design of the early twentieth century.

Photorealistic computer graphics

> Reality is 80 million polygons per second.
> —Alvy Ray Smith in Rheingold, *Virtual Reality*

The philosophy of transparency has a history, and computer graphics and interface design continue this history. Photorealistic computer graphics is about making the medium (the computer screen or other video device) disappear. This was certainly a goal of the computer movement from the time of the first graphics programs in the 1960s and 1970s, when Ivan Sutherland, Alvy Ray Smith, James Blinn, Ed Catmull, and many others led the way.

To achieve transparency, these pioneers adopted the principles of projective geometry, just as the Renaissance painters had done. Historians say that when Renaissance painters perfected the techniques of linear perspective, they were applying mathematical principles to painting. In fact, painters often used their aesthetic judgement to distort the perspective in order to achieve certain effects. In pursuing photorealism in the late twentieth and early twenty-first centuries, computer graphics experts applied rigorous mathematical principles to calculate the exact lines of projection. They have made into algorithms the principles that painters had followed informally and that analog cameras had followed automatically (figure 2.5).

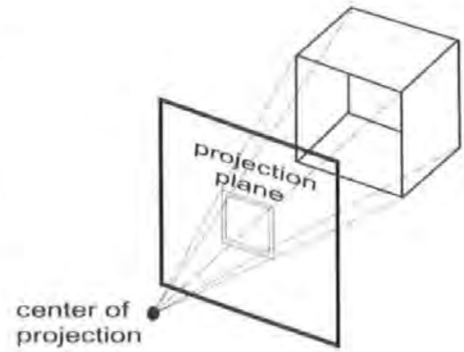


Figure 2.5

Perspective projection: Representing 3D figures in a 2D plane with mathematical precision.

The computer could be programmed to draw the outlines of objects in perfect linear perspective. But in order to achieve photorealism, the objects also had to appear with the proper texture, lighting, and shading. Sophisticated hardware and software were needed for techniques such as texture mapping, (light) ray tracing, and Phong shading (figure 2.6).

As computer graphics specialists developed (and sometimes gave their names to) these techniques, artists and illustrators began to adopt them. Today there are hundreds, perhaps thousands of photorealistic computer artists, both commercial and amateur. (Some of their work is intriguing. Much of it is the digital refashioning of those earnest illustrations that have graced science-fiction and fantasy magazines since the 1930s, with aliens walking

Figure 2.6

The legendary computer graphic teapot: in wire frame, with texture mapping, and with Phong shading.

through vast canyons on foreign planets and spaceships cruising the realms of surrealistic space.) Even harder than photorealism is what we might call filmic realism: creating animated computer graphics that are indistinguishable from live action films. Hollywood animators and special effects artists, who have been using computer rendering and compositing for decades, apparently move closer to filmic realism with each new FX film. Human actors worry openly that animated actors may one day replace them; animated films from *Toy Story* (1995) to *Final Fantasy* (2001) seem to bring that day closer. Graphics pioneer Alvy Ray Smith once said that "reality" was "80 million polygons per second," meaning that the computer would have to be able to display that many polygons on the screen in real time to achieve fully realistic images. This would be the ultimate victory for the strategy of transparency because it would no longer be possible for the viewer to see the medium (computer graphics animation) at all. She would see what appear to be human beings in what appears to be the physical world. What began in the Renaissance, or with Zeuxis in ancient Greece, would culminate in cyberspace.

The GUI in our visual culture

It isn't only computer graphics artists and animators who inherited the strategy of transparency; interface and computer designers did as well. If computer graphics artists are trying to compete with the Renaissance painters, interface designers are trying to do for the computer what Jan Tschichold and modern graphic designers did for the printed book. They are trying to make their designs simple, clear, transparent—in other words, "usable." It is not surprising that modern graphic design and contemporary interface design would share these goals, because both are about communication with words and images. Both developed along with a new technology. Modern graphic design came after lithography and other extensions of nineteenth-century print technology. Interface design grew out of the efforts of computer scientists to make a graphical computer, which gave us the graphical user interface (GUI).

Who invented the GUI? There are several candidates for the honor: Douglas Engelbart, Alan Kay, and those who worked with Kay in the Learning Research Group at Xerox PARC. No one ever thinks of nominating Alberti or Brunelleschi, but they were the patron saints, if not actually the inventors. The details of the GUI—the particular desktop metaphor, the mouse, overlapping windows, and so on—were the result of effort and inspiration by individuals, most of whom worked in the Silicon Valley in the 1970s and 1980s. But the GUI became inevitable as soon as computer graphics technology was developed. The reason is that the desire for transparency has been so powerful in our culture for such a long time, and the GUI is the prime expression of that desire in the medium of computer graphics.

Computer interface design itself began with the development of the GUI. Prior to the work of Engelbart and Kay, we could say that computer applications did not have consciously designed interfaces at all. Computers had devices (punch cards, paper tape, teletype) for input and output, but these devices were not designed to provide the user with a consistent experience. The people who created the GUI recognized the power of the computer as a graphics engine and understood that digital technology could be a visual experience.

The rise of computer graphics also corresponded to the growing importance of the visual in our culture. Movies and television were already established as the dominant popular media, and in these popular media, a style of visual realism prevailed. People went to the movies to watch very unlikely stories of romance and adventure played out in a compelling and visually realistic manner. Television drama and to some extent even sitcoms showed real-looking people in real-looking places, even though what happened to these people was unusual and even absurd. Meanwhile, television news brought us what was happening in the world (such as the Vietnam War), and sometimes it brought us these events "live"(broadcast as they happened). The live action of television seemed to reach almost anywhere on earth and, amazingly, even beyond the surface of the planet, as shown by NASA's broadcasts from earth orbit and eventually, in July 1969, from the surface of the moon. Neil Armstrong's "giant leap for mankind" was also a giant triumph of television technology, as the ghostly black-and-white image of an astronaut setting foot on the moon became the crucial validation of the space program's success. Armstrong's leap became reality because it was televised. Was it long after that supermarkets began to put tags on their sale items reading "as advertised on television," as if that validated the product? We still live in the era of televised reality, a point made seriously by the destruction of the World Trade Center (televised live to millions) and satirically by such films as *The Truman Show* (1998) and *EdTV* (1999).

Prior to the invention of the GUI, the computer did not seem to have anything to do with television or our culture's move toward visual realism. It was by inventing the GUI that Engelbart, Kay, and others convinced us that the computer was a medium. In doing so, they weren't just giving us a new tool for word processing and bookkeeping; they were also showing how the computer could play a role in our visual culture. In the 1980s, when the introduction of the PC and the Macintosh made computers common, we as a culture had to decide once again what computers were for. The PC and the Mac represented the two views. The Mac with its GUI interface presented Xerox PARC's vision that computers could be a new visual as well as verbal medium. The PC with its DOS operating system and ASCII screen insisted that the computer was a symbol manipulator, not a new visual experience. The debate persisted for years. There were those who insisted that the command-line interface was superior to the GUI and claimed they would never touch a mouse. The GUI was for sissies, they would say: real programmers don't point and click. But it soon became obvious that the macho command-liners were defending a cultural definition of the computer that was failing. At first, the GUI was seen simply as a better way to process text, but when color graphics and higher-quality sound were introduced in the late 1980s, the PARC and Apple vision of multimedia triumphed. Microsoft Windows replaced DOS, and soon everyone had a graphical computer.

The computer window

Names matter. When interface designers chose *window* to describe the framed rectangles on the screen that present text or graphical data, they made a choice that had vast cultural significance. As a result we have spent the past twenty years opening, staring at, resizing, minimizing, and closing "windows." The most widely used single piece of software is named for the metaphor that these designers came up with. They could have chosen *frame* instead of *window*, but that choice would have had just the opposite significance from the window metaphor. The reason is that a frame is what surrounds and encloses a window or a picture. The word *frame* reminds us of the interface, while the word *window* helps us to forget the interface and concentrate on the text or data inside. Just as we gaze through a window in the physical world, the GUI's window metaphor suggests that the interface can present data, words or images, as they "really are"—without distorting them. The words and images are "in the machine," just beyond the window and available for our manipulation. The designer's task is to make the interface transparent to the data.

Interface designers were depending on Alberti's powerful cultural metaphor. Painting, photography, film, and television all offered versions of this window, and now the computer was offering its version. And there could indeed be a world beyond the computer screen. Ivan Sutherland, the man who more or less invented computer graphics and did invent virtual reality, came up with the metaphor of jumping into the computer screen and being immersed by a computational world. John Walker elaborated Sutherland's vision in his article "Through the Looking Glass" when he claimed that the goal should be "to move beyond the current generation of graphics screen and mouse, to transport the user through the screen into the computer" (1990, 44). For Walker, the interior of the computer turns out to be cyberspace, a new world, a virtual reality.

Making the interface disappear

To wizard-of-oz has become a verb. When designers are building a complex new system, they may want to test part of the system before other parts have been completed. Suppose they have designed and implemented the graphics for a virtual reality system, but haven't finished the programming and hardware for tracking the position of the user. They rig up a test to give the user the illusion that the whole system is working. Whenever the user moves forward, a programmer seated at another computer simulates the user's movement with a mouse. They call this *wizard-of-ozzing* it, referring to the scene in *The Wizard of Oz* when Dorothy and her companions accidentally glimpse the phony Wizard at the control panel, calling up smoke and noise to enhance his image. Dorothy and her friends are instructed to "pay no attention to the man behind the curtain." In this case, the programmer is the man behind the curtain, and the hope is that the user, unlike Dorothy, will not notice that the programmer is creating the illusion. Like Dorothy, the user is not supposed to become conscious of the interface.

User interface design belongs to the long tradition of art and illusion that we've been considering. The GUI itself is a systematic illusion that makes it easier for the user to interact with the computer. The user thinks she is opening a folder by clicking on it, but her clicks are really launching a series of computer instructions to fetch binary data from memory or the disk, convert that data into a graphic form, and display it on the screen as the "contents" of the folder. All the visible objects of the GUI have such operational behaviors, which must be consistent in order to maintain and complete the illusion.

User interface design belongs to a long tradition of art and illusion.

The legendary designer Bruce Tognazzini explained this process to the interface community in his 1993 article, "Principles, Techniques, and Ethics of Stage Magic and the

Application to Human Interface Design." The creators of the GUI at Xerox PARC, he pointed out, referred to the "user illusion." Their desktop metaphor constitutes an illusion, because what is really happening "behind the curtain"—at the level of the software or the hardware—is nothing like what happens to documents and folders on a physical desk. The task of the GUI is to convince the user that the computer *is* her desktop. To convince her, the interface must function like a smoothly running magic trick, where all the elements of the magician's hands, voice, and physical props conspire to distract the viewer from what is really happening. The interface must function smoothly, regularly, and with a seeming predictability. Tognazzini quotes the expert on magic, David Fitzkee, who tells us, "Irregularities destroy naturalness and conviction. When naturalness disappears, and when something unnatural is evident, the spectator's attention immediately becomes vigilant and alert. In the normal course of events, this is disastrous to deception" (355). In the case of the GUI, it isn't a coin or rabbit that disappears; it is the interface itself.

A demonstration of a new application or a new system always has the quality of a performance, indeed a magic performance. Until recently, when Apple or Microsoft rolled out a new system, Steve Jobs or Bill Gates would stand before an excited audience at MacWorld or Comdex. Behind the impresario was a gigantic video screen with his image, which has to remind us of the smoke and mirrors that produced the giant floating head of the Wizard of Oz. Each of these performances was meant to recall the great demonstrations of the past—above all, perhaps, Engelbart's demonstration of NLS, which might be called the first GUI. The effect was magical; the audience saw a display of file management, text editing, and hyperlinking that was unlike anything they had ever seen before. Since Engelbart's performance in 1968, there have been other legendary computing demonstrations. One of the most important was held for a smaller audience, when Steve Jobs and his colleagues from Apple visited Xerox PARC in 1979.

The Macintosh interface

Because the designers of the Xerox Star and the Apple Lisa and Macintosh could not yet enable the user to jump, like Alice's white rabbit, through the screen, they did the next best thing: their windowed interface was a brilliant attempt to achieve transparency. In this case, transparency meant giving the user the opportunity to see her words and images clearly and manipulate them directly and consistently.

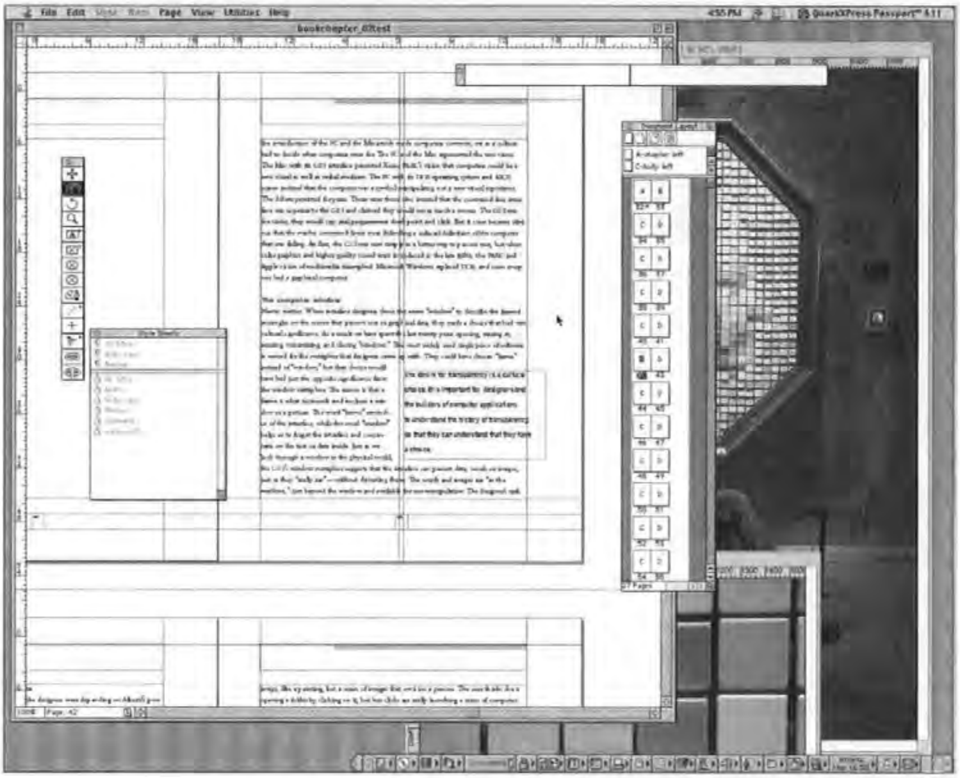


Figure 2.7
The Macintosh interface: Multiple windows present different views and different kinds of information.

The Macintosh interface perfected the computer window that Kay and his colleagues at PARC had invented. Multiple windows were the essence of the Macintosh user illusion—more important in the Macintosh than they had been in the PARC interfaces. (This was not true of the knock-off Windows interface created by Microsoft.) The user saw everything through these resizable, movable blocks that contained, managed, and presented texts and images. Windows could be stacked, they could overlap, and each was a view onto a world of information and visual experience (figure 2.7).

Along with the windows came the rest of the desktop metaphor with folders and files, applications with icons that represented the actions of writing and drawing, and the famous trash can for throwing things away. The purpose of the desktop metaphor was not simply ease of use, but also, and more important, to convince the user what the computer was for. It was for writing reports and memos, figuring budgets, creating layouts and graphic designs—work that goes on in an office or a professional shop. The computer desktop was not a slavish imitation of a physical desktop. There was nothing on a physical desktop that corresponded to the menu bar, and an executive who found a mouse on his desk would call the janitor. Menu bars, tool bars, and pointing, clicking, and dragging with the mouse—these elements all seemed strange to new users. Anyone familiar with a standard line-oriented ASCII display was at first amazed by the GUI—above all, by the ability to work in two dimensions, to be able to move the cursor anywhere within the rows of text arrayed within each window—just as Doug Engelbart's demonstration of NLS had amazed computer professionals more than a decade earlier. After a few minutes or hours of use, however, these features would move from amazing to predictable. In the late 1980s and early 1990s, when Microsoft adopted these features for its Windows operating system, all computer users became familiar with the metaphor—so familiar, in fact, that we no longer think about these features at all. Soon we expected to interact with a personal computer in this way. The GUI seemed so "natural" and "intuitive" to us that an interface *without* menus or a pointing device now seemed odd. To say that the GUI became naturalized is another way of saying that it became transparent. Today, we look right through the GUI interface, unless some feature does not perform as advertised.

The original Macintosh version of the GUI was an exercise in clarity in the very sense that Tschichold and the modernists had described it half a century earlier: the interface tried to reduce everything to an ideal visual simplicity.

The original Macintosh GUI was an exercise in modernist clarity. It tried to reduce everything to an ideal visual simplicity.

The Macintosh computer helped to advance the practice of postmodern graphic design in the 1980s and 1990s, but the interface itself was a triumph of modernist clarity and simplicity. Apple had taken the unusual step of hiring graphic designers, such as Susan Kare, who then put their skills for reduction and simplification to work in creating character sets (figure 2.8) and icons (figure 2.9) that made good visual sense in the pixel matrices available to them. The Geneva and New York fonts, for example, were pixelated versions of Helvetica and Times Roman, respectively the most important sans serif and serif fonts of twentieth-century print

Figure 2.8
Susan Kare, Geneva and New York fonts, 1984: Modernist clarity in popular digital design.

NEW YORK 12
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz 1234567890

GENEVA 12
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz 1234567890

Figure 2.9
Susan Kare, Macintosh icons, 1984.

ORIGINAL MACINTOSH ICONS (1984)

design. Kare radically simplified these fonts in order to transfer them from the continuous medium of ink on paper to the discrete medium of the computer screen. Zuzana Licko took this philosophy even further, creating remarkably sophisticated Emigré fonts from a few pixels. Such fonts were also lessons in clarity and restraint (figure 2.10).

From the beginning, the Macintosh interface was conceived according to a design program. Graphic designers had long been accustomed to creating such programs for print applications and corporate identities. The Macintosh visual program extended from the fonts and icons

Figure 2.10
Zuzana Licko, Emigré fonts.

We Read Best What We Read Most (Oakland 8)
We Read Best What We Read Most (Emperor 15)
We Read Best What We Read Most (Modula Bold)
We Read Best What We Read Most (Emigre 14)
We Read Best What We Read Most (Matrix)

to the larger elements of the user illusion, as described in the *Apple Human Interface Guidelines* (1987). And the whole program, not just the font design, was about transparency: "The real point of graphic design, which comprises both pictures and text, is clear communication. In the Apple Desktop Interface, everything the user sees and manipulates on the screen is graphic. . . . Graphics are not merely cosmetic. When they are clear and consistent, they contribute greatly to ease of learning, communication, and understanding. The purpose of visual consistency is to construct a *believable environment* for the users. . . Simple design is good design. Simple designs are easy to learn and to use, and they give the interface a consistent look" (9, 10).

The guidelines were meant to ensure that cutting and pasting would work in the same way in any Macintosh application and on the desktop itself, dialog boxes would look the same and use the same vocabulary, and all windows would be created from a set of predictable shapes and with predictable behaviors. The consistency of the Macintosh interface meant that once the user learned how menus, icons, and dialogs worked, she would be able to apply that knowledge to any application. These interface elements would become natural to her. The interface would disappear from her conscious consideration, leaving her alone with the content of her windows: the documents she was writing or the image she was creating.

The myth of transparency

Digital design is an exercise in mythology, and among the digital mythographers were the creators of the GUI. The windowed interface has defined the way we interact with computers for nearly twenty years. (And what else lasts for twenty years in the computer world, except FORTRAN and C, which seem to be immortal?) The entire World Wide Web was built on computers using some version of the GUI and is now visited by hundreds of millions of users through their windowed screens. The creators of the GUI realized a commanding digital version of the myth of transparency.

In calling transparency a myth, we mean to describe both its strength and its weakness as a design philosophy. A myth allows its believers to construe their experience in a convincing way. Myths are not lies; they are exaggerations or simplifications. In this case, the myth of transparency is a story that artists and designers have told us (and themselves) in order to justify their designs. Because our culture had believed so strongly and for so long in the myth of transparency, interface designers could rely on it to make their designs compelling to users. Many myths are about origins, and the myth of transparency is one of these.

Here's the version that interface designers tell (filmmakers, television producers, painters have told similar stories inflected to fit their media).

The Myth of Transparency Before there were computers—indeed, before there were media of any kind—people were just in the world. People saw things as they really were: there were no pixels, no aliasing, and no need for Web-safe colors. Objects were present to people; the rays of light reflected by objects entered their eyes undistorted by any intervening medium (other than the air itself). Today, a good computer interface gets the user as close to that original experience as possible.

The strength of this myth is that it explains why icons are better than words, why 24-bit color is better than 8-bit. The myth of transparency fosters the user illusion that the interface needs in order to be compelling. It's not untrue, but it does simplify and exaggerate.

The danger comes when designers fail to recognize that the myth is a simplification of a complex reality. This is a danger because the strategy of transparency is never sufficient to dictate the design of a whole interface or artifact. For one thing, as every designer knows, there is a conflict between the simplicity (or transparency) and functionality. As they add functionality, designers often undermine the transparency of their design.

If we set a new Apple computer next to the original little beige Mac, we see a tremendous increase in both power and complexity. As computer hardware has improved, we have capabilities that we did not have in 1984—in graphic display, processing power, memory, and storage. Designers have added more and more features to the interface because of these hardware improvements, but also because of their desire to expand and elaborate the system. Adding new features is the principal strategy for convincing users to buy new versions of a program. That is why Microsoft Word developed from a simple text editor (patterned after Xerox PARC's Bravo) into a suite of interlocking applications that not only format, spell-check, and evaluate our writing, but also annoy us with that dancing paperclip. It is why Web browsers (both Internet Explorer and Netscape) began adding features to write our e-mails and help us stage videoconferences. And it is why the Mac operating system (as well as Windows) continues to grow; the latest versions occupy one or more 600 megabyte CD-ROMs (the first version fit on a 400 kilobyte floppy disk).

With the Mac operating system, as with other software, growing complexity works against transparency. The operating system now contains so many features that it often acts in ways that even an experienced user cannot predict. Perhaps this "feature creep" is inevitable even with the best designs. If it is, then transparency is an ideal that can never be achieved. In an effort to make the system more powerful, designers are inevitably caught in this trade-off.

As designs grow old and familiar, designers get restless. For interface designers, the possibilities of the GUI seem to be played out. It is a magic trick that is no longer a challenge to perform. Designers want to stay ahead of their audience, so it isn't surprising that designers have tired of the GUI, although their users have not. It's a familiar story in the history of design. In 1951, the head of art direction for CBS, William Golden, designed the famous logo, the eye in the clouds. When he told CBS president Frank Stanton the following year that it was probably time to change the logo. Stanton wisely demurred. He knew that although the designer was ready to move on, the viewers were just getting comfortable with the logo, which lasted decades in its original form and still inspires today's design (Meggs 1998, 364).

Much of the digital design community and certainly HCI specialists seem convinced that at least the GUI, and probably the whole desktop computer, should be replaced. Although the desktop computer with its mouse and overlapping windows has become natural to hundreds of millions of general users, many specialists assume that 3D graphics would provide an even more natural interaction.

Virtual reality and the myth of the natural interface

Transparency goes by other names. In the history of writing and rhetoric, transparency was explained by the terms *simplicity* and *clarity*. In the history of painting, the ideal for many painters was to be "true to nature." In a famous example, the British landscape painter Constable called his *Wivenhoe Park* a transcript from nature (E. Gombrich, 1961), and like painters two hundred years ago, interface designers today want to be true to nature. In their desire to replace the desktop computer and the GUI, they appeal to another myth.

The Myth of the Natural Interface **Before there were computers—indeed, before there were any technologies—people were just in the world. They experienced the natural world in three dimensions, and they moved around it with six degrees of freedom. They could touch and manipulate things directly; there were no keyboards and no mice. A good digital interface gets us as close as possible to that natural state, allowing us to interact by movement and direct manipulation.**

This myth, which also simplifies and exaggerates, lies behind the work to replace the GUI.

The most conservative approach is to replace the flat look of the GUI with a three-dimensional representation on the computer screen. In place of the two-dimensional folders (already shaded to give a hint of a third dimension), we would see files and folders themselves arranged in three-dimensional perspective, and we would navigate through this projected space. In the movie *Jurassic Park* (1993), the young girl and her brother are trapped in the island's command center. The vicious velociraptors are about to burst in and devour them unless the high-tech, computer-controlled doors can be sealed in time. The girl, a computer geek, manages to navigate the computer system and close the doors, because she can make sense of a 3D interface to the UNIX operating system. The truth, however, is that if she really had to cope with such an interface, the velociraptors would probably be dining before she managed to find the program file.

The more sweeping proposals are to eliminate the need for the user to sit in front of a screen at all. Instead, the user would pass through the windowed screen of the GUI by putting on a VR headset and immersing herself in a world of visualized data. As we have noted, Ivan Sutherland envisioned such an interface when he invented virtual reality in the 1960s and 1970s. As Howard Rheingold wrote in *Virtual Reality*, "Sutherland opened a window, and pointed to the day when people would be able to go through that window and enter the abstract territory that computer simulations could create" (1991, 93). Sutherland was working at about the same time as Alan Kay (at one time a student of Sutherland), but the GUI was ready for the general user long before VR moved out of the research lab. All through the 1980s, as the GUI was conquering the command-line interface, researchers continued to work on VR, and Jaron Lanier, the dreadlocked guru of VR, began claiming that it would replace symbolic communication. He was really imagining that VR would become the ultimate transparent interface. There would be no screen between the user and the information and no way for the user to step back and contemplate the screen at a distance, because she would be wearing the screens as eyepieces that completely covered her field of view. The user would occupy the same space as the data itself. Instead of using a keyboard and mouse, she would grasp and explore data with her hand (wearing a special glove fitted with sensors). Virtual reality as a transparent interface to all human data systems is, after all, the original vision of cyberspace that William Gibson suggested in *Neuromancer*.

VR interfaces are supposed to be natural because they create a visual world in three dimensions, like the physical world we inhabit. Yet the natural interface is a myth, a story that interface designers tell (us and themselves) in order to justify their designs. It is a compelling story because it has roots deep in the history of our culture. We can easily believe that seeing a picture is more basic, more direct, more "natural" than reading words. Even the cultural relativist John Berger wrote in his landmark *Ways of Seeing,* "Seeing comes before words. The child looks and recognizes before it can speak. But there is also another sense in which seeing comes before words. Seeing establishes our place in the surrounding world; we explain that world with words, but words can never undo the fact that we are surrounded by it" (1972, 7). If seeing is more natural and direct than reading, then any visual interface, even the GUI, is more natural and direct than an ASCII interface. By the same logic, the GUI is less natural than an immersive 3D interface, which relies even less on words or other arbitrary symbols.

However, what is considered "natural" can change. Why should it seem natural to put on a headset and navigate in the virtual world? Why is this any more natural than typing on a computer keyboard, or reading a book, or writing on a roll of papyrus (as the ancient Egyptians, Greeks, and Romans did)? For some, the term *natural* is simply a way of indicating that the interface is easy for a beginner to learn or efficient for an experienced user. But even by this definition, the idea of the natural is not constant, because what is efficient or easy in an interface depends on what the interface is for. Some sort of virtual environment is almost certainly more efficient than a GUI in allowing the user to practice visual and motor skills, for example, for flight simulation. But if the task is to navigate through a collection of reports, memos, and spreadsheets, then the GUI may still be easier and more efficient.

Furthermore, 3D interfaces are not radical departures from the GUI. Like the desktop GUI, they are still based on the myth of transparency; they are attempts to make the interface disappear. They simply go further in the direction established thirty years ago by the designers of the GUI. They try to do with pixels what Brunelleschi tried to achieve almost six hundred years ago with paint. The pursuit of transparency is endless, because transparency is redefined with each new technology. The Renaissance painters pursued transparency by applying the technique of linear perspective. The desktop GUI attempted to achieve transparency on screen-based computers, and VR technology now pursues transparency by offering the illusion of three dimensions. These are all versions of the same myth: that a technology can disappear completely and put the viewer or user in touch with reality.

The reason that designers must understand the myth (and the history) of transparency is that the strategy of transparency can be misapplied. As designers, we want the interface to disappear for the user for part of the time, but not completely and not irrevocably. At some subliminal level, the user must be aware of the interface at all times. She must know that she is using a computer and not actually writing on a piece of paper on the desktop. In VR, she must know that she is looking at a virtual world, or she is likely to run into a wall in the physical world. There is always a tension between the two worlds: the world depicted by any digital application and the physical world in which the user must function. (Even the characters in the movie *The Matrix* eventually had to return to the dystopic physical world in which their bodies lived.)

Finally, even if it could be achieved, perfect transparency would be a dangerous mistake. Think of the window metaphor. When a window pane is perfectly transparent, the glass perfectly clear, there is a danger that a bird will fly into it or a person will try to put his hand through it. In the story of the painter Zeuxis, no one, of course, was concerned about the crows who presumably broke their beaks against the wall while trying to get the grapes. But we do know of instances where humans can be endangered by interfaces meant to be transparent.

The dangers of transparency

It's 4:00 A.M. on March 28, 1979. Late night or early morning are the most likely times for natural deaths and serious industrial accidents, perhaps because human operators are at the ebb in their circadian rhythms. (Think about that the next time your pilot is making the complicated preparations for landing your plane in Paris at what is for him 3:00 A.M.) The Bhopal chemical spill in India happened around midnight. At Three Mile Island, it was 4:00 A.M. when the disaster began.

As is usually the case in advanced technical systems, a cascade of failures contributed to the infamous near-meltdown of the Three Mile Island reactor near Harrisburg, Pennsylvania. Emergency feedwater valves had been closed days before for a repair and had never been reopened. The coolant system failed because an unknown operator had destroyed the valve control system by misconnecting a hose. The heat built up. At one crucial point, moreover, operators were supposed to ensure that the cooling system continued to carry away the excess heat. They were watching an indicator that told them that the water level in the coolant system was rising (when in fact it was falling), so they stopped adding water

(Casamayou 1993, 103; Johnson 1999). The problem was that the operators did not question their interface. They treated the valve indicator as if it were a transparent window on the level of water inside the reactor. The operators should have been prepared for that possibility; they should have looked *at* the indicator rather than *through* it. Under the pressure of an emergency, however, they made the assumption of transparency.

At Three Mile Island, the interface consisted largely of analog dials and indicators. But transparency can be the wrong design strategy for any kind of interface, analog or digital, if it lulls the user into thinking that the system is foolproof—if the operator fails to remember that the system may fail precisely in a way that masks its own failure.

Consider our sleepy airline pilot. Ordinarily, he wants to look through the instruments on the control panel (which, by the way, is now likely to be a "glass cockpit," in which the readings are delivered by a computer interface). But when something appears to be wrong with, say, an engine, the pilot always asks himself whether the problem lies in the engine itself or in the instrumentation. Perhaps the engine is fine and the interface is faulty. Pilots need to remember what the operators at Three Mile Island forgot in a moment of high stress: that the instrument is an interface and is never completely transparent. In this case, it may now be called a glass cockpit, but in fact the glass may be a mirror, reflecting what the user is inclined to believe, rather than a transparent window.

It does not have to be a matter of life and death, of course. Failures in transparency occur regularly in desktop computer interfaces. It happens to all of us, even the most experienced users, in part because we do not think to question what the interface is telling us and in part because the interface confuses us with its transparency. For example, in the Windows operating system, users make frequent errors because the interface (by default) hides the three-character extensions on file names. We assume that a file has a certain extension (for example, .htm). We want to open the file in our Web editing application, so we call up the application's dialog box and point it to the folder where we know the file is located. But the file does not appear in the list of files available to be opened. The reason is that the dialog box is "helpfully" filtering out files that do not end with the .htm extension. Because our file doesn't end with that extension, we don't see it. And when we look back at the folder on the desktop, the extensions aren't listed, so it doesn't occur to us that the file doesn't have the proper extension. We can't figure out why the program can't see the file. In the name of transparency, the system puts a cloak of invisibility over the file's full name.

This is the danger of transparency: that the interface will mask the operation of the system exactly when the user needs to see and understand what the system is doing. When something unexpected happens, the user should be able to look at the interface. This is the notorious problem with software agents.

The danger of transparency is that the interface will mask the operation of the system exactly when the user needs to see and understand what the system is doing.

Deirdre Smith-Jones is a graphic designer with an interest in cultural studies. When she visits amazon.com from her home computer, she gets a message on the start-up screen: "Hello, Deirdre Smith-Jones. We have recommendations for you." The recommendations include Marita Sturken and Lisa Cartwright's *Practices of Looking* and Lev Manovich's *The Language of New Media*, which make good sense given Deirdre's interests. But a year ago, Deirdre bought her nephew *Dave Madden's All-Star Baseball 2000*, so now she continues to get offers for new Nintendo games. She bought her mother (who is notoriously hard to shop for) a Martha Stewart book for Christmas, and now she is offered every paean to stylish living published by the Martha Stewart machine. The amazon.com software agent can't easily distinguish between the kinds of books that Deirdre buys regularly for herself and those she buys for others on an occasional basis.

Software agents, especially those on the World Wide Web, try to be transparent and present the user only with results. But these programs are never really smart or subtle: they all make mistakes. And when it fails, a software agent is no longer transparent, no longer the silent butler that it is supposed to be.

Another strategy

The computer window is such an effective design because it can rely on the assumption of transparency. It is important for digital designers to understand this because designers work within and through such cultural assumptions. Like clever magicians, they offer the audience an illusion that it is already prepared to believe. In this case, hundreds of years of painting, printing, and photography have prepared us to look through the new windows that the computer offers. These traditions have inclined us to accept the illusion of virtual reality and other 3D interfaces as well. The task of the designer is to encourage users to follow their inclination to look through the interface.

Designers must also bear in mind that the strategy of transparency, although popular, is not the only one available to them. *Wooden Mirror* in fact uses another strategy, which is the counterpart to transparency: the strategy of getting the user to look *at* the interface or object of design rather than *through* it. *Wooden Mirror* is not transparent; it is an opaque, richly textured surface that nevertheless manages to show the viewer to herself. This is the most important lesson, perhaps, that digital art has to offer for digital design: an interface can be not only a window but also a mirror, reflecting its user.

Chapter 3. Nosce Te Ipsum

SEEING YOURSELF IN THE DIGITAL MIRROR

Digital artists suggest not that we look through the experience to a world beyond,

but rather that we look right at the surface.

Nosce Te Ipsum

If we walk a few steps from *Wooden Mirror,* we encounter another piece that is ultimately a mirror. On a large scrim hanging from the ceiling, we see projected a contour drawing of an androgynous human figure (figure 3.1). The artist, Tiffany Holmes, describes our experience: "As you move closer to the image, you see a line of words across a floor dotted with circular targets. As you walk forward, following the words, you trip a pressure sensor that triggers a change in the animation. Suddenly, layers pull back and reveal that beneath the drawn body lies an

Figure 3.1
Tiffany Holmes, Nosce Te Ipsum: *The first image.*

Figure 3.2
Tiffany Holmes, Nosce Te Ipsum: *Collage technique in digital art.*

interior composed of flesh, letters, words, and marks. Stepping on each target triggers another sensor and a continued shift in the animation as the body folds back on itself, revealing layers of images that give way to further images. When you step on the final sensor, your face, captured in real time with a video camera, appears beneath the embedded layers" (*SIGGRAPH 2000,* 47).

The layered images are more complicated than the single textured image offered by *Wooden Mirror,* and more complicated than the combinations of letters and video images of *TEXT RAIN* (figure 3.2). But like both of these other pieces, *Nosce Te Ipsum* turns out to be a mirror, because it reveals its viewer behind layers of self-dissecting images. *Nosce Te Ipsum* is a digital collage, or "decollage," as layer after layer peels off as we move toward the scrim (figure 3.3).

The phrase *nosce te ipsum* (know yourself) suggests that the user will learn something about herself as she walks forward and is revealed. As she walks, she reflects on her relationship to the digital application. Like other pieces in the SIGGRAPH Gallery, we can understand *Nosce* as a lesson in digital design and a comment on how digital applications affect us as viewers or users. Like the other pieces, *Nosce* is all interface: it does not accomplish the work of information processing as a productivity application (word processor, spreadsheet, or database) does. The viewer, however, does have a task—one of pure discovery. As Holmes explains, "In order to reveal the final image, you must participate in the dissective process. . . . Your steps, timed as you choose, alter the projected body, penetrating the palimpsests of imagery that pull back, one after another, to reveal your face within the larger work" (*SIGGRAPH 2000,* 47).

As we interact with *Nosce,* we make (or unmake) a picture of ourselves. In one sense, *Nosce* is a direct interface, because we make the picture simply by walking along the

Figure 3.3
Tiffany Holmes, Nosce Te Ipsum: *The layers peel back.*

prescribed path. But *Nosce* is not a transparent window. We do not look through this piece to an imagined world, and we never forget that we are interacting with a digital interface. *Nosce* shows us how a user interface can reflect us as we use it. It calls attention to what we are doing; it makes us stop and think about our relationship to the computer. Even when we are performing the mundane tasks of information processing, we always bring a part of ourselves to the digital applications with which we interact. Digital applications are never fully transparent; they always reflect the user.

Reflectivity: The counterpart to transparency

We break off our tour of the SIGGRAPH Art Gallery for a moment in order to visit an older and even more famous exhibit, the National Gallery in London. We have come specifically to see *The Ambassadors* (1533) by Hans Holbein the Younger. It is a highly realistic scene of two men in Renaissance dress, along with various scientific and musical instruments, but on the floor between them, there is a disturbingly unrealistic and unintelligible shape: an irregular, bone-colored disk (figure 3.4). What can it be? We think it might be useful to get another angle on this part of the picture. (The guard is helpful; he has been helping people find the proper angle, presumably, ever since he started working in the museum.) If viewed from an extreme angle to the right of the painting, in a radical perspective called "anamorphic," the blob turns out to be a skull, a reminder of mortality. The anamorphic skull forces us both literally and metaphorically to look at the painting in a different way. We have to stand at a different place, and we have to think about the whole picture differently because of the skull.

The skull challenges the illusion of transparency, so that the painting is no longer just a window onto the world. We can't look through the canvas; instead, we have to take an active role in constructing the meaning of the painting. Our experience of viewing the painting is enhanced, but at the same time we are made conscious of our role as a viewer.

From the Renaissance to the end of the nineteenth century, many paintings offered an alternative to the illusion of transparency: humorous paintings in which, for example, a

Figure 3.4
Holbein the Younger, The Ambassadors, *1533. Reprinted with the permission of the National Gallery.*

human face is constructed out of fruit and vegetables; depictions of hell, where the view is deliberately unrealistic; and so on. There are anamorphic drawings and paintings that present a distorted or impossible point of view. There are many paintings in which mirrors are included in the scene, sometimes reflecting the artist and suggesting where the viewer himself might become part of the image (Alpers 1983). Such techniques not only disrupt our ability to look comfortably through the canvas to the world depicted; they also make us think about the process—how a painting functions to represent a world and how we as viewers become part of that process.

In twentieth-century art and design, the alternatives to transparency grew more numerous and influential. It is true that modern designers such as Tschichold wanted to create clean, transparent designs, but that was only one aspect of modernism. Alongside the desire for clarity, there was the desire to create a complex and striking image, to awaken us as viewers from the complacency of looking through the painting or design. This other desire led artists to the technique of collage, which originally meant pasting one media form onto another—for example, pasting newsprint onto the canvas of a picture. The term expanded to include a variety of techniques for layering images produced by different media: paint, print, photography. Although collage has been called the defining technique of modernism, it does not belong to the cool, clear modernism of Tschichold and other graphic designers. It belongs instead to the improvised modernism of the futurists, dadaists, and lettrists. Because these modernists wanted to make us think about the surface of the painting and the process of creation, their designs were eclectic and multiple. Their work carried over into the 1960s and later, as modernism gave way to various versions of postmodernism, which delighted in the eclectic and in pastiche.

Figure 3.5
Wolfgang Weingart, exhibition poster, 1977: An influential example of postmodern design.

Postmodern designers and artists insisted that the viewer should become part of the process itself. They created disrupted and fragmented images that required us to work to understand them, such as the illustrations of the pioneering Wolfgang Weingart in the 1970s (figure 3.5). There are great cultural and artistic distances between *The Ambassadors* and Weingart, but they share something important: an emphasis on process and an awareness of the act of making.

When transparency and clarity were the dominant goals of our culture's artists and designers, there were always those who questioned this strategy. *Nosce* is part of that tradition of questioning. Its collaged interface is in no way transparent; instead, it promotes itself as an experience in its own right, not a representation or model of something unattainable. The strategy of transparency remains popular today—on TV news programs, for example, and in television and film drama—but its counterpart is also increasingly popular in our media-saturated environment.

When transparency and clarity were our chief cultural goals, there were also artists and designers who questioned this strategy.

Multiplicity in contemporary culture

You're watching a music video on television. (You turned it on as visual wallpaper, but then it caught your attention.) You see a series of rapidly edited images, one disconnected moment after another, with each image lasting five or ten seconds at most. The singer is walking down the road; now she's on the beach. Now she's wearing a dress, now a tuxedo, now a bikini. Is this a video representation of schizophrenia? It is MTV, and it has been among the most popular television channels for almost two decades.

You walk into a bar. Four large television sets are mounted on the walls, so wherever you sit, you can see one or two. Each set is showing a different football game. (The volume is turned down on all the sets, so you can listen to the bar's own sound system as background music.) At the bar itself are small video units offering a networked sports trivia game in which you can compete against not only the other players at the bar, but patrons of other bars on the network.

You go to a rock concert, which is part of the tour of a famous group. When you find your seat in an arena about the size of Yankee Stadium, you gaze down on the stage seemingly a football field length away and look for the musicians, who at this distance are the size of tiny toy figures. Behind the musicians are giant video screens and huge speakers the size of small cars. The show itself is a barrage of sound and light, a multimedia experience in which the actual musicians are only the smallest part of the action. Projections on the giant video screens alternate between live video of the musicians dancing around the stage and prerecorded video appropriate to the concert's theme.

What do these experiences have in common? They are all examples of our contemporary media culture. Many people today, indeed the vast majority in our urban society, choose to surround themselves with complex media forms. They enjoy the multiplicity and prefer not to concentrate on any one medium or representation for very long. Even if they are watching a single media form (say, MTV on television), that form itself is fragmented and multiple. When we surround ourselves with multimedia in this way, the various media forms *constitute* the experience for us. This is a contemporary alternative to transparency: it is the mirror rather than the window—the strategy of reflection, multiplicity, self-awareness in action.

The striking fact is that this strategy is so popular today. The work of painters like Holbein and Vermeer appealed to a relatively small middle and upper class of collectors in the seventeenth century. In the early twentieth century, the futurists, such as Marinetti, and the dadaists, such as Tristan Tzara, performed their multimedia events in tiny coffee houses. They were denounced by mainstream art connoisseurs and were utterly unknown to people who flocked to silent movies and other popular entertainments. Today, Madonna performs her light and sound shows for sold-out crowds of a hundred thousand, who riot if she cancels.

Contemporary design in all its forms must take into account this aspect of our culture. Designers should respond to and appreciate the desire for multiplicity, for making the medium itself an experience to be savored. And, of course, contemporary visual design does respond. Rave design, for example, is a whole aesthetic built around the multiplicity and multimediacy of the mass concert or rave event. Breaking the illusion of transparency is not an esoteric or elite practice. It's what MTV producers, rap singers, and technorock groups are also doing. MTV producers join digital artists in suggesting not that we forget the medium, but rather that we enjoy the medium or process as an experience—not that we look through the experience to a world beyond, but rather that we look right at the surface.

Contemporary culture is receptive to transparency (the window) and also to an alternative, self-reflective style (the mirror). This latter style, which was truly avant-garde in the early twentieth century, has become the aesthetic of rock concerts in the early twenty-first century. So digital graphic designers and the growing world of digital entertainment need to master both styles. Digital interface design needs to master both styles as well.

Contemporary culture is receptive not only to transparency (the window), but also to an alternative, self-reflective style (the mirror). Digital designers and the growing world of digital entertainment need both styles.

Interface design

What we have been describing is a second strategy, a counterpart to the strategy of simple transparency. We can compare this second strategy with the first by listing their respective characteristics:

	Strategy of Transparency	Strategy of Reflectivity
Goal	information delivery	compelling experience
Metaphor	interface as window	interface as mirror
Response by user	look through interface	look at interface

These two strategies form a continuum: no digital design can achieve pure transparency or pure reflectivity. Each design is a combination of these two strategies—perhaps with more elements of one or the other. We might be tempted to think that transparency is for "serious" digital applications, such as productivity software, while reflectivity belongs exclusively to art and entertainment. But it is not that simple.

It is true, however, that digital art emphasizes reflectivity. The art of SIGGRAPH 2000 calls into question the assumption that the strategy of transparency can be all-inclusive and self-sufficient. One function of art in the past century has been to challenge such assumptions. The task of the SIGGRAPH Art Gallery is to place itself in the middle of a premier conference on digital technology and ask questions about how digital technology works with us and for us. *Wooden Mirror, Nosce Te Ipsum,* and *TEXT RAIN* playfully question our role as the user, the subject, of a digital interface. These pieces are not simply "art"; they are also "demos," which we expect to find in a computer conference. They demonstrate compelling possibilities for our interaction with digital applications. They demonstrate how the interface can be made visible to us as a vital part of our experience.

The importance of oscillation (between design strategies)

Designers of digital artifacts—in fact, designers of any media form in our digital era—must mix strategies and create an interface that is both transparent and reflective. This mixing of strategies means that the designers must examine their designs in two ways: from the outside and from the inside. They must look at each design as if they were users, and they must also be able to look at each design critically, from the outside.

When Bruce Tognazzini compared interface designers to magicians, he suggested that designers, like magicians, must live in two worlds: "Magicians live in both the world of their mechanical tricks and the illusory world they are creating for their spectators, but they 'believe' in the spectator's world" (1993, 359). Magicians always deal in two realities. Digital artists and designers too must believe in their illusions—but only up to a point. And the same is true for their audience. In a magic trick, the magician never wants the audience to see the interface, to guess how the trick works. But designers *do* want their users to be able to get behind the illusion at certain times.

Good designs oscillate between hiding and revealing themselves. *Nosce Te Ipsum* oscillates as it unfolds itself before the user and as the elements of the collage peel back to reveal the user to herself. The rhythm of oscillation comes from the interaction of the user with the system and is determined by the pace of the user's walk.

Interfaces should oscillate in a controlled way between transparency and reflectivity. The essence of the GUI is controlled oscillation.

Interfaces should oscillate in a controlled way between states of transparency and reflectivity. The essence of the GUI interface, for example, is controlled oscillation. Alan Kay understood this when he invented overlapping windows, the key element in the GUI. One window in isolation is meant to be transparent, to show the user the data that it contains. Kay and his colleagues came up with the idea that multiple windows on the screen can be stacked or overlapped. At any time, the user can call any window forward and make it the focus of the interaction, and that action of calling the window forward (by a click of the mouse) requires that the user acknowledge the interface, at least momentarily. For a moment, she must look at the interface, at the stack of windows, and select one, and in that moment the window is no longer completely transparent. It is not only a view of the data, but also a tool to help the user organize her information.

The Macintosh designers inherited overlapping windows (and much more) from Kay and his colleagues at Xerox PARC. In the previous chapter, we noted that the Mac interface strives for transparency, but that is only half the story of this remarkable design. The success of the Mac interface stems from the fact that it does not fully accept its own transparency. But Microsoft Windows, which copies the GUI of the Macintosh, doesn't provide a graceful oscillation. Windows shows the folly of accepting the simple definition of interface design as transparency.

Microsoft Window (sic)

The real problem with Windows is that it was designed by people who didn't love what they were doing. Unlike Alan Kay and his people at Xerox PARC and unlike the Macintosh designers, the Windows designers were following a pattern without fully understanding what it meant. There's no magic in this interface. All the mythology has built up around Alan Kay and the people at Xerox PARC, Steve Jobs, Bill Atkinson, and the makers of the Macintosh. No one ever talks about the makers of Windows. (They have become transparent.)

What's wrong with Windows? It is a remake of the Star and Macintosh interfaces, and it functions adequately. As a result of brilliant marketing and business strategy by Gates and company, it has established itself as the platform for most of the personal computer development of the past decade. But it is precisely because of its dominance that the interface has never had to be as good as the Macintosh. Windows could rely on its market share to perpetuate its market share, because applications developers continue to develop for the most popular operating system. The newest software is always available for Windows.

Yet there are unmistakable, egregious flaws in the interface, and these flaws can be ascribed to an unquestioning pursuit of the transparent. Unlike the designers of the Macintosh, the designers of Windows (or perhaps their managers) lacked the subtlety to understand how to control the rhythms of the desktop metaphor, how and when the interface should oscillate between transparency and its opposite. They always thought they were striving for transparency, which they equated with consistency. They didn't realize when to be inconsistent. It will come as a surprise to many bewildered first-time users, but in fact Windows is too consistent. The user crashes into the clear window that the system tries to be, and the result is confusion and mystification. Here are three examples.

Multiple programs The multiple launch feature combines with the window-minimizing feature to create a double-whammy for beginning and even some intermediate users. When minimized, the window shrinks to an icon in the taskbar. Often a beginning user will launch Word or another application, type in a paragraph of text, and then hit the Minimize button by accident or because she wants to see something on the desktop. Suddenly her document has disappeared. So she finds the Word icon and launches again. To her dismay, the document she was working on doesn't return (she doesn't understand that the document is pinned to another version of the program). So she types the paragraph again and minimizes again. Beginning users may soon have three, four, or five invocations of the same program in their taskbar, each with the same paragraph (figure 3.6).

This behavior on the part of Windows is logical and consistent, but it is almost *never* what the user wants to do. She doesn't think of the program as separate from her document; she thinks of the two united.

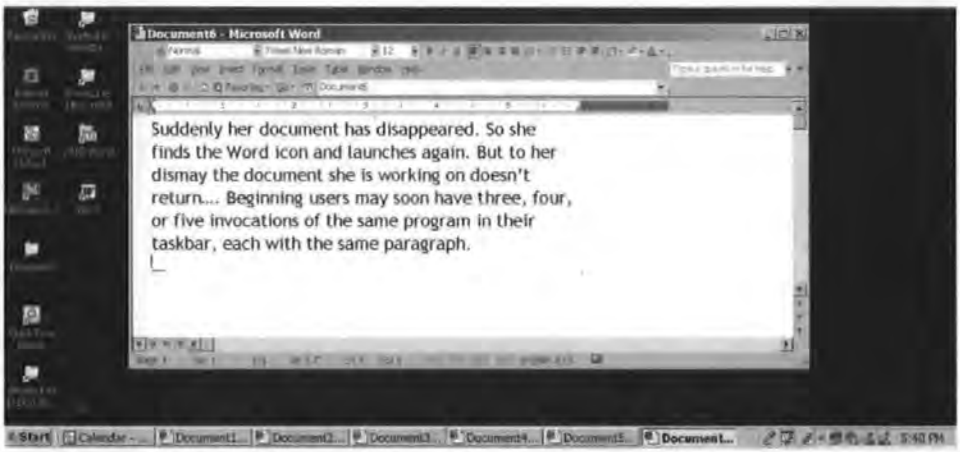


Figure 3.6
Windows taskbar: A failure of transparent design.

Hiding the extensions The Windows interface was built on the DOS operating system, where files had eight-character names followed by dot and a three-character extension (.doc, .txt, .htm, and so on). Those three-character extensions still linger in the Windows system; however, following the principle of transparency, the designers decided to make them invisible. In the default mode, the user sees the file names without the extensions. The problem is that two files in the same folder may now appear to have the same name because their different extensions are not visible. Also, the dialog box that opens files shows only files with the "appropriate" extension. As a result, even an experienced user can have trouble finding the file she wants to open (figure 3.7).

The developers presumably reasoned thus: "The extensions are primarily used to identify the program to which a file belongs. Since the files automatically open their programs, why bother to clutter the screen with the extensions?" The answer is that the operating system is not smart enough to anticipate when the users may need to see the extensions. It should always provide them.

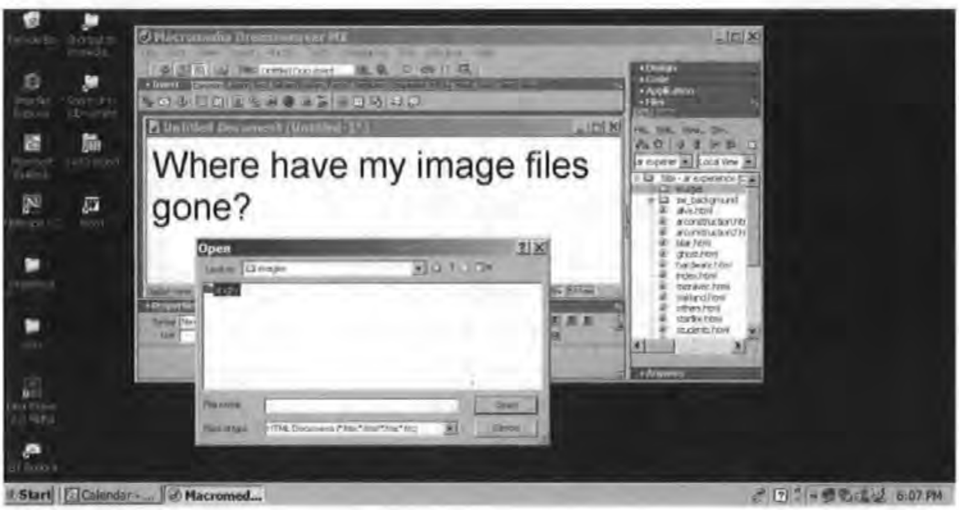


Figure 3.7
Windows file dialogue: It is impossible to distinguish between files with the same name but different extensions.

The menus The designers decided that menus should be attached to windows. It was a logical decision—except that applications often have commands that apply to multiple windows or to all the information in the dataspace regardless of whether there are windows open or not. The consistency of requiring that menus belong to windows leads to inconsistencies: some commands must be attached to a window even when they do not apply to the data in that window, and the whole desktop itself has no menu bar. The user has to look elsewhere and switch her mode of thinking when she reaches the desktop itself and wants to issue a system command. There is a different interface—an elaborate, nested pop-up menu called the *taskbar.*

Despite the inconsistency, users would no doubt have found it easier to have a menu bar on the desktop as well. These are apparently small problems, except that user interface design (like all other visual design) is the sum of a series of small decisions. Furthermore, these and other decisions in Windows are not isolated flaws; they form a pattern. The operating system interface is called Windows, but it should be called Window, because the system does not encourage or help the user to maintain multiple windows. Some applications maximize a single window automatically and block the user's view of the desk. Many users employ key commands to switch from one application to another rather than changing focus by clicking on another window. In every way, it is harder to get an overview of all the applications and resources than it is with the Macintosh interface.

The designers of the Windows wanted a single transparent window onto the world of data; they had no sense of the multiplicity of services and applications that the personal computer supports. Their problem was a slavish consistency rather than understanding when to break a rule.

The designers obviously believed that simplicity and a dogged consistency would promote a sense of transparency. However, the reverse happens: the user often has to spend more time thinking about the interface, when she wants to be thinking about the data, because the interface often hides information that the designers believed the user wouldn't need. Such decisions require extreme finesse. It is very hard to know what details to hide and which to display. To know requires user testing, of course, but also intuition. The designers had too little of either, it seems, or they would never have made the default to hide the three-character extensions to file names. They would never have created the maximized window that sticks tenaciously to the whole screen and refuses to let the user drag it.

Seeing the interface

When, as a designer, do you want your user to be aware of the interface? There are many such moments. For example . . .

- When the user wants to modify the parameters or turn off the automatic features. In the Windows operating system and in Microsoft applications, it can be exceedingly difficult to turn off the automatic features. In trying to be transparent to the task, the program buries such parameters inside layers of interface.
- When the user wants to know where a program is saving temporary files or making archives—for example, where the mail program saves its attachment files.
- When the user wants to know where all the support files are located when she installs a program. For a typical application, there may be fifty or a hundred support files.
- When the user wants to know what is happening when she downloads an application from the Web. The file may be unzipped; it may add a variety of files to her disk and then insert itself (as a plug-in) into her browser.

In general, the user wants (and needs) to be aware of the interface whenever something goes wrong because bugs and failures in a system break the illusion of transparency.

True user-centered design: The interface as a mirror

We now have another perspective on the struggle between Designers such as David Siegel and Structuralists such as Jakob Nielsen, which we described in the Introduction. (If you skipped the Introduction, you can go back to it.) The war of the Structuralists and the Designers is about transparency and reflectivity. Whereas the Designers want their designs to be reflective as well as transparent, the Structuralists believe that transparency is the ultimate goal of all good design.

The study of HCI and usability almost always assumes that transparency should be the goal of all digital artifacts. Nielsen (2000) clearly makes this assumption, for example, in his book on Web design. For Nielsen, a Web site should always be a pipe that delivers information effortlessly to the user, yet such an idealized information Web site would in fact be ineffective. Idealized information sites do not really take into account the audience's contexts and needs.

They turn their audience into consuming units in order to deliver information efficiently. Nielsen thinks that in his design strategy, the users' needs drive the Web site, but in fact it's the site that defines and conditions the users as consumers. Good Web design, however, reflects the users' needs and wants in all their complexity. Good design does not mold users according to its recipe; instead, it allows users to see themselves (and the process and contexts of design) in the interface.

Good Web design is both transparent and reflective. It reflects the user's needs and wants in all their complexity.

An effective interface functions as a mirror as well as a window. *Wooden Mirror* shows this, as does *Nosce Te Ipsum.* Although HCI talks about the need to model the user, the interface should in fact reflect the user, a somewhat different and more complex undertaking. That would be true user-centered design, a strategy that reveals and reflects user, process, and context. This is exactly the metaphor in *Nosce Te Ipsum,* in which, by walking toward the screen, the user is revealed in the center of the image.

Usability testing is meant to uncover those aspects of the interface that confuse, frustrate, or otherwise fail the user. Traditional usability testing looks for the limits of transparency. It reveals those moments when the user must think about, and occupy herself with, the interface. To usability experts, such moments always indicate mistakes in the design. But they can also be moments of revelation, when the user comes to understand her relationship to the interface. Such moments are symbolized by the user's final steps in *Nosce Te Ipsum,* when all the other layers peel away and she recognizes herself on the screen.

Usability testing must come to appreciate the need for the interface to oscillate between transparency and its opposite. It must learn to measure this oscillation, which in fact defines each digital interface. The best rate of oscillation will vary for different users and different purposes. The GUI (first in the Xerox PARC machines, then in the Macintosh, and finally in the less successful Windows version) has flourished for almost three decades because its rhythms of transparency and reflectivity make good sense for most users and for a variety of applications.

Chapter 4. Magic Book

THE NEW AND THE OLD IN NEW MEDIA

Remediation refers to
the way we borrow reality
from prior media forms.

Like the printed book, film, and television before it,
the computer is not a neutral space for conveying information.

It shapes the information it conveys and
is shaped in turn by the physical and cultural worlds
in which it functions.

Magic Book

TEXT RAIN, *Wooden Mirror*, and *Nosce Te Ipsum* are located in the Art Gallery itself. When we walk from the gallery into the Emerging Technologies exhibit, we see experimental designs, some of which could be mistaken for digital art. They too are radical experiments, and they too are concerned, at least implicitly, with the experience that they offer the user. Whether we call them art or technology depends on many factors, including not just the intentions of those who created the pieces, but also what institution or department the creators belonged to and who financed the work. (If the National Science Foundation or the National Institutes of Health pay the bills, it has to be technology.).

Magic Book was created by students and researchers from the Human Interface Technology Lab at the University of Washington, the ATR MIC Labs, and Hiroshima City University in Japan. *Magic Book* looks like a conventional printed book, which the reader or readers gather around, as it rests on a table. As they turn its physical pages, they can see colorful gnome-like characters and read a simple story. There is more to the experience, however. When the reader holds a special digital lorgnette before her eyes (figure 4.1), the figures and buildings in the illustrations emerge from the page and appear to her in three dimensions. The book has become a digital pop-up book (figures 4.2 and 4.3). Finally, when the reader presses on the base of the lorgnette, the scene on the page rises up and surrounds her. She can now

Figure 4.1
Human Interface Laboratory, ATR MIC Labs, and Hiroshima City University (Mark Billinghurst, Rob Blanding, Winyu Chinthammit, Tom Furness III, Nick Hedley, Hirokazu Kato, Lori Postner, Ivan Poupyrev, and Lily Shirvanee), Magic Book.

use a switch on the lorgnette to fly through and explore the virtual scene. She is no longer reading the book as a physical artifact; instead, she has "put on" the book and is experiencing it as a virtual reality. Two readers can share this physical and virtual book. If both are holding lorgnettes, one can enter into the virtual book, while the other continues to look at the three-dimensional image on the pages of the physical book. In this case, the first reader appears to the second as a tiny avatar within the image.

Figure 4.2
Magic Book:
Looking through the digital lorgnette . . .

Figure 4.3
Magic Book: . . . *the user sees a computer-augmented view of the page.*

Shrunk to the size of the other characters, she seems to have become part of the story not only to herself, but to the other reader as well. She experiences the story in the first person, while the other reader experiences her in the third person.

Magic Book moves through three stages, from the physical artifact to a digitally augmented artifact to a virtual reality. The second stage is called augmented reality, in which computer graphics augment the user's view of the physical world. In this case, a video camera is attached to the special glasses, so that the reader experiences the pages of the book as a video image with computer graphics overlaid. The third is virtual reality, where the computer is drawing the whole visual scene. In this stage, the physical book disappears and is replaced by the virtual environment in which the user is immersed. When the author's style of telling the story is compelling, a printed book can metaphorically immerse the reader in the story. The Magic Book renders that metaphor visual, as the reader watches the images first rise off the page in AR and then surround her in a VR experience. Here is how the creators describe these stages:

> Readers often gather around a real storybook and are transported to imaginary magic places by the pictures and text on the pages. Similar to a normal book, people can turn Magic Book pages, look at the pictures, and read the text. . . . The Magic Book expands on the idea of a "pop-up" book by offering three-dimensional animated and interactive virtual images. If they read the book wearing an AR HMD [augmented reality head-mounted display], they see virtual images appearing out of the pages. People can read the book together in the real world and also experience the virtual images that appear attached to the real book pages. . . . Finally, readers can fly into the virtual images and experience the story immersively. Thus, the AR book allows people to experience the full Reality-Virtuality continuum. <www.hitl.washington.edu/magicbook/background.html>

The goal is to make the movement from the flat symbolic space of the printed page to the visual, three-dimensional space of virtual reality as simple as possible.

Magic Book is an experiment in what we can call remediation—the making of new media forms out of older ones. It begins as a printed book. This physical book offers its readers an experience that the designers of *Magic Book* wanted to imitate, enhance, and ultimately refashion in digital technology. Through their remediations, the designers of *Magic Book* sought to bring out the multiple levels of experience that were latent in a printed storybook.

When the designers asked themselves "What is reading?" their answer was that (at least for young readers) to read is to be transported to a world that the reader can see with her mind's eye. The augmented reality interface allows the reader to see that world in three dimensions not with her mind's eye, but with her physical vision. The enhanced view is in turn followed and reimagined by the fully immersive experience of virtual reality. What fascinates readers of *Magic Book* are the transitions among these three versions of the book. The virtual reality experience grows out of and yet still depends on the physical book with which the reader began (figure 4.4).

Magic Book **as an interface**

A printed book is an interface. Read a book with a five-year-old child, and you will realize how complex and varied that interface can be. A child who cannot quite read by himself makes full use of the book's interface. Much more space is devoted to images than to text in his books; there are pictures on every page. The pictures matter, and the child wants to look at them carefully. If we are reading the text to the child, we may rush to turn the page and get on with the words (which for us is the point), but our companion knows better. He wants to savor the pictures and understand the text as an interplay of words and images. If it is a familiar book, he will probably not choose to read the pages in order. He will go to a favorite page, examine it, then perhaps move back to another favorite, and so on. Children have known for decades (since the flourishing of children's literature in the nineteenth century) how to read hypertextually. There is a long tradition of experimental interfaces in

Figure 4.4

Magic Book: (a) *Physical space of the book,* (b) *augmented reality (the physical world is seen through a computed overlay),* (c) *immersive virtual reality (the physical world is no longer seen).*

children's books—pop-up books, books in odd shapes, books with holes in the page so that the reader can see a portion of the image on the next page. In other words, children treat the book as a reflective interface.

It is we adults who have lost our imagination and insist on treating the book as transparent. Our books often have no pictures, and we (at least those of us who are not designers or editors) have learned not to care about, or even to notice, the typeface and the layout. We have learned to look through the text rather than at it. We have learned to regard the page as a window, presenting us with the content, the story (if it's a novel), or the argument (if it's nonfiction). For us adults, *Magic Book* is an experiment in the meaning of reading, a radical remediation. It reminds us of possibilities for the book as interface that we knew once as children.

Readers of *Magic Book* can move from the conventional form of the book to the immersion of virtual reality, and they can go in the other direction as well—from fully immersive to the augmented or conventional forms. *Magic Book* is an adaptive interface, which the user can set to the appropriate mode: from symbolic to pictorial and immersive (virtual reality). *Magic Book* also reminds us of the whole story of the development of the computer interface. The first interfaces on cathode ray tube terminals and on the first personal computers were text only. They were straightforward remediations of the printed page, although the printed page was much more comfortable than the twenty-four lines and eighty columns of monospaced, sans serif letters on the terminal screen. The GUI is a mixed interface—a more legible combination of text and images. And today the various attempts at immersive or natural interfaces are almost entirely pictorial.

Magic Book carries us right through the myth of transparency, offering three different interfaces, each with a unique combination of the transparent and the reflective. The paged book was the transparent interface of the past; the immersive virtual reality is (perhaps) the transparent interface of the future. Between these extremes comes the augmented reality interface, which is perhaps the most reflective of the three interfaces, precisely because it joins two forms of representation that we are not used to seeing together. We are used to reading texts in printed books; we are used to seeing moving images in movies and on television. We are not used to seeing three-dimensional moving images occupying the same space as the book. This combination makes us aware of the tension between the two forms and of our relationship to both. *Magic Book* remediates the book by suggesting that digital technology can change the relationship of word and image, the relationship that was the focus of graphic design throughout the twentieth century.

How digital art remediates

Remediation is the making of new media forms out of older ones. When we walk back into the Art Gallery, keeping in mind the experience of *Magic Book,* we recognize practically every piece as a remediation, borrowing from and depending on other media forms. Sometimes the earlier, remediated form is the printed book; more often it is television, video, or film. *TEXT RAIN* itself combines print and video by putting both the poem and its reader into a video stream. Many of the pieces are mixed media, composed of electronic as well as analog elements.

Remediation is the making of new media forms out of older ones.

Stewart Dickson's *3-D Zoetrope* is an analog piece that simulates a digital effect—the effect of morphing. It also recalls for us attempts, in the nineteenth century prior to the invention of cinema, to make static images move. The traditional zoetrope was a cylinder lined with photographic images. When the viewer looked into the whirling cylinder, the images came together to give the illusion of movement. *3-D Zoetrope* is a kinetic sculpture in which sixty individual pieces mounted on a rotating wheel merge into a smoothly morphing image as we watch. This piece acts out as a physical sculpture what computer graphics achieves virtually through the technique of digital morphing.

3-D Zoetrope serves as a bridge between the physical and the virtual and between the present digital technology and the old technology of the zoetrope. We cannot look at *3-D Zoetrope* without thinking about computer graphics and the century of film that comes between the first occurrence of this pretty whirling cylinder and its revival. *3-D Zoetrope* asks us to consider how these technologies create the illusion of movement and which media forms we choose to explore and develop and which we choose to leave behind.

Kathleen Brandt's *Exclusion Zone* takes us elsewhere in the history of media. The piece includes three lab tables with microscopes (figure 4.5). Each microscope presents us with texts—not in the form of a printed book or pamphlet, but as text printed in miniature on microscope slides. We read these texts laboriously, one at a time, by placing them under a microscope and adjusting the knobs. Why does the artist make it so difficult for us? Because she wants us to imitate the process by which a biologist examines the world of living cells under a microscope. This too is a new kind of reading that combines the science of medical imaging and the art of storytelling.

In the evening, we visit the SIGGRAPH Electronic Theatre, a screening of dozens of short films that showcase the latest techniques in computer animation and special effects. It is an extremely popular event, with a line that trails out into the humid New Orleans evening. In the screening, practically every short that we see is a remediation—most often of live action film, from which the animations borrow camera style, editing techniques, and conventions of plot and character. *The Last Drawing of Canaletto* is like *Magic Book* in the sense that it allows us to enter into an earlier creative work. In this case, it is not a book that is remediated, but a painting by the Venetian artist (figure 4.6). We step into Canaletto's imagined world and move around and through it.

These are just a few examples of the dozens of SIGGRAPH pieces that remediate. *Wooden Mirror, Nosce Te Ipsum, Magic Book,* and the pieces we visit in following chapters (*Fakeshop, T-Garden,* and *Terminal Time*) are all deep remediations—of documentary television, painting, collage, and even the microscope. These pieces make us aware of earlier media forms in the very act of refashioning

Figure 4.5
Kathleen Brandt, Exclusion Zone: *The microscope as a medium.*

them, and it is important to develop this awareness when we set out to design digital media. As designers, we need to understand how our work functions in the history of media precisely because we are both doomed and privileged to repeat that history in our designs.

Figure 4.6
Cameron McNall, Shane Aker, Doren Garcia, Jim Gayed, David Hutchins, Gareth Smith, and Jackie Stewart: Last Drawing of Canaletto. *Computer animation allows the user to enter into a 3D realization of the world of this painting.*

Borrowing reality

It is not only the computer that remediates. Each medium in general and each particular media form reconfigures and remediates others. As viewers or users, we are always being asked to compare and contrast forms. Historically, this process has been going on at least since the Renaissance, when linear perspective painting was invented, and probably much longer. Perhaps the only art that did not remediate were the first pieces of art in a culture.

Does remediation ever stop? Isn't the ultimate purpose of media forms to present the world to us? And don't we evaluate media in terms of their ability to show us what the world is "really" like? For example, television news broadcasts are supposed to present electronic images of real events as they happen—sometimes live events from thousands of miles away. In fact, however, we don't compare television broadcasts only to the physical world as we experience it. Most broadcasts show us events (such as earthquakes and wars) that we will never experience if we are lucky. We generally compare television news to other television broadcasts and to other media forms, such as newspapers and (now increasingly) Web sites. Sometimes television news even acknowledges that it is covering itself covering the news. During the Persian Gulf War in the early 1990s, CNN seemed to have the best coverage, with reporters on the ground in Baghdad and Israel as well as with the U.N. coalition. The other networks simply broadcast CNN's reporters live; they were reduced to remediating CNN. The war itself was (for us, not for the combatants) a media event, and the fact that CNN's reporters remained in Baghdad became part of the war story itself.

Such ironies are not new. Throughout modern history, media have been understood and appreciated precisely because of their reconfiguration of an earlier medium. Whenever a new media form is introduced, there is an inevitable rivalry with other forms to prove which can offer an experience that is authentic. The enthusiasts for a new medium (photography, film, television, virtual reality) want to believe that it will allow them to experience events and people just as they would experience them without any media at all. The irony is that this claim to reality usually depends on earlier media forms. Photography supposedly finally got linear perspective right, but linear perspective had been defined centuries before by Renaissance painters. Film represents motion by recording a series of still photographs and playing them back at a rapid rate. Television depends on a similar trick, although in this case, it claims to surpass film because television images can be broadcast "live." In each case, techniques of earlier media were borrowed and reconfigured. Photography reconfigured elements of landscape and portrait painting; film reconfigured techniques of stage drama; television borrowed from conventions of vaudeville, stage drama, and film. Throughout the history of media, the context has been one of rivalry to create an "immediate" or "authentic" or "compelling" experience.

This rivalry is expressed in the work of individual artists, designers, technicians, and inventors. Remediation has been part of almost every design strategy in the modern era. Some designers have intentionally and explicitly remediated earlier media; others have done so implicitly and perhaps unconsciously. Once we understand this historical process, we can see how digital applications, especially Web and Internet applications, offer opportunities for remediation as an explicit design strategy.

Media forms

The computer is not a neutral space for conveying information any more than the printed book, film, or television are neutral. The computer shapes the information it conveys and is shaped in turn by the physical and cultural worlds in which it functions. For this reason, the computer is more than what Claude Shannon defined in his communication theory—more than a pipeline that channels the content from sender to receiver. As they have done with books, film, and television, designers use the computer to give shape to the content that it transmits; they transform the delivery of content into an experience of a particular kind. Furthermore, digital technology is not a single medium, but rather a network of related media forms.

The computer is not a neutral information space: it shapes the information it conveys and is shaped in turn by the physical and cultural worlds in which it functions.

The World Wide Web has already produced many such forms, each with its own conventions and its own audience. For example, there are news and information Web sites modeled on newspapers and television, and in fact the major newspapers and television news organizations all have their own Web sites. We expect such sites to offer a layout with a menu bar on the left and information area on the right (figure 4.7). Such an information site typically operates through a series of subject links, usually in the navigation area on the left. We expect the sites based on newspapers (such as the *New York Times on the Web*) to offer stories taken from the printed newspaper or written in a similar style. We expect the sites based on television networks (like CNN.com) to include video clips along with the articles. These expectations come from our knowledge of these media forms.

The same is true of our experience of earlier media forms. When we read a novel, we have expectations about the "interface"—the way the text is laid out on each page and page by page. We have expectations about the shape of the novel as well—how the story is told with one or more narrators, how time moves in the telling of the story, how characters interact. The novelist may experiment with these expectations. He may break some of the conventions, but he cannot ignore them entirely. In the same way, for many digital applications we have expectations that have already arisen from our experience with digital genres.

Figure 4.7
Standard design for an information Web site, with menu bar on left and information area on right.

There are Web radio and television stations, Web soap operas, sites to promote and advertise corporations and organizations, official and unofficial fan sites for celebrities, gambling and pornography sites. Audiences already know how to read these various media forms, how to tell good sites from poor ones. The same is true of computer games delivered on CD, DVD, or over the Web. Already, the fans of such games can draw subtle but (to them) important distinctions among the various subgenres: action, adventure, role playing, simulation, puzzle, and so on.

Remediations are not forever

In 1945, American radio was thriving with different media forms for drama, comedy, and news and information. Other than a few enthusiasts for television (who must have sounded rather like VR enthusiasts do today), no one thought that within fifteen years, these forms would all but disappear. Between 1951 and 1956, longstanding favorites such as *The Life of Riley, The Shadow, The Adventures of Ozzie and Harriet,* and *The Lone Ranger* went off the air. (*Gunsmoke* lasted until 1961.) Television didn't kill radio, but it killed radio as a medium for telling stories. Many of the qualities of radio entertainment were taken over by television in the 1950s, and many radio series, such as *The Lone Ranger, Amos and Andy,* and *The Adventures of Ozzie and Harriet,* migrated to television.

Media forms and even media can become moribund and can be replaced. Radio continues to spawn new forms: the pseudo-political talk show, endless subtle varieties of popular music programming, the non-news news format (where reports of traffic jams and local thunderstorms are treated as news items). These too are remediations—of the Hyde Park (eccentric) orator, the disco dance, and the gossip once exchanged in barbershops. And there are the interesting hybrids: radio broadcast over the Web, music downloadable from the Internet, and so on. But media forms for narrative and drama hardly exist on broadcast radio anymore.

Remediations are always provisional. Because remediation, like beauty, is in the eye of the beholder, the task of the designer is to convince the user of the value of each remediating design. When designers succeed, new media forms are born. But a new form is not better in any absolute sense than the older form. It depends on what criteria we use to judge the new and old forms. Designers and producers of the new form want the audience to adopt new criteria. Television programs are better than the experience of film only if we measure the two forms by the standard of "liveness." Television news is more up-to-date and therefore (by some standards) more informative than the film newsreels that used to run in theaters in the 1940s before the feature presentation. If we measure by the quality of the image, however, film was always and is still better (as we wait for HDTV). Web sites are better than television if we judge them by the standard of point-and-click interactivity. But television is still better than the Web at delivering higher-quality moving pictures in real time. The key is which standard is applied.

In digital design, the standards seem to be changing more rapidly than ever before. Everything about digital design is in motion, including the criteria by which we judge it. The standards for judging a printed book—the transparency of the layout and typography—remained much the same from 1600 to 1900 and beyond, although there were changing ideas about how to achieve that transparency. But with the new media of photography, then film, radio, and television, the criteria changed several times in the space of 150 years. Today, digital design is at most 30 years old, and the criteria seem to change often, as digital technology is presented as a rival to different earlier media and their forms. First, the computer was a new kind of book, then a new kind of graphic design, and now also a new kind of television and film.

The variety of digital remediations

In a sense, electronic computers started to function as remediators as soon as they were tinkered together in the 1940s. They were built to remediate the mechanical calculating machines and the card tabulators that had been used since the turn of the twentieth century to record the U.S. Census and similar data for business. It was these tabulators that made IBM an important company before electronic computers were ever built. The early electronic computers used punch cards or punched paper tape as input and sometimes as output. What they remediated was what happened between input and output: they replaced the mechanical operations of sorting with electronic comparisons. We did not see this replacement as a remediation, however, because we did not understand the computer as a medium at all. Instead, in the early years, we were captivated by the idea of the computer as an electronic brain rather than as a medium of representation. Although the computer was already a remediator in the 1940s and 1950s, our culture did not get the point until much later, when we began to see how the computer could explicitly supplement or replace other media forms.

It is no coincidence that the researchers at Xerox PARC, such as Alan Kay, who finally and convincingly demonstrated that the computer could be a medium, also introduced the

part of its meaning, because the computer as a secretary's desktop in a business office. The
on the original. This is especiphysical desktop become electronic files and directories in the
computer interface is a remecs files into folders by manipulating them with the mouse. It is a
In our media-saturaerts tell us that a metaphor is or should be operational: that it
computer games, or even prouser to go through the steps required to accomplish a task in
comparisons so quickly and a
love metaphors and computer, have a larger purpose, precisely because the computer is now
igital metaphor should explain the meaning and significance of the
The rhythms of remediatiothe user to an earlier media form. There does not have to be, and
Suppose you had invented a erfect correspondence between the operations of the computer and
ences in a way unlike any otlat a desk. The historical importance of the desktop metaphor was
What do you say? How coul personal computer was good for. It explained that unlike the
have to say: "It's like televisiopast, these computers were meant for the work that secretaries,
"It stores symbolic informaticademics used to do with pen, paper, and typewriters. (And
information." You have to tel pen and paper, the personal computer has almost eliminated the
Until you can explain how it phor obeyed the double logic of remediation: it depended on the
nize it as a medium at all. l yet it asserted that the computer could improve on the past.

This very thing hap|hor incorporated, rather inconsistently, an earlier metaphor that
not understand the computer| and Alan Kay had perfected. As we have noted, the display of
began to explain how it couldable, overlapping rectangles on the screen could have been given
canvas, and so on. They had topers chose the name *window* and so invoked a cultural
indicate what was different. Renaissance painting. Today, computer windows can replace not
defines a rhythm of the old ally other media forms such as printed books, to offer us a view
artifact is a perfect replica of a The first computer windows held only blocks of text; now,
utterly and completely new, th of the World Wide Web, computer windows contain static and

The rhythm of rem offer experiences and not mere data, and they constitute the
between the transparent and n on the desktop computer.
medium, it seems transparenws are (sometimes) meant to be transparent, the computer itself
look like a newspaper? Becauoday. We see computers and computational devices all around
Put a story in a multiple-coland obvious examples of a media revolution. Furthermore, the
as news (as newspapers thems perhaps the most vigorous and eclectic remediator of all the
local, national, or internatione. Various digital forms, and particularly the World Wide Web,

borrow from, reconfigure, and remix all of the principal media of the twentieth century (film, radio, audio recording, and television), as well as two great earlier media: photography and print itself. All of these were new media themselves at one time and defined themselves in distinction to earlier media.

Computers and computational devices are the most visible and obvious examples of the media revolution.

Like their predecessors working in graphic design, photography, film, and television, digital designers are becoming used to borrowing from earlier forms. Digital art has the important task of explaining how this borrowing works: we borrow in order to offer a new experience for the viewer or user, but that experience always depends on our remembered sense of the reality or authenticity of earlier forms. The magic of *Magic Book* lies in the way it recalls our childhood belief that the stories that books tell are real worlds—worlds that we should be able to explore and inhabit.

Magic Book is nostalgic in this sense. It is striking how many digital designs, particularly Web sites, make a nostalgic appeal to "simpler" technologies from "simpler" times. For this reason, radios and television sets, jukeboxes, photo albums, and control panels with quaint analog displays are all popular metaphors on the Web.

Metaphors and remediation

A digital metaphor may be a navigational tool, but at the same time it shapes the user's experience of the site. This is the way to think of navigation in general: it is not simply the movement between units of information but an experience. To design the navigation and interaction strategies of a Web site (or any computer application) is in large part to define the user's experience of the site.

Usability experts claim that designers use metaphors too freely. A metaphor, they argue, can be misleading if users fail to understand its limits. In fact, digital metaphors are never perfect analogies, and users soon realize that they are not meant to be. If the computer desktop was perfectly like a physical desktop, folders would be as hard to rename and reorganize in the computer as they are on a physical desk. Texts of letters and other documents would be as hard to change. Why would anyone then bother to buy a computer to do word processing and file organization? The purpose of a good design metaphor is to emphasize differences from as well as similarities to the original. The divergences from the metaphor are part of its meaning, because they show the ways in which the computer application improves on the original. This is especially true when the metaphor is to another medium, when the computer interface is a remediation of an earlier form.

In our media-saturated culture, it is inevitable that we should understand Web sites, computer games, or even productivity tools in comparison with other media. We make these comparisons so quickly and automatically that they become almost unconscious. That is why we love metaphors and computer icons, even when usability experts tell us that both are overused.

The rhythms of remediation

Suppose you had invented a new medium—a technology that transmitted and created experiences in a way unlike any other. A friend comes to you and asks what your invention is for. What do you say? How could you describe it without referring to other media? You would have to say: "It's like television, only you view images in three dimensions on a headset." Or: "It stores symbolic information like a printed book, except that the reader can change the information." You have to tell people how it fits into the ecology of existing media forms. Until you can explain how it resembles and how it surpasses other media, people won't recognize it as a medium at all.

This very thing happened with the computer. For the first several decades, people did not understand the computer as a medium. It became a medium only when Licklider and Kay began to explain how it could combine the functions of the book, the telephone, the painter's canvas, and so on. They had to indicate what was familiar about the new medium in order to indicate what was different. Each designer of a new media artifact in effect does the same thing: defines a rhythm of the old and the new and makes that rhythm intelligible to the user. If the artifact is a perfect replica of an older form, the user will see no need for it. And if the artifact is utterly and completely new, the user will not understand what it does or why he should learn it.

The rhythm of remediation is another name for the rhythm discussed in chapter 3: between the transparent and the reflective. Because the user is accustomed to the earlier medium, it seems transparent and natural. Why design a news and information Web site to look like a newspaper? Because a newspaper is still seen as the "natural" way to present news. Put a story in a multiple-column format with headlines and bylines, and people will regard it as news (as newspapers themselves prove every day by running stories that tell us nothing of local, national, or international significance). The very fact that these stories appear in the proper format qualifies them as news. The stories on the news and information Web sites often follow the same structure and present the same content as in newspapers. What is new and (at least at first) unexpected is that Web sites can present links that allow the user to jump to other stories. Hyperlinks are reflective elements in the interface: they compel the user to consider where the link might take her.

Remediation as a conscious design strategy

The rhythms of the old and new will be different for different sites, depending in part on whether the remediation is explicit or implicit—for example, whether the site looks and acts like a television or simply recalls the medium forms of television broadcasting implicitly in the way it addresses the user. But the borrowing of older media forms always has a double sense: it both honors the older forms and challenges them. The borrowing helps explain a new technology to its users. One piece at SIGGRAPH 2000 says to its users, "This virtual reality application is like a book in the sense that it imagines a world for you to experience. At the same time, it improves on the book by allowing that world to surround you as a visual experience." Another says, "This Webcam site is like a television show, but with the advantage that you as the viewer can decide which camera view to watch and when to switch."

Digital design should take this lesson from digital art: designs, as media experiences, borrow a sense of authenticity or reality from previous media forms. Like digital art, commercial designs borrow from earlier forms in order to claim to improve on them. Whether she is working on a Web site or the interface for a new word processor, the digital designer is remediating some earlier forms. Likewise, the user will be consciously or unconsciously comparing her site or interface to earlier media. He will be trying to read a Web site as if it were a print publication, he will read the graphics as if they came in a magazine, or he will read the streaming video as if it were a television broadcast. As it was for the artists of SIGGRAPH 2000, the strategy of remediation should be a conscious part of design, especially now that we understand the computer as a medium that can offer us new media forms. The poet and critic T. S. Eliot said that good poets borrow and great ones steal. We could say that all designers remediate and good designers do so consciously and consistently.

Chapter 5. Fakeshop

THE DIVERSITY OF NEW MEDIA

New media is not one media form,
but a series of convergences—a series of
temporary and provisional combinations
of technologies and forms.

Fakeshop

In the SIGGRAPH Gallery, the *Fakeshop* project is represented by an elaborate Web site. We see multiple windows, offering streams of information (text, stills, and video), reported through a richly layered interface. As the artists (Jeff Gompertz, Prema Murthy, and Eugene Thacker) explain, "This work is the result of a fascination with aesthetic by-products of computer procedure. It is an example of electronic audio/visual transfer (CUSeeMe video-conferencing, Real Audio broadcasting, and other assorted hi/lo tech tools.) We've endeavored to build an electronic theatrical device, to create conditions in which simultaneous transfer of digital information can occur in real time" (*SIGGRAPH 2000*, 42).

The site at SIGGRAPH 2000 is a collage of different times and places, and it is one expression of the larger *Fakeshop* project. Fakeshop is a team of artists whose work combines installation, Web, and performance elements. The installations themselves took place in Brooklyn during summer 1999 and at Ars Electronica in the fall. The experience offered was both physical and virtual: it was an exhibit that a user could enter and explore, and it was a Web presence. The Web page in figure 5.1 shows the many threads of the experience.

The window in the left corner comes from *Coma*, a dystopic 1978 science-fiction movie, in which victims are kept in a coma in order to harvest their organs. The *Fakeshop* installation is a remediation of a scene from the movie, in which live actors lie on futuristic

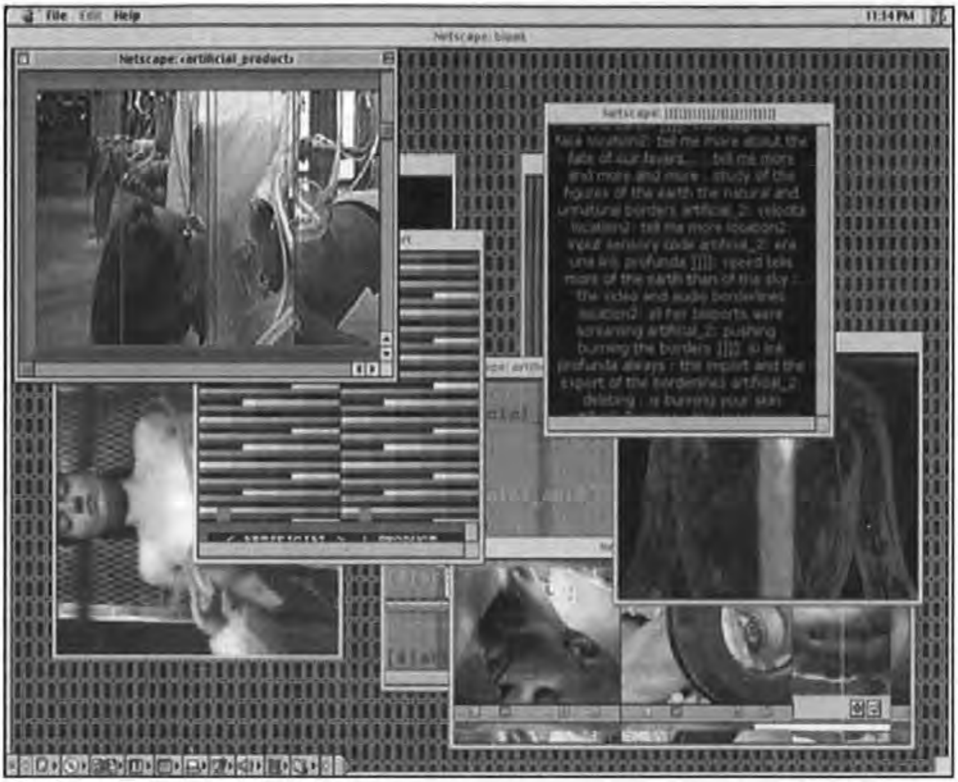


Figure 5.1
Jeff Gomperz, Prema Murthy, and Eugene Thacker, Fakeshop Web site: The diversity of new media forms.

platforms pretending to be comatose. Visitors to the installation can walk among the actors, who remain perfectly still. Meanwhile, video cameras are streaming images of the comatose actors over the Web; one such image appears at the lower left of the Web page. Other images and texts occupy other windows on the page. The text window, for example, holds excerpts of appropriate texts as well as logs of chats recorded from past performances, as people from around the world were invited to log in using CUseeMe (videoconferencing software) and contribute to a live discussion. All of this material is collected on the Web site, which is projected on a wall of the installation and can also be viewed by anyone browsing the Internet.

Fakeshop is about the human body as a physical presence and about the representations of our bodies that we send through cyberspace. On the Web site, we see bodies as envisioned in a film, bodies of actors recreating the film, and 3D models of the body (rendered in a graphics program called Poser). We read texts that describe what is happening to our embodied existence in an age of information. The diverse ways in which bodies are presented and represented illustrate the diversity of media and media forms surrounding us today. Even the "live" bodies of the actors were, after all, part of a media event, an electronic theater piece.

Fakeshop borrows and refashions most of the media that we now find on the World Wide Web. As viewers (or users or participants) of the site, our attention is drawn successively in many directions: toward the text, the images, and particularly the digitized video appearing in the windows, and then back to the windowed interface itself. The interface itself is a collage of media forms.

Other pieces we have visited—*Nosce* and *TEXT RAIN*—have the quality of collage. *TEXT RAIN* is diverse in the sense that it combines two distinct media, the book and the video camera, that were at odds with each other throughout the second half of the twentieth century. (Readers over the age of thirty will remember how television was often blamed for the decline in print literacy in the United States, although the truth is that the United States has not been a very literate society since the nineteenth century, if it ever was.) The World Wide Web and computer games, the new villains for traditionalists, are now sharing the blame with television. Digital art in general is extremely diverse, reviving old and even archaic media forms and at the same time exploring the newest technological possibilities (such as genetic programming, virtual and augmented reality, and artificial life).

Digital art is not concerned about being pure. It often mixes the virtual with the physical, as does *TEXT RAIN,* which as an installation consists of both the physical presence of the participants and their projected images on the screen. The diversity of digital art reflects the diversity of the digital world, which, despite predictions, shows no sign of converging to a single medium or media form. Far from unifying all media into one, digital designers and entertainment corporations are busy devising new combinations of older forms. The closest thing we have to a converged medium is in fact the World Wide Web, already a complex mix of forms and audiences.

The myth of convergence

Digital technology may not have converged, but the predictions of the enthusiasts have. When they describe our digital future, it almost inevitably comes down to interactive television. Viewer-users will sit in their family room converged around a wall-sized, high-definition television screen and "interact" with the shadows on the wall. If they are watching a drama, they will be able to switch points of view, follow their favorite characters around, and influence the story. If they are watching news, they will be able to choose among the stories, as well as the amount and kind of background information, they receive. They will participate in local, national, or global forums and make their opinions immediately known through electronic voting. They will visit electronic shopping malls and make purchases. The predictions are utopian and, for some, breathtaking. Despite decades of experimentation and promises, however, no interactive television system has proven workable or popular.

On the other hand, so-called enhanced television has been a surprising success. In order to enjoy enhanced television, the viewer must set up a traditional computer and a television in the same room (or be willing to watch television in a window on her computer screen). Before, during, or after the show, the viewer can visit a Web site. For a sports show, the site might offer additional statistics and background information. TBS might enhance its fortieth rerun of a James Bond movie by offering a trivia quiz on its Web site. Real-time enhanced television demands that viewers split their attention. They cannot concentrate exclusively on the television broadcast, but must oscillate between the computer screen and the television screen. Enhanced television is therefore not the unified experience promised by interactive television, where the interaction is supposed to involve the viewer more deeply in the content of the broadcast. In enhanced television, the user cannot change the plot or experience the story from different points of view, techniques that have been proposed, but never successfully implemented, for interactive television.

Although enhanced television is clearly not for everyone, there are apparently millions of viewers who are willing to divide their attention in this way. Instead of the transparent experience promised by interactive television, these viewers prefer the self-conscious experience of moving back and forth between two different forms in different media. But enhanced television doesn't have to be for everyone. Millions more viewers can continue to experience television without visiting a Web site. Unlike interactive television, which would completely replace linear broadcast television and movies, enhanced television is a provisional design solution that coexists with the traditional form. It is a reflective design, and reflective designs are by nature tolerant of other forms because they do not require the user's undivided attention or complete allegiance.

So while enthusiasts continue to plead for the total solution of convergence, enhanced television illustrates what really works. In general, instead of a single convergence of all digital technologies, what we are witnessing is a series of convergences—provisional combinations of technologies and forms. We have general-purpose desktop computers (still with us in the tens of millions); laptops that play DVD movies; handhelds and palmtops that combine notebooks, clocks, and calendars; electronic books (computers that you really can take to the beach or read in bed); MP3 devices that receive music downloaded from the Internet; and cell phones with Web browsers and e-mail.

We are witnessing a series of convergences—provisional combinations of digital technologies and media forms.

Designers and companies have arranged a kind of dance in which all the various underlying technologies (central processing units and memory chips, cathode ray tubes and liquid crystal display screens, hard drives, DVD drives, keyboards, graphics hardware and software, handwriting recognition software, Ethernet cards, modems, and so on) come together to form new devices and interfaces. Some of these devices catch on and begin their own course of development; others disappear. Other designers and companies may split and reformulate the elements to create still newer devices. The desktop computer itself combined the television screen, the typewriter keyboard, and the central processor on a chip (or a small set of chips). Designers then shrank the desktop computer to create the laptop. They shrank the laptop again and removed its keyboard to give us the palmtop. (In the process, they changed the design model from the typewriter to the notebook, from typing to handwriting.) Then, taking the printed book as a model, they enlarged the display of the palmtop, simplified the interface, and created the electronic book. While all this was happening, between 1980 and 2000, telephones (both fixed and mobile) began to acquire small LED (light-emitting diode) screens to allow access to e-mail and the Web.

Convergence is a myth—a story that designers and digital promoters tell themselves and us. There are more and less convincing versions of the convergence myth. The more convincing ones (such as enhanced television and the mobile phone) capture the provisional and specific nature of digital convergences.

Diversity on the World Wide Web

As the most popular expression of digital media, the World Wide Web also shows how digital convergence really works. The Web combines most, if not all, popular media and media forms: the magazine, newspaper, graphic design for advertising and display, various forms of photography, and, more recently, radio, film, and television. Web designers are creating new forms from these borrowings, not a grand, single converged form. The Web itself has diverged or divided into many different forms, each serving a particular audience of thousands or millions. Web forms have found various niches, based on the needs and expectations of these audiences and on the various delivery platforms.

Although both HCI experts and designers acknowledge the diversity of the Web, few in either camp seem willing to accept the consequences of diversity. They still want to articulate a set of design rules that are universal, even though the universe of the Web is too varied to fit comfortably into any one scheme. Their mistake is to assume a single kind of user with a single goal.

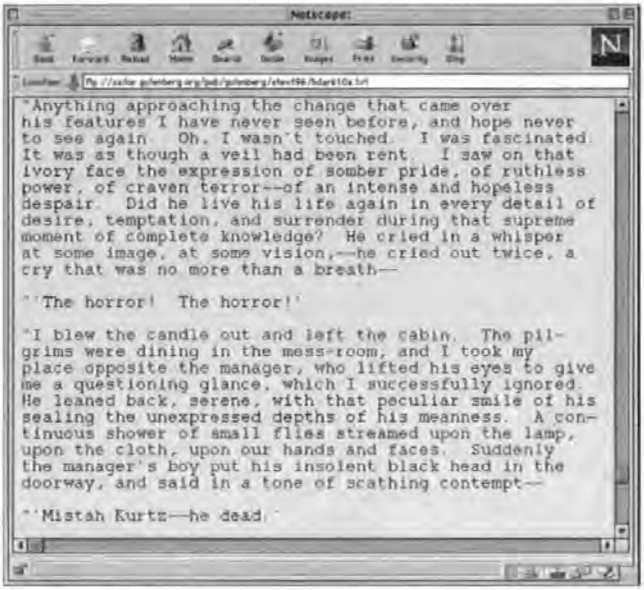
Jakob Nielsen's user is a customer, who visits the Web to buy something. In *Designing Web Usability* (2000), Nielsen writes, "The Web is the ultimate customer-empowering environment. He or she who clicks the mouse gets to decide *everything*. It is so easy to go elsewhere; all the competitors in the world are but a mouseclick away" (9). And later: "While I acknowledge that there is a need for art, fun, and a general good time on the Web, I believe that the main goal of most Web projects should be to make it easy for customers to perform useful tasks" (11).

Nielsen's users are none other than the rational consumer units that economists long ago recognized as an inadequate description of human beings, even at their most economically driven. If a Web page takes ten seconds to load, then Nielsen's users will try a competing site that is only "a mouse-click away." They are not interested in having an experience. Because they prize efficiency above all—to get prices, make a transaction, and then be off to another site—they prefer the transparent delivery of information to attractive graphics. The curious thing about Nielsen's vision is that he sees the Web as a consumer media form but seems to ignore the earlier consumer forms of television and magazines. Television and magazine advertisements have shown that creating an experience can be the key to commercial success. Advertisements certainly do not provide a transparent view of the product or service being offered, and both television and magazines have been rich fields for creative designers. Graphic design, after all, was born (in the United States at least) in the late nineteenth and early twentieth centuries out of the need for companies to promote the mass consumption of their products.

In *Creating Killer Web Sites* (1997), David Siegel's Web users are also consumers. They too are on the Web to purchase something, but like television viewers or magazine readers, they respond to visual design. They will succumb to a Web site that provides the proper experience, but they demand perfection. Although they expect graphics and a high-concept design, they too are unwilling to wait for long download times. If a pixel appears out of place or a color gets remapped, they will go elsewhere.

Even Siegel refuses to acknowledge adequately that the diversity of the Web audience demands diversity of design. There are few rules of Web design that can apply across the whole spectrum of Web users. In this sense, the Web is infinitely more diverse than broadcast television or radio, which must operate within quite narrow parameters. For example, thirty years ago, the media theorist Raymond Williams described the concept of flow on television—how a continuous stream of programs and commercials washes over the viewer. Has the concept of flow really changed in the intervening decades? Different, more frenetic rhythms are now possible, but would any one of the (traditional or cable) networks intentionally program even three seconds of dead air?

What design principle could we define for the Web that is similarly unbreakable? No graphics larger than 50K, 100K? A digital artist may choose to show larger graphics on her gallery site. And in fact the most commercially profitable Web sites, pornography sites, have users who will pay for the privilege of waiting several minutes for a particularly "graphic" download. (By the way, pornography sites violate every design rule you can name. They feature illegible fonts, misplaced graphics, grotesquely textured backgrounds, hard-to-find links, misleading banner advertising, multiple pop-up windows—and yet their users continue to pay to visit them. They are definitely not Nielsen consumers.) No single page should be longer than one or two screenfuls? But scientists and scholars often use the Web as an archive for their papers, which they load into a single page. This simple format is perfectly adequate for their colleagues, who want a quick printout. Project Gutenberg provides classic literary texts in this format; you can get all of Conrad's *Heart of Darkness* on a single web page (figure 5.2). On a


"Anything approaching the change that came over his features I have never seen before, and hope never to see again. Oh, I wasn't touched. I was fascinated. It was as though a veil had been rent. I saw on that ivory face the expression of somber pride, of ruthless power, of craven terror--of an intense and hopeless despair. Did he live his life again in every detail of desire, temptation, and surrender during that supreme moment of complete knowledge? He cried in a whisper at some image, at some vision,--he cried out twice, a cry that was no more than a breath--

"'The horror! The horror!'

"I blew the candle out and left the cabin. The pilgrims were dining in the mess-room, and I took my place opposite the manager, who lifted his eyes to give me a questioning glance, which I successfully ignored. He leaned back, serene, with that peculiar smile of his sealing the unexpressed depths of his meanness. A continuous shower of small flies streamed upon the lamp, upon the cloth, upon our hands and faces. Suddenly the manager's boy put his insolent black head in the doorway, and said in a tone of scathing contempt--

"'Mistah Kurtz--he dead.'

Figure 5.2

Project Gutenberg, Heart of Darkness: *Entire text on a Web page <sailor.gutenberg.org/pub/gutenberg/etext96/hdark10a.txt>, July 5, 2002.*

broadband connection, the download takes only seconds. However, a scholar would clearly be willing to wait for several minutes (or hours) to get a machine-readable copy of a text if he wants to do some textual analysis to test a theory. No flashing text? A site for children might break even this rule successfully. (And again, there are the pornography sites.)

Perhaps the only rule is that the design of each site should suit its envisioned community of users. It should establish a rhythm that corresponds to their needs. To achieve this rhythm, a site may emphasize transparency or be more reflective. Each Web genre, each site, and to an extent each page will define its own convergence, its own combination of old and new media forms. The multiplicity of the Web is in part (but only in part) due to the increasing divergence of the platforms on which we can now browse the Web. We can now view sites on everything from a giant projection television to a cell phone. We should not forget the traditional desktop, which provides better resolution and color than the giant screens.

Still, it seems that in the future, we will be doing more of our browsing on smaller portable devices, as the trend toward ubiquitous computing continues.

Bricolage at SIGGRAPH 2000

On and off the Web, the commercial successes (and failures) of the previous decades show that digital design is the practice of putting disparate elements together in new ways. Any one configuration of elements may be temporary. The French word *bricolage* has been used to describe this practice among postmodern artists and designers. Bricolage is the art of putting things together with the materials that happen to be at hand, and even when it is carefully planned and meticulous, digital design has the feel of bricolage. One reason is that the materials of digital design (the digitized forms of earlier media) change rapidly as technologies mature. A few years ago, for example, digital video was rare on the Web because of bandwidth limitations; it promises to be ubiquitous soon. Another reason is that digital designs do not often integrate the elements of earlier forms fully or seamlessly. Like digital artists, computer researchers working to create new technologies are also *bricoleurs*. To test concepts, they put together software and hardware in a provisional fashion, employing libraries of code written by others, adding code here and there, and often building their own helmets, trackers, and vision systems. They are tinkerers at heart.

At SIGGRAPH 2000, bricolage is everywhere in evidence. There is Elliot Peter Earls's frenetic performance piece, *EYE SLING SHOT LIONS*, which Earls himself describes as "a melange of typography, sound, video fragments, interactive digital video, simulated live performance, short films, and pop music" (*SIGGRAPH 2000*, 41). Each performance is "occasional"—a selection of elements to suit the particular conditions of that performance and occasion (figure 5.3).

The interactive installation by Rania Ho has the unexpected title *Free Range Appliances in a Light Dill Sauce* (figure 5.4). Ho calls this an "an irreverent look at the meaning of 'smart' appliances," in which "kitchen appliances are liberated from their mundane existences and taught motor skills so they can fully realize their suppressed ambulatory desires" (*SIGGRAPH 2000*, 46). Motorized toasters, egg beaters, and kettles wander around in a fenced area attracted to and repelled by each other. The appliances on wheels certainly have the appearance of being tinkered together out of spare parts. These "smart" appliances are in search of a mission, embodied parodies of the concept of the information appliance.

Figure 5.3
Elliott Peter Earls, EYE SLING SHOT LIONS: *The performance piece as collage.*

Figure 5.4
Rania Ho, Free Range Appliances in a Light Dill Sauce *(mixed media, 2000): Bricolage as art.*

And what could be more provisional than *TEXT RAIN,* in which the user herself is invited to become a bricoleur by making temporary meaning out of the letters that happen to fall?

The bricolage of SIGGRAPH 2000 shows how the myth of convergence is another version of the myth of transparency. Media gurus who tell the myth of convergence assume that media should always become naturalized and disappear. The converged medium in the future is ultimately supposed to be transparent, which is why the ultimate medium is usually supposed to be a giant high-definition TV. Enthusiasts describe high-definition, interactive television as a medium we can look right through, a window onto a world of pure experience. The pieces of SIGGRAPH 2000, however, don't fit this description. Disparate and diverse, they call attention to themselves. We can't simply look through them, because they are reflective, and what they reflect is the relationship between the old and new media forms that they combine.

The enthusiasts for convergence do not expect the digital interface to work in this way; they expect that users will grasp the converged medium automatically and without reflection. Yet this doesn't happen with the art of SIGGRAPH 2000. It is not that these pieces are always "difficult" or esoteric. Many of them (*TEXT RAIN, Wooden Mirror, Terminal Time*) appeal to a broad audience of artists, computer experts, designers, and many others. Nevertheless, the pieces refuse to converge to a single, simple media form, because that is not the direction in which our digital culture is heading.

Where we are heading instead is toward ubiquitous computing.

Ubiquitous media

Mark Weiser's pioneering work in the early 1990s added a new term to the digital lexicon. In a *Scientific American article* in 1991, he predicted:

> My colleagues and I at PARC believe that what we call ubiquitous computing will gradually emerge as the dominant mode of computer access over the next twenty years. . . . When almost every object either contains a computer or can have a tab attached to it, obtaining information will be trivial: "Who made that dress? Are there any more in the store? What was the name of the designer of that suit I liked last week?" The computing environment knows the suit you looked at for a long time last week because it knows both of your locations, and, it can retroactively find the designer's name even if it did not interest you at the time. Ubiquitous computers will help overcome the problem of information overload. There is more information available at our fingertips during a walk in the woods than in any computer system, yet people find a walk among trees relaxing and computers frustrating. Machines that fit the human environment, instead of forcing humans to enter theirs, will make using a computer as refreshing as taking a walk in the woods. (104)

Weiser drew a contrast between ubiquitous computing and virtual reality:

> The opposition between the notion of virtual reality and ubiquitous, invisible computing is so strong that some of us use the term "embodied virtuality" to refer to the process of drawing computers out of their electronic

> shells. The "virtuality" of computer-readable data—all the different ways in which it can be altered, processed and analyzed—is brought into the physical world. (98)

"Embodied virtuality" recognizes the fact that digital designs intersect with our physical world: they cannot escape from it into pure cyberspace. While VR (virtual reality) seems to eliminate the computer, as it takes the user into a graphic world, ubicomp (ubiquitous computing) or embodied virtuality does just the opposite: it scatters computational devices throughout our environment. With ubicomp, the computer joins us in our physical world; with VR we join the computer in its world. Ubicomp recognizes the divergence and diversity of design; VR wants to be the ultimate convergence. Ubicomp seems to be winning. Although VR has proven useful for specialized applications, we are not any closer today than we were in 1990 to a general 3D, immersive interface. Meanwhile, computational devices continue to multiply, and we continue to purchase and surround ourselves with them.

Digital designs intersect with our physical world; they cannot escape from our world into pure cyberspace.

But Weiser got one thing wrong. Even while he was drawing a contrast between virtual reality and embodied virtuality, he insisted that ubicomp too would be invisible computing. His *Scientific American* article began, "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it. . . we are trying to conceive a new way of thinking about computers in the world, one that takes into account the natural human environment and allows the computers themselves to vanish into the background" (94).

Media are among the most profound technologies, and they do not disappear. Instead, media and their forms oscillate between being invisible and visible—between being windows and mirrors. When media become visible, they become mirrors, reflecting the world around them, the contexts in which they function.

The ubicomp enthusiasts show a great interest in the information processing of everyday housekeeping tasks—smart refrigerators, toasters, doors, windows, and thermostats all talking to each other. While there have been a certain number of these "free-range appliances," our culture is far more interested in ubiquitous media devices: digital cameras, MP3 players, and mobile phones. Most digital devices with which we now surround ourselves are functioning as media forms, representing the world to us and sending these representations back and forth through twisted pair, coaxial cable, fiber optic cable, or through the "luminiferous ether."

Media are everywhere today—in our living rooms, bedrooms, dens, and kitchens. They follow us when we leave the house—not as free-range appliances, but under our close supervision. Our cell phones accompany us everywhere, while radios, cassette decks, CD and DVD players, and sometimes even navigational computers travel with us in our cars. And when we reach our destinations—offices, malls, restaurants, bars—we find that many of these same media are already there as well. In offices, assistants and their bosses listen to the radio while working at their word processors. Many of us now seem to prefer both working and leisure environments in which two or more media forms compete for our moment-to-moment attention. It's no wonder writers on media are convinced that attention is the most important currency in the information economy.

The World Wide Web is the perfect example of a complex of new media forms driven by competition for our attention. E-commerce on the Web is all about attention, because at any moment (as Jakob Nielsen reminds us) the user can click on a link, choose a menu item, or type in a URL, and fly off to another site. Web advertisers talk about "buying and selling eyeballs"—trying to convince the user to lend her attention to their banner advertising and click through to their site. The Web also contributes to our hypermediated environment by morphing into a combination of media forms: text, graphics, animation, audio, and video. Competition for attention is the ultimate motive behind remediation—competition not just between various instances of the same form (various television channels) but also between forms from different media (for example, between television and Web sites or between movies and computer games).

On the Web and elsewhere, ubiquitous computing has become ubiquitous media. We want more media forms on more varied devices. In many cases, these devices are portable, and in some cases, we are even prepared to wear them.

Wearable media forms

Wearable computers are more than 400 years old. Admittedly the first wearable computer, the wristwatch, whose basic design and purpose was relatively unchanged from the sixteenth century to the twentieth, was an analog device. The wristwatch set a standard to which all current wearable computers are (usually implicitly) compared. Meanwhile, the clock (portable or fixed) was the prototype for the entire mechanical technology that dominated Europe and then North America from the Middle Ages to the arrival of the integrated circuit. Before there was ubiquitous computing, our society experienced hundreds of years of ubiquitous mechanization, as people surrounded themselves with mechanical devices.

We might think that the watch is a perfect example of a transparent information technology—its purpose to indicate the time as quickly and efficiently as possible. Yet we also know that a watch not only tells the time; it also makes a fashion statement and tells us something about the wealth or poverty of the wearer.

From the eighteenth century to the mid-twentieth, the Swiss were the best watchmakers. No one could match the perfection of the Swiss mechanism. When the American manufacturer Bulova began marketing the Accutron, a watch with a quartz controller, in 1960, the Swiss smiled and continued to construct their beautiful and precise mechanicals. But quartz watches instantly began to win every contest for accuracy. Rather than admit defeat, the Swiss simply declared an end in Switzerland to accuracy contests in the wristwatch category (Landes, 1983, 346). Quartz watches and then fully digital watches proved in the coming years that the mechanical clockwork mechanism was utterly obsolete. The digital watch delivered information more cheaply and so much more accurately that there was no reason for anyone ever to own a mechanical watch. As we know, no one wears a mechanical watch any longer . . .

Well, in fact millions of people continue to wear watches with mechanisms or at least analog displays. What saved the Swiss industry was the realization that it was not only selling time; it was selling a design. The Swiss (and others) developed ever more elaborate and expensive designs that people could display as marks of wealth. They developed the Swatch line to sell a lifestyle, rather than a wristwatch, just as the Coca-Cola company sells a lifestyle rather than brown fizzy water.

The Rolex and the Swatch are interfaces that are obviously and emphatically not meant to disappear. They are meant to be seen and appreciated not only by the user but by his acquaintances as well, with each design appropriate for a certain social group or a certain fashion context. In general, retro designs and advertising have worked so well that analog watches are considered cool, and digital watches are often regarded as appropriate apparel only for geeks.. However, digital watches are clunky and uninteresting only when they appear to pursue transparency. The strategy of digital watchmakers is to sell the transparent interfaces to geeks, but to market more self-conscious, reflective designs to a public that may regard high technology as a part of fashion.

Now, too, the digital watch is marketed as a device for convergence. Companies are trying to find ways to put calculators, pagers, even e-mail readers and Web browsers in a form factor that we can strap on our wrists. By converging these technologies into a wrist-size package, they are creating information appliances that are really new media forms.

Meanwhile, others are developing another transparent technology, glasses, into wearable media forms. I-O Display with its I-glasses <www.i–glasses.com>, Sony with its Glasstron, and others are trying to convince users to wear their television sets. Again, they promise a transparent medium. But while the technology may strive to be transparent from the inside, it is conspicuous (and opaque) from the outside. The form factor is suitably futuristic—according a retro concept of the future that recalls the sleek designs of art deco and streamlining of the 1930s and 1940s (figure 5.5). (The wearer inevitably looks like Cyclops from the *X-Men* comics.)

Figure 5.5
Sony Glasstron: a headset designed for consumers to watch television or have virtual reality experiences.

Although wearable computers take many forms, they all deliver media experiences. They are examples of the specific convergences of earlier media, and they are reflective as well as transparent. These devices are meant to be seen as well as seen through.

From information appliances to media forms

Wearable computers are closely related to the category of information appliance, which includes not only computing devices that we can wear but also ones that we carry in our hands and may put on the table in front of us. We have dated the history of information appliances from the introduction of the wristwatch, but we could also date it from the Sony Walkman in the late 1970s. This device is at the root of a ramifying evolutionary tree that now includes many forms of cassette, CD, and MP3 players. We could also start with handheld computers, of which the Palm Pilot was the great success story in the 1990s.

Don Norman regards the information appliance as the key to the future of computing. Like Mark Weiser and his ubicomp colleagues, Norman predicts that computers will spread throughout our environment and at the same time become invisible, concealed inside information appliances. The story of computers in the new millennium will resemble the story of the electric motor a hundred years ago. At first, you bought a general-purpose electric motor with various attachments. But as they were built into appliances such as vacuum cleaners, mixers, and drills, motors disappeared from our view and our conscious concern. So computers are being and will be built into individual devices, each designed to do one thing: organizers, electronic books, Web browsers, and so on (Norman, 1998).

Norman agrees that the future does not lie with one converged medium (certainly not a wall-sized interactive, high-definition TV). Each of his appliances converges some set of technologies to solve a single "information" problem. However, the future does not seem to lie exclusively with such single-purpose appliances either. These devices are proliferating, and some are becoming more specific. We now have electronic books that are designed exclusively for reading downloaded texts. An example is the Rocket Ebook, which refashions the features of the printed book, while also offering some hypertextual linking and annotation. There is, however, an opposite trend to combine more functions in a single appliance. The handhelds are experiencing feature creep because designers are trying to tie them into the Internet through wired or wireless connections. Recent versions of the Palm Pilot and other handhelds offer not only calendars, calculators, and notebooks but also e-mail programs and Web browsers.

These devices are not invisible computers; instead, their interfaces are often highly visible and reflective. The best designs are effective when they oscillate between being transparent and reflective, as the designers of the Palm Pilot understood from the beginning. The Pilot interface required handwriting recognition with a high degree of accuracy, but the technology was not sufficiently accurate if the user could write or print the traditional alphabet. The Pilot designers took the remarkable gamble of requiring the user to learn a simplified alphabet, called Graffiti. This violated the principle of transparency in interface design, because it meant that users must adapt their writing to the machine; however, users were willing to make this adjustment. The shorthand

Information appliances are not invisible computers with transparent interfaces; their interfaces are often highly visible and reflective.

soon becomes transparent to the experienced user, in the sense that she no longer has to think about how to form the simplified letters. Even after it has become second nature to the user, however, the ability to write on a Palm Pilot remains visible to others. It marks you out as a new media adapter.

Like digital watches and mobile phones (and every other consumer product), handhelds are not designed simply to be invisible deliverers of information. The design strategy is expressed in the form factor as well as our interaction with the device. The slender and determinedly futuristic look of the handhelds constitutes part of the interface in the largest sense.

The computer industry had already learned this lesson with desktops. In the 1980s, Apple Computer's original Macintosh showed that the form factor was part of the interface, and Apple showed that again in the late 1990s with the bright plastics and retro-futuristic design of the iMac and G3 computers. The information appliances of today are no less visible than the desktops. In fact, they are more visible, because unlike the desktop computer, we often use our laptops and handhelds in public or quasi-public places: in an airport or on a plane, in a café, in a library.

Finally, as we have already noted, the so-called information appliances are usually media forms, and the term *appliance* does not work well for media forms. We don't call books, paintings, or photographs "appliances." We don't even think of television sets or radios primarily as appliances, because we don't apply them to solve problems. Instead, we experience them.

The mediascape

As it presents us with a welter of pseudo-information, *Fakeshop* serves as a parody of the media landscape in which we live. The whole SIGGRAPH conference is a microcosm of our mediascape. As we walk through the exhibits hall at SIGGRAPH 2000, we are bombarded with media forms competing for our attention. Touring the Art Gallery in particular, we see caricatures, parodies, and radical transformations of digital and earlier media. Information appliances, supposed by Norman to make the computer invisible, are visible all around us. They don't need to be concealed, as if they embarrassed us, as if they were "unnatural," because media are now a part of our world as much as trees, animals, and the other manifestations of nature. The purpose of digital design is to add in compelling and informative ways to the landscape of converging and diverging media devices.

Chapter 6. I-Garden

THE MATERIALITY OF NEW MEDIA

We are moving toward a philosophy of *design* that acknowledges both the place of computers in the world and the importance of the body and physical environment within and around the interface itself.

T-Garden

Before entering *T-Garden* in the SIGGRAPH Gallery, we dress ourselves in brightly colored robes that have sensors and audio speakers sewn into the fabric. When we walk into the dark space of the main chamber, we find the floor covered with transforming, polymorphous video- and computer-generated textures. In the words of its creators, the digital art group Sponge, *T-Garden* is a "responsive environment where visitors can put on sound and dance with images in a tangible way to construct musical and visual worlds 'on the fly.' The play space dissolves the lines between performer and spectator by creating a social, computational, and media architecture that allows the players to shape patterns in the dynamical environment" (*SIGGRAPH 2000*, 71).

Where we stand and how we move in the space of *T-Garden* changes what we hear and see (figure 6.1). And if we are not alone, our interactions with other visitors matter as well. Our location and our grouping can strengthen or lighten the density of the visuals and vary the sound space.

T-Garden is about the interaction of the physical and the virtual, of the virtual computational objects that manifest themselves in sound and video with the presence of the participants. *T-Garden* is like virtual reality in that it surrounds the user; its space resembles a VR cave. However, the designers of a VR cave are seeking to create the illusion of a world beyond

Figure 6.1
Sponge, T-Garden: *A dancer (Anne-Maria Korpi) interacts with the physical-virtual environment.*

its walls. What matters in *T-Garden* is the experience that participants make for themselves within the space bounded by the walls.

T-Garden is an experiment in experience design, showing how digital design can be physical and embodied. It is also an experiment in gesture recognition, as the system senses and responds to the visitor's motions. Visitors are participants whose embodied presence brings the space to life; they become part of the interface as they move around *T-Garden.* The point here is not to make the interface disappear, but rather to insist on the tangible nature of the interface.

Like *TEXT RAIN,* the interaction with *T-Garden* is a kind of writing. In *TEXT RAIN,* the participants write by interrupting the rain of letters as they fall. In *T-Garden,* there are no letters; the participants simply write with their bodies as they make gestures that leave visible and audible traces in the space. Like *TEXT RAIN,* the writing in *T-Garden* is ephemeral; the visible and audible traces fade. Like *TEXT RAIN,* the writing is vigorous and physical.

The participants in *T-Garden* are asserting their physical presence as they interact with the system. As they dance, they are defining a kind of embodied cyberspace. And so, like *TEXT RAIN* and other pieces in SIGGRAPH 2000, *T-Garden* questions another myth of the digital world: the myth of disembodiment, the belief that digital technology can (and should) allow us to divest ourselves of our bodies and enter a world of pure mind.

The myth of disembodiment I: Artificial intelligence

At the beginning of William Gibson's cyberpunk classic *Neuromancer* (2000), the nihilistic hero, Case, has been banned from cyberspace. "For Case, who'd lived for the bodiless exultation of cyberspace, it was the Fall. In the bars he'd frequented as a cowboy hotshot, the elite stance involved a certain relaxed contempt for the flesh. The body was meat" (6). If Case is any example, these cybercowboys go to considerable lengths to show their relaxed contempt:

they take a variety of drugs, drink excessively, and have sex with cyborg women whose implants pose hazards to continued enjoyment of the flesh.

In his peculiar way, Case is a contemporary fictional expression of a long prejudice against the body and against ways of knowing the world through our senses. The prejudice goes back at least to the Greek philosopher Plato, who argued that the world of the senses is a mere copy of an abstract reality. It was reinforced by Descartes in the seventeenth century, when he argued that certain knowledge could begin only when we removed ourselves as far as possible from the senses. This prejudice was picked up by the artificial intelligence movement, the dominant paradigm for understanding the computer from the 1950s to the 1980s. Artificial intelligence specialists defined intelligence as the logical manipulation of abstract data—manipulations that could be specified in an algorithm and "embodied" in a computer program running on a Turing machine. Even a few years ago, enthusiasts like Hans Moravec (1997) were still speculating how a human being's essence, his intelligence, might eventually be transferred from his body to a some sort of digital representation, which would then be immortal:

> Picture a "brain in a vat," sustained by life-support machinery, connected by wonderful electronic links to a series of artificial rent-a-bodies in remote locations, and to simulated bodies in virtual realities. . . . Why not use advanced neurological electronics like that which links it with the external world, to replace the gray matter as it begins to fail? Bit by bit our failing brain may be replaced by superior electronic equivalents, leaving our personality and thoughts clearer than ever, though, in time, no vestige of our original body or brain remains. . . . Our mind will have been transplanted from our original biological brain into artificial hardware. Transplantation to yet other hardware should be trivial in comparison.

This cyber-Frankenstein scenario is quite outdated. By 1997, virtual reality had replaced artificial intelligence as the paradigm of what computers can do. Moravec's prediction is doubly strange, because he himself builds robots, which are the tangible manifestation of artificial intelligence. Robotics is the attempt to embody artificial intelligence and make it active in our world—for practical purposes such as industrial processing and romantic purposes such as the exploration of Mars. Yet Moravec remains fascinated by the earlier paradigm—the myth of disembodiment that began with Plato. It is a myth from which the artificial intelligence movement never seems to escape.

At the end of *Neuromancer*, an artificial intelligence named Wintermute "takes over." Wintermute is a fictional version of what artificial intelligence specialists have been frightening us with since the 1960s: a programmed intelligence so advanced that it operates entirely on its own and for its own benefit. Wintermute is pure mind, and not surprisingly, it finds cyberspace to be its natural home. At the same time, Wintermute is so ephemeral that it cannot manifest itself outside the network. Although it is meant to represent the menace of ultimate power, in fact Wintermute seems almost benign, and benignly impotent. The main character Case has a conversation with Wintermute, who takes the form of a friend's face appearing on a wall-sized video display:

> "I'm not Wintermute, now" [the face says].
>
> "So what are you."
>
> "I'm the matrix, Case"
>
> Case laughed. "Where's that get you?"
>
> "Nowhere. Everywhere. I'm the sum total of the works, the whole show."

But when Case then asks, "So what's the score? How are things different? You running the world now? You God?" Wintermute replies:"Things aren't different. Things are things" (259).

After that conversation, Case hardly ever catches a glimpse of this manifestation of pure mind, even when he returns to the cyberspace that he loves. The fact is that the Web sites Orbitz and Amazon.com have greater significance for the daily lives of millions today than Wintermute does on the inhabitants of Gibson's cyberpunk future, precisely because such sites are designed to reach beyond cyberspace into the embodied world.

The myth of disembodiment II: Cyberspace

By the 1990s, when the artificial intelligence paradigm was in decline, the coming of the World Wide Web provided new hope for those who still wanted to pursue the myth of disembodiment. For them, the Web seemed to be the realization of the cyberspace that Gibson had imagined in the previous decade. There was no need to wait (hundreds of years?) for artificial intelligence to create computer programs that could replicate our intelligence, if the Web could provide a place where we could individually and collectively escape the limitations of the flesh. In 1996, the U.S. Congress, with its typical clumsiness, had attempted to limit pornography on the Web, which led John Perry Barlow to write his equally clumsy "Declaration of Independence for Cyberspace." Barlow told us that the Internet and Web had become a space beyond the reach of the laws and social practices of our physical world:

> Governments of the Industrial World, you weary giants of flesh and steel, I come from Cyberspace, the new home of Mind. On behalf of the future, I ask you of the past to leave us alone. You are not welcome among us. You have no sovereignty where we gather. . . . Our world is different. Cyberspace consists of transactions, relationships, and thought itself, arrayed like a standing wave in the web of our communications. Ours is a world that is both everywhere and nowhere, but it is not where bodies live.

Even if we sympathize with Barlow's position for freedom of expression on the Internet, we still must recognize that he was quite wrong about the disembodiment of cyberspace. Just as the computer itself cannot remain invisible, the cyberspace of the Internet and the Web is not and cannot be detached from the rest of the world. The Internet is important today precisely because it is integrated so tightly into our social and economic networks and our physical environment. The World Wide Web is not just a series of pages on our computer screens; it intersects in countless ways with our daily lives. We see URLs not only on television but in magazines, in telephone directories, on billboards, and even scrawled as graffiti on buildings.

Many of us work in businesses that exist because of the Web and that may close and leave us out of work when the value of the dot-coms falls in the cyberspace that we call the stock market. Cyberspace is continuous with our physical world: we order pizzas, cameras, and computer peripherals on the Web, and a delivery van pulls up in front of our house. Cyberspace is an extension of our social world as well—a new place for us to refashion who we are and who we want others to think we are. On the Internet, we represent ourselves to others through e-mail, chatroom conversations, and Web sites, and these digital postings are added to all the physical manifestations of our identity.

Just as the computer itself cannot remain invisible, the cyberspace of the Internet and the Web cannot be detached from the rest of the world.

Disembodied design?

Imagine that we are living in Hans Moravec's world. We have left our bodies behind, and our minds course through electronic networks, along with a host of artificial intelligences. Because these artificial intelligences are vastly more sophisticated than we are, we can only try our best to keep up. In this world, there is no need for visual design. We all speak in the language of symbols, and indeed everything important about the world is expressed in symbols. Vision itself becomes an algorithm for "pattern recognition" performed on digitized visual data. To human designers, this world of abstraction is anything but transparent. To the convinced artificial intelligencer, however, the world of symbols is a transparent representation of an underlying reality, uncluttered by the distractions of the body and even of the visual world.

This would be a world in which the logical structure of things shows through. It would be the contemporary (or almost contemporary) version of Plato's rejection of the physical.

Imagine that we are living in John Perry Barlow's cyberspace. People still have bodies, which they drag through the dull world of "flesh and steel," subject to the obsolete rules of national and local governments. But whenever they can, they rush to their computers to connect with the Internet, where they can live their real lives, freed of all markers of the body. They are no longer Europeans, or African Americans, or Asians; they no longer have brown or white skin, black or blonde hair; they are no longer fat or short or disabled; they are no longer men or women. They are all manifestations of pure mind and, at the same time, pure individuality; yet they are stripped of all the markers that make them individuals.

Both of these are extreme conceptions of how digital technology might remake our culture. Both subscribe to the myth of transparency, although they define transparency in different ways. For an enthusiast of artificial intelligence, arbitrary symbols can represent the world perfectly and transparently—not "natural" language, which is flawed and ambiguous, but an ideal language of thought, which computers and humans share (although computers can ultimately speak it more fluently). For Barlow, cyberspace is a transparent environment in which we can see through each other's bodies to the pure minds that live within. In both of these extreme visions, transparency and disembodiment go together.

Digital technology does not require disembodying the user, however. We are now moving in a direction different from both of these earlier visions. We are moving toward a philosophy of digital design (interaction design, sensorial design, experience design) that acknowledges both the place of computers in the world and the importance of the physical environment within and around the interface itself. Because the computer as a medium is part of our physical and social world, digital design must always be grounded in the appropriate physical and cultural environments. Because there can be no such thing as an abstract design (one that merely floats in Barlow's cyberspace), designers need to understand and care about the contexts in which their designs will function.

Because the computer as a medium is part of our physical and social world, digital design must always be grounded in the appropriate physical and cultural environments.

Visual art and design have never been pure, abstract, or removed from the physical. For many designers, the senses of sight and touch always go together, so that the world is seen and felt at the same time. This has been true in earlier media, including print, and it remains true in new media. Those who build digital interfaces and applications cannot escape from the physical world, for the obvious reason that digital design itself remains a physical activity. When the designer uses a mouse or a touchpad, rather than (usually in addition to) pencils or brushes, she gets used to how these tools feel. When she works at a computer monitor, she gets used to the adulterated colors that the monitor provides, and learns how to calibrate the monitor to get the best colors possible, just as the graphic designer has learned for decades to accommodate his design to the vagaries of color-separation printing. Designers working in any medium become viscerally aware of the capabilities and limitations of their tools. The computer too is a material medium, and the designer feels the process of design as a physical interaction with the medium. Repetitive stress injuries are a blatant reminder that digital workers cannot leave their bodies behind. Beyond that obvious fact, the digital designer seldom designs without making printouts, sketches, photographs, or physical models. This work requires a constant interaction between paper and electronic forms. Finally, digital design is material in the sense that the products, such as computer applications and Web sites, are materials that circulate and make a difference in our social world.

Digital artists in particular insist on the materiality of their work. They will never abandon or disparage the ways of knowing that the senses give us. For them, even the experience of seeing is not disembodied; it is visceral. Seeing is feeling. What fascinates digital artists are the ways in which their embodied existence is redefined in cyberspace. So they use digital technology to examine the interaction between the physical and the virtual. Every piece that we have visited in the SIGGRAPH Art Gallery explores that subtle and changing relationship. Digital design oscillates between the physical and the virtual, just as it oscillates between the reflective and the transparent.

Digital designers can explore the oscillation between the physical and the virtual in any technology, from desktop computers to wearables. Even the technology that seems dedicated to pursuit of the transparent—that is, even virtual reality—can be used to examine the nature of embodiment.

Virtual reality and embodiment

You are sitting in a Huey helicopter as it rumbles over a rice paddy in Vietnam. Your body vibrates with the roar of the engines. Machine-gun fire rattles in your ears. You look out the window and see the trees beyond the paddy, but you cannot locate the source of the fire (figures 6.2 and 6.3).

Figure 6.2
Larry Hodges, Virtual Vietnam: *Immersion and embodiment in a virtual reality application.*

Figure 6.3
Virtual Vietnam: *A view from the helicopter.*

This is not a movie but virtual reality. You are not in a darkened theater looking up at a movie screen; instead, you are wearing a VR headset (in the facilities of Larry Hodges's company, Virtually Better). Watching a traditional movie can be a compelling and even immersive experience, but as a viewer, you are in fact looking through a screen. In a VR application, you are wearing the screen, and the images of Vietnam surround you. The sounds are also immersive, coming from stereo headphones that you wear and from a subwoofer that vibrates to enhance the illusion. The result is a vivid simulation that might frighten anyone, but it can be terrifying (and physically real) to those whose experiences in Vietnam have led to posttraumatic stress disorder.

You are sitting in a darkened room wearing a VR headset. In this virtual Meditation Chamber, a voice in your headphones takes you through a series of relaxation exercises. You are asked to tense and then release the tension in various muscle groups in turn: first your legs, then your arms, shoulders, and neck. When you look down, you see a three-dimensional graphic representation of your body performing the tensing exercises as the voice describes them. You work to bring your physical body into synchronization with the interactive model (figures 6.4 and 6.5).

Virtual Vietnam and the Meditation Chamber show how virtual reality can explore the relationship between the physical and the psychological or the present and the past. When virtual reality entered the popular imagination in the 1980s, enthusiasts and critics represented it too as a technology to escape from our embodied world. Computer graphics would eventually be able to create images indistinguishable from the physical world, and designers would be free to create worlds limited "only by their imagination." The notion of escape pervaded

Figure 6.4
Diane Gromala, Larry Hodges, Chris Shaw, and Fleming Seay, Meditation Chamber: *An immersive environment provides users who are new to meditation with real-time feedback.*

Figure 6.5
Meditation Chamber:
The user's physical responses, via a biofeedback device, control the images.

the whole rhetoric. In an article ironically entitled "No Interface to Design" (1991), interface designer Meredith Bricken, for example, described how virtual reality could free you from a single point of view defined by a single body: "You can be the Mad Hatter or you can be the teapot; you can move back and forth to the rhythm of a song. You can be a tiny droplet in the rain or in the river; you can be what you thought you ought to be all along. You can switch your point of view to an object or a process or another person's point of view in the other person's world" (372). In other words, when virtual reality was perfected (any day now), we would supposedly have the freedom to abandon our own bodily limitations and become another self, animate or inanimate. We would also escape from the world of texts, as Jaron Lanier, who coined the term *virtual reality,* told us. He claimed that virtual reality would usher in a world of "postsymbolic communication," in which people would share the same virtual world ("Virtual Reality Built for Two") where they would communicate by creating virtual objects.

Meanwhile, Hollywood films presented us with often nightmarish visions of the divorce between the physical and the virtual. For example, in *The Matrix* (1999), the characters live in a virtual reality that appears to be an American city in our own time. For most, the illusion is seamless: they live and die without ever suspecting the truth. In fact, their world is a "virtual reality built for millions" and bears no relation to the "real" world in which these same characters are kept, fetuslike, in vats and fed nutrients along with their diet of virtual images. The real world is the devastated remnant of our planet: both our physical environment and civilization have been ravaged. The contrast could not be greater. Nothing in their sometimes unpleasant late-twentieth-century existence can possibly compare with the horrors of the real world that is blocked from the characters' senses by VR technology.

Both the enthusiasts and Hollywood got it wrong. Creative VR applications do not seek escape from our embodied world: on the contrary, virtual reality can be a technology for exploring embodiment. Simulators are almost the only commercially successful applications of virtual reality: flight simulators for airlines as well as simulators for piloting oil tankers or testing out new automobile control panels. Such simulators ask the user to develop skills that involve the hand and the eye as well as the mind and therefore require serious engagement with the physical world. The airline pilot's job and the passengers' safety depend on the training the pilots receive in simulators.

Creative VR applications do not seek escape from our embodied world; virtual reality can be a technology for exploring embodiment.

Virtual Vietnam is anything but an exercise in escape. Veterans who suffer from posttraumatic stress syndrome are asked to confront the experiences that led to their illness so that they can live more productively in this world. VR researchers are becoming increasingly interested in medical applications, especially for the treatment of phobias and pain management. Meanwhile, the Meditation Chamber belongs in the long tradition of meditation, which leads subjects to reimagine their relationship to their bodies in order to achieve a state of relaxation that is simultaneously and indissolubly psychological and physical.

Embodied design

Creative applications of virtual reality emphasize the close, though shifting, relationship between digital artifacts and our lived, embodied experience. We don't turn to our computers to escape from our bodies or our world. We can't escape, because we always take our identities formed by our embodied experience with us into cyberspace. The veterans who used Virtual Vietnam took their harrowing experience of Vietnam with them into the virtual environment, and that was precisely the point. Computers and their digital offspring are part of our world. We have chosen to place these devices, large and small, in our offices, homes, and automobiles. Although the space of light and sound that *T-Garden* offers seems at first new and strange, *T-Garden* is in fact a metaphor for the digitally mediated spaces that we inhabit today, in which desktop computers flash messages, cellular phones ring and vibrate, and automobiles honk or flash their lights reassuringly as we approach them (as if they were pets happy at our return).

As designers, we need to keep in mind that we are designing not for Gibson's cybercowboys but for embodied human users. In the era of artificial intelligence and the computer as symbol manipulator, the computing community was not interested in the embodied user. Computers did not really possess interfaces prior to the work at Xerox PARC in the 1970s. The study of HCI began at that time, as computer specialists began to worry about how users as embodied creatures could interact with computer programs. The early HCI workers focused on the empirically measurable aspects of user interaction. They were interested in the human body for the limits of response by its senses, nerves, and muscles: how fast the user could press a key in response to a stimulus, what size icons the user could discern and click on, what color combinations the user could discriminate. Their approach was an outgrowth of the long tradition of ergonomics, the study of how workers use machines, or indeed how workers themselves could become machines. Like earlier ergonomics, HCI analysis looked for principles that could be applied to all humans considered as productivity units, not as human beings living under specific conditions and with specific concerns.

But HCI has changed radically since those early days and now understands the embodiment of the user in more sophisticated terms. Although some are still pursuing a vision of the computer as a tool for a pure virtuality, many researchers and software designers have come to realize that their users will not want to escape into cyberspace like Gibson's cowboys. They see that users will instead bring their computers into their social and physical world. Today, when software designers create an interface, they consider not only the interaction between a solitary user and a computer screen, but also the interactions between the user and her coworkers or colleagues. They develop technologies that integrate the computer into the world.

Mark Weiser's ubiquitous computing integrates the computer into the world by scattering computing devices throughout our environment. Another strategy is to combine our direct perception of the world with graphics provided by the computer. This strategy leads to augmented reality (AR) rather than virtual reality. In virtual reality, the user's view of the physical world is completely replaced by a world of computer graphics. The user typically wears eyepieces that completely block her view of her physical environment. In augmented reality, although the user may wear a headset, she can also see the physical world, because the eyepieces are (more or less) transparent. The computer lays its graphic images over the user's view of the physical world, augmenting that view. VR optics are opaque; the user cannot see the physical world at all. AR optics allow the user to "see through" into world. Ironically, it is virtual reality that (often) follows the Renaissance paradigm of the window, as it tries to provide the viewer with a seamless view of the computer graphic world. Augmented reality is reflective. What the user sees—a combination of her physical environment and text or graphics that the computer draws—could not be mistaken for either the "real" world or a perfect imaginary world. It is a new paradigm in interface design (figures 6.6 and 6.7).

The user does not always have to wear the imaging equipment to experience this new paradigm. In versions of "mixed reality," the computer acknowledges the physical world by projecting information onto various physical surfaces. At the MIT Media Lab, for example, Hiroshi Ishii and his colleagues have created applications out of what they call tangible media, whose interfaces the user can both see and grasp <tangible.media.mit.edu>. Like Virtual Vietnam and the Meditation Chamber, Ishii's tangible media are experiments in

Figure 6.6
Blair MacIntyre, Augmented Reality Construction Project: Assembling a strut.

Figure 6.7
Augmented Reality Construction Project: The worker sees a combination of the physical world and computer-generated overlays.

embodied design that seek to engage with the physical world rather than deny it. The idea of pure virtual reality is losing ground to this mixed approach, as is also indicated by a recent issue of *Communications of the ACM* (July 2002), whose theme is "How the Virtual Inspires the Real." The issue describes research in collaborative augmented reality, virtual tools for eye surgery, virtual reconstructions on ancient archaeological ruins, and so on.

T-Garden is a mixed-reality application, in which computer-controlled light and sound are projected into and through a space. *T-Garden* illustrates that experience design is embodied design. To create digital experiences, we must engage the user-participant on a physical and visual as well as an intellectual level. For what experience in our human lives is purely cerebral? How could any experience be completely divorced from our physical being and still belong to us?

Imagine that we are living in a world of tangible media and mixed realities. We coexist in an easy relationship with virtual technologies, and we move in and out of cyberspace when we want. What we see and hear is a lively and changing combination of projected or interposed computer graphics and our physical surroundings. Our digital artifacts do not try to outthink us or separate us from our physical bodies. Sometimes they may be playfully unpredictable. We know, however, that the unpredictability was introduced by a human designer, whose goal is to engage our senses and our bodies more fully in the experience, as the dancer is engaged with the spheres of light in T-Garden.

As installation art like *T-Garden* (and *Fakeshop*) shows, the user's body is the first context that the digital designer must take into account. Digital art has led the way in looking at other contexts as well: the social and cultural contexts in which digital artifacts must also function.

Chapter 7. Terminal Time

DESIGN IN CONTEXT

Good digital design, like digital art,

can reshape its contexts

as well as respond to them.

Terminal Time

We wander out of the SIGGRAPH gallery itself, walk down one of the endless halls in the Morial Center, and enter a theater. It looks like a conventional movie theater, but when we sit down, the show immediately requires us to participate in an unconventional way (figure 7.1). On the screen, there appear multiple-choice questions, like this one:

> What is the most pressing issue facing the world today?
>
> A. Men are becoming too feminine and women too masculine.
>
> B. People are forgetting their cultural heritage.
>
> C. Machines are becoming smarter than people.
>
> D. It's getting harder to earn a living and support a family.

As we indicate our preferences by applauding, the familiar applause meter registers the collective response of the audience. We sense immediately that this is both frivolous and serious, as we try to read beyond the text to imagine the implications of our answers. Our audience answers three questions in this way and so identifies its ideology. We then watch a six-minute video that presents a breathtakingly swift summary of the history of the (Western?) world from 1000 to 1750 (figures 7.2 and 7.3).

Figure 7.1
Michael Mateas, Steffe Domike, and Paul Vanouse, Terminal Time: *A pseudo-documentary that adjusts itself to the audience's ideology.*

This video is assembled so as to agree with the ideology that our audience has expressed by applauding. Then our audience answers three more questions and watches an almost equally fast tour of the years 1750 to 1950. Three final questions get us a positively leisurely six-minute presentation from 1950 to the present (figures 7.4 and 7.5).

Creators Michael Mateas, Steffi Domike, and Paul Vanouse describe *Terminal Time* as "a cutting-edge, audience-powered history engine that combines mass participation, real-time documentary graphics, and artificial intelligence to deliver the history that 'viewers deserve.' Each half-hour cinematic experience covers 1,000 years of history and is custom-made to reflect audience values and desires" (*SIGGRAPH 2000*, 57).

The presentations are not entirely serious. The videos look like file footage from a wacky local news station whose archives date back to the first millennium, and the narrative has the matter-of-fact,

Figure 7.2
Terminal Time: *Marching off to war in the Middle Ages.*

Figure 7.3
Terminal Time: *The causes of war in the Middle Ages vary depending on the audience's ideology.*

pseudo-objectivity of a Pathé newsreel. Nevertheless, *Terminal Time* is about cultural contexts and how they define our history. As we answer the loaded questions and watch the resulting video, we are ironically led to think about how our own reading of history is constrained by our cultural identities. Whether we are in the majority or minority in that particular audience, we get to see history being rewritten—for us or against us.

Figure 7.4
Terminal Time: *One ideological reading of recent history.*

Figure 7.5
Terminal Time: *The atomic bomb defines one version of recent history.*

Like all other hypermediated digital pieces, *Terminal Time* oscillates between the modes of presentation and participation. When we watch the six-minute videos, we are in the role of spectators at a presentation, a role that we are accustomed to after decades of cinema. When we participate by answering questions registered on the applause meter, we are in a different, newer role. The experience isn't unfamiliar, however, because we play this role when we visit a Web site and are presented with a list of links to click. We play this role when we use a CD or DVD multimedia application, where we register our choices by pressing buttons.

The two roles require two different ways of looking: through the screen or at it. As spectators, we experience a more or less transparent movie. We see characters on the screen and enter into the action that we see. We can't enter in wholeheartedly, of course, because the videos are satiric and purposely amateurish. But we are not meant to think about the interface during the video segments; we are meant to experience the segments as we would a Hollywood film. As participants in the voting process, however, we are very conscious of the interface, and we are meant to reflect on our participation in the vote—in particular, on the notion that our ideology is being tested. The experience is reflective.

Terminal Time has a user-centered design, in which our position as user is made obvious and even gently mocked. In this case, the user is an audience rather than an individual, and the design centers on the user's ideology. *Terminal Time* is making fun of any simplistic concept of the working of ideology, because obviously our complex of beliefs and prejudices, the frame through which we see the world, cannot be adequately measured through a multiple-choice test. Nevertheless, *Terminal Time* makes its point: that we always bring that network of beliefs and prejudices to any media form that we experience. Although new media cannot free us from those prejudices by testing them against an applause meter, it is also true that designers cannot afford to ignore their own ideologies or those of their users. Users bring cultural assumptions to each new media artifact, and they take the artifact (figuratively and sometimes literally) with them back into their cultural contexts. Digital art, especially digital installation art, heightens our awareness of those contexts.

Platonic design

Plato invented installation art. In fact, if there had been a SIGGRAPH 370 B.C., Plato's cave would have been the triumph of the Art Gallery. Plato's version was low tech in comparison to the VR caves of recent years, but it too was a participatory work, even if the participation was a bit masochistic. The subjects in Plato's underground cave would sit facing a wall, and they would be chained together so they could not turn their heads and look behind them. On the wall, they would see shadowy images acting out stories, and behind them would be a fire to cast the shadows, as well as men manipulating the shadow puppets. Actually, Plato's cave was like a VR cave in this respect. He wanted it to be so realistic that most viewers would think that the shadows were real. Plato believed that allegorically, this was the condition of most people: they spent their whole lives figuratively immobile and chained, believing in the reality of shadows. The film *The Matrix* updates Plato's idea of people enslaved by a perceptual technology.

Like *Terminal Time*, Plato's cave was also meant to expose assumptions. Plato believed that one extraordinary viewer might be able to free himself from his chains, turn around, and realize that what he saw on the wall was a shadow play. In fact, this extraordinary individual (the Platonic philosopher) eventually might be able to walk out of the cave and see objects in the light of the sun. He might succeed in leaving the contexts of his companions (his society) behind and contemplate things as they are as a solitary philosopher.

The lesson of Plato's allegory is the opposite of the lesson offered by *Terminal Time*. For Plato, we are not defined by our cultural contexts ; instead, we (or at least a few extraordinary individuals) can stand outside all contexts and understand a higher truth. For the philosopher standing in the sunlight, there would be no shadows and no interfaces; the truth would be transparently obvious.

Almost 2,400 years ago, Plato made the case against cultural context. The best of all possible worlds, he thought, was one removed from the tainting influence of embodiment and even from the taint of human culture. Plato despised politics, just as, like a good Greek aristocrat, he despised the world of commerce. In fact, Plato believed that our embodied, everyday world was only a poor reflection of the real world, which for him was an invisible world of abstract ideas, or forms. This is the great Platonic reversal. It would seem obvious that the world of ideas depends on the world of the senses and culture, because people can't come up with ideas unless they are alive in this world and find themselves in a particular cultural milieu. But Plato reversed the dependency. He argued that the embodied world of human culture is a reflection of an invisible world of abstract ideas. Moreover, the amazing reversal became a major influence on ancient culture and later Western culture. The French philosopher Descartes in the seventeenth century reiterated this reversal and made sure that it would remain part of Western thinking into the twentieth century.

In this sense, many cyberspace enthusiasts are still Platonists. They replace Plato's world of forms with cyberspace, and then they divorce cyberspace from our embodied culture. Rather than understanding cyberspace as an extension of our culture, they see cyberspace as a separate and, in fact, better world. John Perry Barlow called cyberspace the "new home of Mind," suggesting that cyberspace is the higher reality, where we should really want to live. Who would want to spend time in the messy cultural politics of the embodied world, when we can shed our bodies and inhabit a space freed of the concerns of prejudice and economic scarcity?

The cyberenthusiasts may want their new digital medium to be divested of the many layers of cultural assumptions that we have inherited from the past. But we cannot free ourselves, even if we wanted to. Digital technology cannot take us to a place that is purged of cultural assumptions. Even when we go into cyberspace, we bring with us our cultural assumptions—along with, and attached to, an image of our bodies. The traditions of artifical intelligence and the computer as a symbol manipulator still exert powerful influences to make designers forget or downplay the contexts of their designs, and digital art can help to counteract those influences.

Digital art: Recalling the contexts

At SIGGRAPH 2000 and elsewhere, digital art works to reawaken our awareness of contexts. Art can respond to and reshape the physical context in which it is placed, just as *TEXT RAIN* does. *TEXT RAIN* turns a passageway in the Art Gallery into a space where passersby can interact playfully with an electronic text. Similarly, *Wooden Mirror* turns its exhibit area into a shared space in which its visitors strike poses and marvel at the resulting images. *T-Garden* converts a darkened room into a place in which participants can interact with sound and light. These pieces each provide us with an embodied experience that also has social and cultural dimensions. They ask us to react playfully and to wonder whether it is appropriate to play in an art gallery. They help redefine our assumptions about how we behave toward art and, indeed, what art is in an era of digital interactivity.

Digital art works to reawaken our awareness of contexts.

Other pieces at SIGGRAPH make more direct attacks on some of our cultural assumptions—for example, *Exclusion Zone*. We already noted how *Exclusion Zone*, which presents us with microtexts printed on slides that we read by inserting into a microscope, asks us to rethink the act of reading. This unfamiliar act of reading is given both personal and political dimensions. To get to the microscope stations, we must walk over a map of Chernobyl, the site of the worst civilian nuclear disaster of all time. The texts we read describe the artist's own experience with thyroid cancer, which is often caused by exposure to radiation. We cannot remain aloof from these contexts. Chernobyl is all around us, beneath our feet, as we move across the exhibit. And when we pick up the slides, we are acting like biologists (or pathologists) examining specimens. Each time we want to read further in the artist's story, we must select a slide and focus it under the microscope. We are literally putting the artist's life under the microscope, with the supposedly detached scrutiny of a scientist. We act out the myth of scientific detachment.

It isn't just digital art that demands an awareness of context. All digital design is necessarily contextual and therefore reflective, in the sense that it reflects the culture in which it is created. Contextual design requires that we see ourselves as participants in the dance of our culture. Whether there are or aren't any atheists in foxholes, there should not be Platonists in digital design.

Computer software design: From Platonic design to HCI

We could call the decades before the work of Doug Engelbart and Alan Kay the Platonic era of software design. There was no emphasis on the points of contact between the user and the computer. The computer itself was hidden from its users, usually behind a service window in a large air-conditioned hall. The user brought his deck of punch cards to the window, and the operator fed in the deck and later returned him a printed output. It was as if users were consulting an oracle in an effort to communicate with a distant and disembodied god.

Such Platonic design eliminated all the supposedly unnecessary contexts. Computing was programming, and programming in this sense was the art of abstraction—stripping a problem to its essence. Programs written in this period typically devoted a tiny number of lines to input and output; the processing of the data occupied most of the code. The issues were how to develop compilers, programs for efficient numerical analysis, database management, and other forms of symbol manipulation. Once provided with data, the programs operated autonomously until they generated the desired output. It is no wonder that artificial intelligence experts conceived of the goal of making computers completely independent of human operators—self-programming computers that could work like Cartesian egos without any need of the outside world.

Platonic design eliminated all the supposedly unnecessary contexts. Computing was programming, and programming was the art of abstraction.

The discipline of human-computer interaction, which grew up in the late 1970s, was a great leap forward in thinking about context (Badre 2002, 4–6). HCI was a response to the development of interactive computing systems, such as word processors. These systems worked through "event loops" in intimate contact with the user. As a result of this close connection, such systems had to take the user and her contexts into account. But at first, the only context that HCI researchers considered was the individual herself. At this stage, HCI was almost a branch of perceptual psychology, concerned with the user's perceptual and motor skills. Then HCI experts began to regard the user as a "cognitive system" who formed a mental model of how the computer application worked. Later came the notion of user-centered design: when a new system was being developed, intended users should participate so that the system meets their needs. In other words, HCI experts kept expanding the contexts that they were willing to consider in digital design.

The discipline of human-computer interaction was a great leap forward in thinking about context.

Finally, in the 1980s and 1990s, some HCI experts and interface designers began to look beyond the individual to communities of users and the contexts in which they operate. Again, researchers at Xerox PARC, including John Seeley Brown and Paul Duguid (1994), led the way by considering how a proposed computer system might fit into the work environment. They would study the way an office worked before a computer system was introduced and then design the system to suit the needs of intended users. (For decades, programmers had simply built systems and thrust them into the office without bothering to find out what the intended users needed or wanted.) These office studies were among the first attempts to examine the contexts of digital designs.

Today, the World Wide Web makes designers aware of the need to consider cultural as well as work contexts (as Albert Badre shows us in *Shaping Web Usability*). A Web site is a digital artifact that is situated in an enormous variety of contexts. The Web itself is not really worldwide (there are relatively few users and even fewer sites in the developing world), but it does reach into many cultures throughout the industrialized world. And it can be used for a variety of purposes: e-commerce, personal expression, art, entertainment, and to support or oppose various political and religious ideologies. To design a good Web site or any digital application, the designer should try to understand as many of the contextual levels as possible: from the psychology of the individual user to the constraints imposed by the user's language, system of beliefs, and popular cultural knowledge. It is not just a matter of avoiding certain cross-cultural mistakes (e.g., using the wrong color or human gesture). Cultural awareness should inform the design process from the beginning.

Digital art and contextual design

In the previous chapter, we identified a new paradigm in computer design, pointing out how augmented and mixed reality and ubiquitous computing explored new relationships between the physical and the virtual. We can now give a name to this new paradigm: contextual design. Designing for and in context has been a principal concern of architects and visual designers since modernism, and increasingly it is a concern of interface designers as well. Augmented and mixed reality attempt to recognize the context in which digital artifacts operate—the lived world of human experience. The art of SIGGRAPH 2000 acknowledges the world of human experience, sometimes playfully, as in *Terminal Time,* and sometimes with the seriousness of *Exclusion Zone.* Digital design in general must take account of contexts in this same way.

That is not to say that digital applications must simply adapt themselves to the existing conditions of the user's world. Good digital design, like digital art, can reshape its contexts as well as respond to them. In fact, it reshapes contexts *by* responding to them. Digital art redefines contexts. *Terminal Time,* for example, seeks to remind us of the ways in which ideologies shape our telling of history. By making us aware of our ideologies, it will also aspire to change us—to make us less comfortable with our own dogmatic views. It will help us acknowledge the multiplicity of possible ways in which history can be written and read.

Like digital art, good digital design can reshape its contexts as well as respond to them.

Any digital artifact—a productivity tool, a Web site, or even a computer game—is meant to change something in the user's relationship to her physical and cultural environment. Otherwise, there would be no reason to produce the artifact at all. In fact, an exemplary design not only takes account of its users' needs, but also identifies new users beyond any audience originally intended. This is the definition of a "killer app" (digital or otherwise): the telephone, the television, the word processor, and the World Wide Web all created new user communities by redefining the contexts of communication.

Chapter 8. The Art Gallery

O F

S I G G R A P H 2 0 0 0

Digital art is about performance.
As users, we perform the design
just as we would a musical instrument.

The gallery as experience design

We leave the theater, where we've been applauding to the rhythm of our cultural prejudices with *Terminal Time*, and file back along the corridors of the Morial Hall, until we reach again the entrance to the gallery itself. We have examined individual pieces in the gallery, but not the gallery as a whole, which was designed and programmed to be an experience—part of and yet distinct from the experience offered by the rest of the SIGGRAPH conference.

Some conferences are events that the attendees sit through listening to papers and panels, but SIGGRAPH is a peripatetic experience. If, at any given hour, hundreds of name-tagged participants are attending paper sessions, thousands more are in motion, ambling en masse through the large exhibit and lecture halls or in single file along the corridors. The Art Gallery is a walk too; however, its dark pathway flanked by the exhibits is meant to encourage a more reflective pace. From the entrance, the visitor is invited to follow a gently curving path, more or less in the shape of the backward S. Certain exhibits, the ones the visitors are immediately drawn to, serve as anchor points, like data points fitted along the Bezier curves of the path (figure 8.1).

The space of the gallery is negative space, and like the concept of negative space in graphic design, the gallery gives meaning to the exhibits by enveloping, contextualizing, and relating them to each other. The whole gallery functions as a counterexhibit to the carnivalesque commercial exhibits. While the hall of commercial exhibits is flooded in the bright

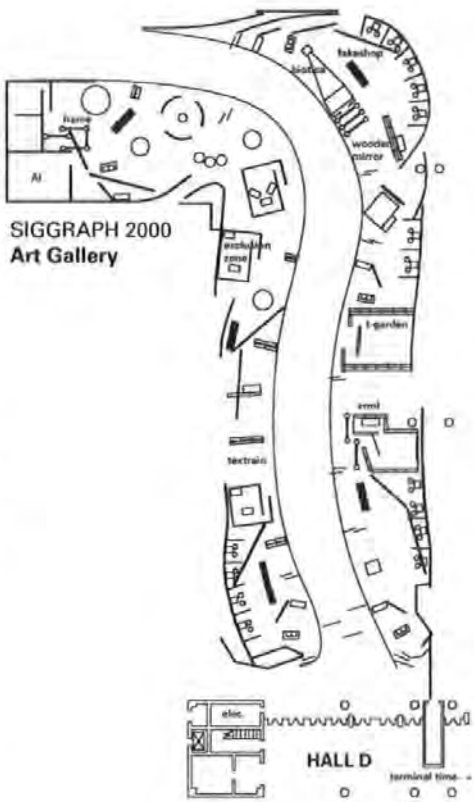


Figure 8.1
SIGGRAPH 2000 Art Gallery: Some exhibits serve as anchor points along the visitor's path.

lights of transparency, the gallery, although large, seems almost intimate because of the black curtains that absorb the light and offer a contemplative space to the visitor. The gallery is about contrasts of light and dark. The whole space is as dark as the fire marshals would allow, with only neon signs to indicate the exits. The rest of the light is provided by spotlights that isolate various exhibits and by the electronic glow of the exhibits themselves (figure 8.2).

Although the gallery is no cathedral of art—reverence is not the desired tone—still the visitor is meant to experience the gallery, almost like a medieval cathedral, as a vertical space. Her gaze is led upward by the curtains that disappear into the forty-foot-high darkness. There are few horizontal lines to interrupt her view; instead, vertical banners are hung to mark out the exhibit, and at three places, giant projection screens draw her gaze along sightlines of the gallery. These projection screens look like heroic-sized paintings, except that the projected images are dynamic. The images are of Web sites, installed on computers below, and they change as the users visit different pages.

Walking along the path, we see how the pieces are arranged, often according to principles of contrast and similarity, which highlight their individual effects and at the same time contribute to the larger experience of the gallery. When the anchoring exhibits, like *Nosce,* draw us off the path, we notice other subtle pieces grouped around them. The reflective quality of some pieces, such as *Exclusion Zone,* needs a quiet, almost solemn atmosphere. Other pieces, like *TEXT RAIN* itself, can tolerate, and indeed thrive, amid the background noise of peripatetic visitors. Some pieces, like *TEXT RAIN* and *Wooden Mirror,* want

Figure 8.2
SIGGRAPH 2000 Art Gallery: The lighting of the gallery directs visitors to the exhibits.

to be in the open, approached casually by visitors. Others, like *T-Garden* and *Exclusion Zone,* need their own enclosed space and controlled entrances. In these cases, drapes of black velvet are hung to create enclosures and cut down further on unwanted light and sound. The Web art is especially hard to integrate into the public experience of the gallery because Web sites are usually designed to be appreciated by a single individual in front of a relatively small monitor. In the gallery, computers are set up along the outer edges of the aisle to display the sites, and large video screens project what the individual user can see on the smaller computer screens. The projected Web sites become massive kinetic paintings that punctuate the negative space of the gallery and invite visitors to interact with the sites on a more intimate scale (figure 8.3).

The pathway of the gallery leads right into the Emerging Technologies (ETech) exhibits, and the works placed closest to ETech (such as *TEXT RAIN* and Richard Brown's *Biotica*) are the ones that most effectively blur the boundary between innovative technology and digital art.

Finally, the docents and artists themselves are present to help shape the experience that the gallery offers. Wreathed in fiber-optic lights, the docents circulate among the visitors (many of whom are not experts in art and design), explain the conventions by which these

Figure 8.3
SIGGRAPH 2000 Art Gallery: The large screen at the extreme right projects a Web site and makes it part of the gallery experience.

digital pieces function, and suggest why certain pieces were chosen. The artists themselves clarify or perhaps debate their works. A further layer of explanation and debate is provided by artists' talks and panels that take the gallery beyond Hall D and into the conference rooms of SIGGRAPH 2000. Altogether, the gallery functions as a performance, or a series of performances, rather than a static exhibit.

Digital art is about performance, which is perhaps an even better word than *interaction* to describe the significance of digital design in general. As users, we enter into a performative relationship with a digital design: we perform the design, as we would a musical instrument. Digital artists and designers create instruments that the user will play. Sometimes the play may be as predictable as the music of a Hammond organ (where pressing one key produces an entire Viennese waltz). At their best, however, digital designs will enable their users to produce results unforeseen by their designers.

Digital art is about performance. As users we perform the design, just as we would a musical instrument.

The rhythm of digital design, the oscillation between transparency and reflection, is the rhythm of the whole SIGGRAPH Gallery. At times, the gallery is meant to disappear and leave the visitor alone with the pieces. At other times, the visitor is meant to be aware of the gallery as it puts the pieces into focus for her.

Digital focus

Film and television sometimes make use of a technique called rack focus: the camera shot begins with the background in focus and the foreground blurred, and then the focus shifts to the foreground, blurring the background (or vice versa). We see a character in the background looking with excitement at something in front of him. Then the character blurs, and we see clearly the object of his gaze. The technique of rack focus helps us to understand the meaning of that object for him.

In a sense, digital art translates the technique of rack focus into a new technology, framing and refocusing the meaning of digital design. The pieces in the SIGGRAPH Gallery are all ultimately about refocusing our vision. They ask us to look at the unexamined foreground or the unnoticed background. And experience design in general is the art of refocusing our vision as designers so that we can then refocus the vision of the end user.

Digital art reframes and refocuses the world of digital design.

In film and television, rack focus is not natural; it is a manipulation of our vision. The technique can be compelling because it makes us aware of the relationship between two elements in the scene, which we may not otherwise have appreciated. At the same time, rack focus makes us aware of the power of the medium of film. As a technique, rack focus is both transparent and reflective.

Digital art reminds us that we should approach every design task with the dual focus of transparency and reflectivity. Designers of digital experiences should always be conscious of the rhythm that the design establishes between its own transparent background and its visible, reflective foreground—between what is conventionally called the content and the interface that frames, focuses, and gives meaning to the content. The designer must embed the digital equivalent of rack focus into the design for the user to experience.

How does the designer do this? By taking into account the technological, historical, cultural, and economic dimensions of the media with which he or she is working—by remembering that:

- Experience design is remediating design: like *Magic Book,* it understands its relationship to earlier media forms.

- Experience design is diverse: like *Fakeshop,* it welcomes the multiplicity of digital media forms.
- Experience design is embodied design: like *T-Garden,* it recognizes how digital technologies seek to embody the virtual.
- Experience design is contextual design: like *Terminal Time,* it understands the importance of the cultural and economic contexts in which it will function.

By working with and through these dimensions, the designer can find the appropriate rhythm of transparency and reflectivity.

If we walk out of the Art Gallery and back into the general exhibit hall—into the carnival of booths offering us the latest in games, 3D graphics, Web design, and interactive technologies—we see that successful digital interfaces are ones that find such a rhythm. In every case, the designers have recognized when and how and to what extent to question the transparency of their designs. Computer and video game designers know how to create "cheats" that permit their users consciously to violate the rules (including the physics) of the games. Although productivity tools are often praised as being transparent to their task, such tools in fact shape the user's understanding of the task. Their success depends on the user's ability to work reflectively as well as transparently. That is, such tools must help users evaluate and manipulate the meaning of their work. Finally, the most successful digital consumer products are not merely transparent, but instead make the interface part of the experience, as Apple taught us with the original Mac in 1984 and again with the iMac in recent years.

The digital interface is always both a window and a mirror.

Chapter 9. Before and After

SIGGRAPH 2000

Designers cannot afford to ignore the need for transparency,
but they can show the Structuralists
how sites can be reflective as well as transparent.

The Structuralists and the Designers

On a morning in June 2002, designers all over America switched on their computers and must have been startled by the following news that flashed over the Internet from the User Experience 2002 Conference in San Francisco. The news was about Macromedia's vector-animation design environment Flash MX:

MACROMEDIA AND USABILITY GURU JAKOB NIELSEN WORK TOGETHER TO IMPROVE WEB USABILITY

Plan to develop best practices for developing rich Internet applications

User Experience 2002

San Francisco June 3, 2002

Macromedia, Inc. (Nasdaq: MACR) and Jakob Nielsen, Ph.D., usability guru and founder of Nielsen Norman Group, today announced a strategic relationship to focus on improving the usability of rich Internet applications and content. Nielsen will be developing best practice guidelines for creating usable rich Internet applications with Macromedia Flash MX. Macromedia Flash MX, which began shipping in March, contains features that enable designers and developers to be more productive while ensuring their work is both usable and accessible.

Designers who have lived and breathed Flash for years must have been struck by the irony, because Nielsen had scorned this application in the past. A Structuralist, Nielsen had taken the iconoclastic position that Web pages should have as few images as possible, while Flash has been the Designers' favorite tool for creating visual experiences on the Web. It seems now that the lion is lying down with the lamb to create sites that are usable and visually rich at the same time. It remains to be seen who is the lion and who the lamb. Nielsen may not be able to tame what he regards as the dangerous (byte wasting) exuberance of visual designers, and the designers may not convince Nielsen of the importance of negative space. But even if this particular marriage of convenience turns into a banquet for one of the parties, it is a good indication that Structuralists and Designers are becoming more aware of the need to work together and that disciplinary and corporate barriers between the groups may be breaking down. The two groups need to work together precisely because they do not look at Web sites (or other digital designs or magazines or books) with the same eyes.

Don Norman too is beginning to emphasize this need. In "Emotion and Design" (2002) he complains that he has been misunderstood: he does not believe that *usable* and *ugly* are synonyms. Attractive things work better, he tells us, because users will overlook minor flaws in their artifacts if they are pleased by the appearance. He pronounces: "Let the future of everyday things be ones that do their job, that are easy to use, and that provide enjoyment and pleasure" (41). Still, Norman does not go far enough here. He is still conceiving of functionality and beauty as separate qualities, and seems to suggest that we can add beauty to an artifact as an afterthought, in order to put the user in a better frame of mind. The lesson of the SIGGRAPH Art Gallery is that good digital designs provide an experience that is both informative or functional and compelling at the same time.

Information architecture and experience design belong together, just as transparency and reflectivity go together in any digital application. Transparency is the key element for the Structuralists; they believe that a Web site or other digital design should transparently reveal its contents, the information it has to offer. Designers cannot afford to ignore the need for transparency, but they can show the Structuralists how and why sites can be reflective as well as transparent.

Designers cannot afford to ignore the need for transparency, but they can show the Structuralists how sites can be reflective as well as transparent.

We don't know whether Nielsen took the time to visit the SIGGRAPH 2000 Gallery or whether he has visited the galleries at the subsequent SIGGRAPH conferences. But digital art at the SIGGRAPH conference and elsewhere has continued to provide vibrant examples of radical design. Art continues to help us understand that information itself can be and should be an experience, and every digital experience has, in a sense, information to impart. No matter how flashy, every digital design must convey a message to its viewer or user. Even the most businesslike information Web site should provide the user with a compelling experience. If Designers and Structuralists work together, the distinction between information sites and experience sites should disappear, although the various genres of sites will still offer different experiences and different forms of information.

The world of digital art

The SIGGRAPH 2000 Art Gallery was a snapshot, showing us a moment in the complex history of digital art. But it could not adequately represent that history as it has developed over the past twenty or more years. Nor could it encompass the creativity of the digital art world at the beginning of the new millennium. Indeed, this book could not even describe all the works in the SIGGRAPH 2000 Gallery (see the appendix for a complete list) or all the ways in which digital artists are collaborating with experience designers and information architects. At the SIGGRAPH conference itself in the years since 2000, the Art Gallery continues to show how digital art can be seen as an experiment in radical digital design.

The SIGGRAPH 2000 Art Gallery was a snapshot. It could not encompass the creativity of the digital art world at the beginning of the new millennium.

In this conclusion, we want to convey a sense of the variety of digital art today by including some of the many artists who did not happen to participate in SIGGRAPH 2000 or whose work at SIGGRAPH 2000 we have not described in detail. Like those featured in previous chapters, these artists too are addressing the issues of reflectivity, remediation, diversity, embodiment, and cultural context, and so we present them here under those categories.

Mirrors and new media

Many digital artists are exploring the theme of reflectivity explicitly by creating pieces that (like *TEXT RAIN* and *Wooden Mirror*) reveal the viewer to herself or others through live or processed video. What the viewer sees in such interfaces may reflect the culture as well as the individual. Natalie Jeremijenko's surveillance system *Suicide Box* automatically captured the flight of human bodies from the Golden Gate Bridge over a hundred-day period and used the results to produce a "despondency index" <www.yale.edu/opa/v27.n25/story9.html>. Elizabeth Diller and Ricardo Scofidio's *Refresh Project* <www.diacenter.org/dillerscofidio/intro.html> consisted of a set of twelve fictionalized, office Webcams, each with its own story to tell about American corporate and human relations. Natalie Bookchin's *Marking Time* <jupiter.ucsd.edu/~bookchin/marking_file/markingTime.html> placed the user in the role of a prison guard examining the faces of three inmates.

Remediation: The relationship of digital and other media

Digital artists and designers must all take into account both the old and the new in new digital media. For some, digital forms borrow and refashion older media forms in film and television. Others see the new digital medium as a technological revolution that will make possible new forms of storytelling, visual art, or audio art. Janet Murray is one who argues that interactive fiction is a new form, and she is particularly interested in a visual narrative that combines elements of film and artificial intelligence to control the appearance and behavior of virtual characters (Murray 1997). Lev Manovich <www.manovich.net> is an artist-theorist who reimagines visual technologies, in particular film, to define a "language of new media." Glorianna Davenport at the Media Lab produces experiments in interactive cinema <ic.media.mit.edu> that question the future of traditional, linear film.

Meanwhile, hypertext has been calling into question the future of the book and literature, an issue that engages, among many others, Johanna Drucker, Louise Sandhaus, and N. Katherine Hayles. Michael Joyce (*afternoon*), Stuart Moulthrop (*Victory Garden*), Shelley Jackson (*Patchwork Girl*), Talan Memmott (*Lexia to Perplexia*), and many others have fashioned hypertext into a new kind of literary fiction. At SIGGRAPH 2000 and elsewhere, Mark Amerika <www.markamerika.com> has exhibited his hybrid work *PHON:E:ME*, a Web-based piece that is "part oral narrative, part experimental sound collage, and part written hypertext" (*SIGGRAPH 2000*, 32). In the same way, Bill Seaman's *Recombinant Poetics* <oldcda.design.ucla.edu/faculty/seaman> and John Caley's digital poetry are attempts to define a new digital form of poetry that is active, interactive, and eclectic.

Telematic art, a form that dates back to the 1970s and was pioneered by Roy Ascott and others, makes a medium of expression out of transmission technologies such as video broadcasting itself. Networking and e-mail are refashioned into art forms such as cyberspace opera by the work of Madelyn Starbuck and others. In *Alive on the Grid*

<dolinsky.fa.indiana.edu/alive/apps/index.html>, Margaret Dolinsky combines networking and a VR cave to fashion a diverse, interactive art experience.

Video games and computer games are a form that draws on our expectations from film and print as well as traditional board games. Through interactivity, they seek to refashion the experience offered by these earlier forms. The SIGGRAPH 2000 Gallery offered an example of computer games as cultural comment in word.com's *SiSSYFiGHT 2000* <www.sissyfight.com>. Brenda Laurel <www.tauzero.com/Brenda_Laurel>, Eric Zimmerman (whose game *BliX* appeared also in the Gallery), Mary Flanagan <www.maryflanagan.com>, and many others have been expanding the form of the game to explore its potential for cultural expression.

Convergence and diversity

As we noted in chapter 5, digital media are not converging to a single form; instead, they are combining and recombining in many, more or less permanent, allegiances, and digital artists have been leading the way in exploring these allegiances. Almost every piece of digital art is a new convergence in this sense. The works of Diller and Scofidio, the telematic and network art by Ascott, Starbuck, Dolinsky, the collages of Seaman and Mark Amerika all exemplify the convergences of new media.

Because the World Wide Web is by nature an eclectic and hypermediated form, the whole field of Net art is an exploration of diversity. Rhizome.org, a site devoted to Net art, includes a piece featured at SIGGRAPH 2000, *Starry Night* by Alex Galloway, Mark Tribe, and Martin Wattenberg, which visualizes as a map of stars the popularity of various pages on the Rhizome site. There is Andruid Kerne's Web-based *Collagemachine,* a Web crawler (with a modernist aesthetic) that anticipates and visualizes the user's interests <mrl.nyu.edu/~andruid/ecology/collageMachine/>. There is Matt Owens's remarkable site *volumeone.com,* a collage of digital art forms and experiences, whose "Web novelties" test the limits of this media form. Noah Wardrip-Fruin, a. c. chapman, Brian Moss, and Duane Whitehurst offer us an "antibrowser," in their *Impermanence Agent* <www.siggraph.org/artdesign/gallery/S99/essays/noah.html>. The interplay of the virtual and physical is explored by George LeGrady's *Pocket Full of Memories,* in which visitors to the exhibit in the Pompidou Center scanned objects in their pockets, which then became part of the Web site <legrady.mat.ucsb.edu/pfom_lang.html>. *Riding the Net* by Christa Sommerer and Laurent Mignonneau <www.mic.atr.co.jp/~christa/> shows how digital art can offer insights into interface design: this browser picks out appropriate images from the Web based on the user's oral remarks.

Sommerer and Mignonneau are among a diverse group of artists who are exploring another convergence: between digital media and the computational models of artificial life and artificial intelligence. Sommerer's and Mignonneau's artificial life environments include *Life Spacies II* and *PICO_SCAN*. Richard Brown <www.crd.rca.ac.uk/~richardb/> has created such pieces as *Neural Net Starfish* and *Biotica*. Featured in SIGGRAPH 2000, *Biotica* was "a visceral and immersive 3D experience of evolving, responsive, and abstract artifical life forms," in which users fly through the Biotica world using arm gestures" (*SIGGRAPH 2000*, 35). Pattie Maes at the Media Lab <pattie.www.media.mit.edu/people/pattie/> experiments with artificial life as well as artificial intelligence to build software agents, which serve practical purposes for Web searching as well as providing digital experiences. And in Rebecca Allen's *Emergence* system, users can define their own characters and objects in a three-dimensional artificial life world <emergence.design.ucla.edu/home.htm>. Is this user interface design or digital art?

Embodying the virtual

The relationship between the virtual and physical is one of the most pervasive subjects of digital art today. As we suggested in chapter 6, by examining this relationship, artists help to combat the myth of disembodiment.

At the intersection of the virtual and the physical, robotic art has been an important field for decades (Kac 2001). In recent years, Eduardo Kac and Ed Bennet have created the telerobotic bird *Ornitorrinco* and later the *Rara Avis.* Ken Goldberg and his collaborators planted the famous *TeleGarden,* which enabled people to water and tend plants over the Web. Simon Penny has made a series of pieces, in which viewers watch and interact with robots, including the playful *Petit Mal* <www-art.cfa.cmu.edu/Penny>. Stelarc created his *Robot Arm,* which controlled him as much as he and others controlled it, and Alan Rath's numerous robotic sculptures have made technology both the subject and the medium <www.hainesgallery.com/AR.statement.html>.

Some digital artists now perform and even dance in spaces that combine the virtual and physical (as indeed *T-Garden* invited users to dance with virtual forms). Yacov Sharir has performed simultaneously on a proscenium stage and in a VR world created in collaboration with Diane Gromala, entitled *Dancing with the Virtual Dervish: Virtual Bodies.* Media artist and choreographer Thecla Schiphorst explored the "sensuality and anarchy of the act of touching and being touched" in *Bodymaps, Artifacts of Mortality* <www.telefonica.es/fat/eschip.html>. In *trajet: a video dance installation*, Gretchen Schiller and Susan Kozel have assembled a "dynamic and interactive space," in which "numerous screens ... receive projected moving imagery, sound and light in synchronized sequences." Its interactivity brings attention to the users' movement through space, and in effect offers the bodily knowledge of dancers to nondancers <www.banffcentre.ca/wpg/Past_Exhibits/dgames>. Like several other virtual reality artists, Char Davies has redefined the immersiveness of virtual reality as a new kind of embodiment in her pieces *Osmose* and *Ephémère* <immersence.com/immersence_home.htm>. Stephen Wilson questions the myth of disembodiment in *Body Surfing* <userwww.sfsu.edu/~swilson>.

Many are using installation art to explore the architecture of hybrid virtual and physical spaces. Working with Jeffrey Smith and Phoebe Sengers, Simon Penny has created *Traces*, in which visitors leave virtual tracks of light as they interact in a highly mediated space of light and sound. In this vein too, Christian Möller's sonic and visual installations include *Virtual Cage* and *Audio Grove* <www.canon.co.jp/cast/artlab/pros2/pers-01.html>. In numerous pieces, Monika Fleishman and Wolfgang Strauss <maus.gmd.de/imk_web-pre2000/people/fleischmann.mhtml> have been exploring the aesthetics of digital space and insisting on the importance of embodied experience in the digital environment. And for the past ten years, Marcos Novak <www.centrifuge.org/marcos> has been examining how the digital realm redefines architecture.

Design in context

Never pure formalists, digital artists are inclined to ask how their art articulates with its own physical, cultural, and economic contexts. They use their art both to pose cultural questions and to suggest solutions.

Brenda Laurel, Mary Flanagan, and others have created video and computer games that correspond to the needs and affinities of girls, who are not traditionally encouraged to develop their computer skills. Artist and educator Victoria Vesna <vv.arts.ucla.edu> examines the physical and cultural contexts of the digital in both her art projects (such as *n0time*, which combines a Web site, a physical installation, and cell phone connections) and her writing. Indeed, she is coediting a book to be entitled *Context Providers: Conditions of Meaning in Digital Arts*.

Meanwhile, many artists are exploring the intersections of art and science—a cultural dialogue that Roger Malina has fostered and shaped for a generation in the journal *Leonardo*. Stewart Dickson <www.wmgallery.com/dick_395.html>, who created the kinetic sculpture *3-D Zoetrope* for SIGGRAPH 2000, shows how 3D information visualization (and in particular fractal mathematics) can be a new, materially realized media art form. Donna Cox <www.ncsa.uiuc.edu/People/cox> uses information visualization and 3D computer graphics in work ranging from abstract to ironic photorealism. Among his many pieces, Eduardo Kac is best known perhaps for his *GFP Bunny*, a genetically altered creature that glows green when exposed to certain light <www.ekac.org/gfpbunny.html>. The rabbit poses questions about the limits of art, the relationship of art and science, and the layers of cultural contexts that are wrapped around any artifact, especially a living being, that is claimed to be art. In addition to Kac, those working in the thriving fields of bioart and biotech art include Oron Catts and Ionat Zurr, who are exploring tissue culture and tissue engineering as a medium for artistic expression.

For many digital artists, art is a critical technical practice, a means of critiquing the assumption that technology is a tool to be applied to all social problems. In her interactive installations and performances, for example, Lynn Hershman Leeson <www.lynnhershman.com> questions our cultural roles and identities. As director of media and visual arts at The Banff Centre, Sara Diamond <www.banffcentre.ab.ca/mva/mvastaff/sara.htm> has fostered critical practices through conferences, exhibits, and publications, as well as through her own pieces, such as *Code Zebra*, software to define a collaborative game space on the Web. Teal Triggs, Liz McQuiston, and Sian Cook, founders of WD+RU, have developed numerous projects (such as the "conceptual typeface" Pussy Galore) that can be described as critical digital design practice. Sandy Stone <sandystone.com/sandystone.orig.html>, Joel Slayton <cadre.sjsu.edu/area210/Joel/joelbio.html>, Mark Pauline <www.srl.org>, and Natalie Jeremijenko also use their art to ask critical questions. Indeed, there is a dimension of cultural critique to the work of almost every artist we have mentioned.

For many digital artists, art is a critical technical practice, a means of critiquing the assumption that technology is a tool to be applied to all social problems.

Finally, many leaders in the design community have come to realize the importance of cultural awareness and cross-cultural sensibilities. Aaron Marcus has become a champion of cross-cultural interface design. Albert Badre recognizes the importance of culturally aware design in his book *Shaping Web Usability* (2002). And S. Joy Mountford <www.idbias.com/people.html> continues to do work that defies categorization (which is to say that she is appropriately diverse and eclectic for the era of digital media): she is designer, HCI expert, and artist in her work on contextually aware digital interfaces and applications.

Perhaps the most important program for shaping digital art has been the CAiiA-Star design Ph.D. program, directed by Roy Ascott <www.caiia-star.net> and integrating art, science, and technology. Its fellows and graduates constitute a global collegium, contributing to the understanding of digital art as contextual practice.

Colophon: Excretia

AND READING AS A REFLECTIVE EXPERIENCE

In Excretia,
any text is both
a window
and a mirror.

Digital design must always provide users with an experience, even as it conveys information.

The design of this book

A colophon is typically a brief list at the end of a book of production-related facts, such as: the designer, typeface, compositor, stock, printer, and binder. We have more to say because we have tried to produce this book according to the principle that we have been preaching: to make it an experience that is both transparent and reflective. The layout of the book is not an afterthought. The visual design—the bold quotes at the beginning of each chapter, the hierarchy of fonts, the placement of images—is part of the meaning of the book. The body text of this book is set in Adobe Garamond, an old style typeface, whose goal is clarity (transparency). The headings are Univers and Dalliance.

Our design is not meant to be wholly transparent, however. Reading today is also a reflective experience, in which the medium (the letterforms themselves) matters. We wanted the design to encourage the reader to reflect on the contexts of this book (as both a printed artifact and a description of the world of digital design).

Excretia

The splash page at the beginning of each chapter incorporates an eclectic digital typeface called Excretia, designed by Diane Gromala. Actually, these pages can show only snapshots of Excretia letters, because this is a dynamic typeface, meant for display on computer screens and wearable LCDs (liquid crystal displays), not book pages. On a computer screen, the characters would be constantly changing before the user's eyes. Excretia is a combination of various modern and postmodern typefaces: its uniqueness lies in its continuous morphing.

Excretia is also an algorithm, which determines how the letterforms will change as they are displayed to the reader. Although it is itself an expression of digital technology, Excretia has something in common with the calligraphy of the handwritten manuscript: how it looks and what it says can never really be separated. The letterforms in a text set in Excretia are never entirely transparent, as the shapes of the letters become part of the text itself.

This is an old idea. One thousand years ago, the Japanese understood the art of writing in the same way:

> In the eleventh-century *Tale of Genji*, Genji is with his lover, Lady Murasaki, when he receives a letter from his prospective wife, the Third Princess. Murasaki doesn't need to read the contents of the letter. Once she glimpses the handwriting, she concludes that the girl will not be a threat to HER. GEnji is embarrassed by the childish writing. "You see" he says to Murasaki, "you have nothing to worry about." (2001, 558)

For the Japanese, calligraphic handwriting was not just a way to transmit messages. The style of the writing was integral to the message itself. Western culture promoted that idea of writing in the Middle Ages, but never perhaps as strongly as the Japanese did, and we lost it definitively with the triumph of the printing press. From the first, printed letters were extremely regular; every "a" looked almost exactly like every other. Printed texts, as visual texts, could not and still cannot express the personality of the writer. In fact, the writer is usually not the printer, and the writer usually has little or nothing to say over the choice of a typeface or the layout of his words on the page. The separation of writer, designer, and printer has guaranteed that the visual appearance of the book will not transparently express the author. So we look for the author's character in the choice of words themselves, not in the appearance of the text. Unlike the Japanese or Chinese or even Europeans before printing was invented, we are taught as readers to become "word processors"—that is, to ignore the texture and appearance of the texts that we read. Today only designers learn this other art of reading.

Digital technology seems to go even further than printing to distance us from the hand of the author, because algorithms produce the letters that we see on the screen. Digital letters displayed on a monitor are not even touched by the printer's hand. On the other hand, digital technology can help to reawaken our interest in the visual appearance of words. In the 1980s, the Macintosh gave the average user the power to choose her own typefaces and fonts and determine her own layouts. Through desktop publishing, the author could become the printer. Desktop publishing has led to some excruciatingly bad page design, but it has also educated a whole generation of writers to consider the visual dimension of their texts.

There are other ways in which digital technology could empower writing as an art of visual expression, because unlike printed letters, digital letters can change and morph under the eyes of the writer or reader. Such changes need not be random; they can happen in response to a stimulus, an input stream coming into the computer. This is how Excretia works. The writer is hooked up to a biofeedback device, which measures her heart rate, respiration, and galvanic skin response. As she writes, these continuous streams of data affect the visual character of the typeface. The words "throb" as her heart beats; they grow tendrils and spikes if she becomes "excitable." As the writer works, the text she has already written may continue to change, or she may choose to freeze it to reflect her state at the very instant of the writing—in effect, to create a biological-typographical record. The same words may have a very different feel, texture, and therefore meaning at different times. Excretia is the first in a type-style family Gromala calls biomorphic type (figure 10.1).

With Excretia, a word processor is no longer simply a productivity tool but a reflective experience in itself. As the writer works, he sees how his biofeedback reshapes his words. Galvanic skin response is also used in polygraph machines, and we could say that Excretia makes writing truthful in the ironic sense that it reveals the writer's bodily states. For the writer, Excretia is not only a visual experience; it invites the writer to take account of his body in the act of writing. He becomes literally aware of his autonomic states of heart

Figure 10.1
Diane Gromala, Excretia: *A typeface that responds, in real time, to a user's physical states.*

rate, respiration, and galvanic skin response (figures 10.2 and 10.3).

A lie detector, however, is designed to extract a single meaning from its subject: whether he is telling the factual truth. (Lie detectors cannot really determine the truth, which is why they are not generally acceptable in court, but that is the premise under which they are used.) Biomorphic type does not attempt to generate a single meaning. There is no simple correspondence between the writer's condition and the moving image of his words on the screen, for the simple reason that heart rate and skin response are not under the writer's conscious and easy control. Furthermore, the meaning the user ascribes to his physical state is always changing, just as Excretia changes. Even if users try to manage their writing by controlling their respiration, unpredicted, "spiky" moments occur, in which the letters form interference patterns that are themselves vivid and almost pictorial (figure 10.4). Nevertheless, Excretia reflects the writer in a way that printed or static type does not. It offers a new interface between the text and its writer (and later readers as well). It reunites the act of writing with a physical awareness, a unity that the printing press denied.

Figure 10.2
Excretia: *Through a biofeedback device, brainwaves drive changes in the font.*

Figure 10.3
Excretia: *The writer's heart rate causes the font to morph continuously.*

Writing as a reflective interface

Writing has always functioned as an interface, even thousands of years before there were computers. Writing has been and is a visual interface between readers and ideas expressed in language. Prior to the

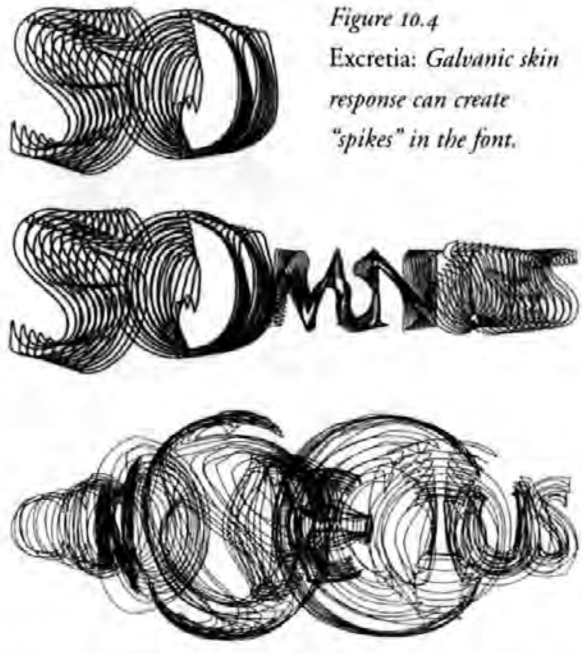


Figure 10.4
Excretia: *Galvanic skin response can create "spikes" in the font.*

computer, it was an interface powered by the individual human reader, who turns the text back into spoken or subvocalized language. With the computer, the task of powering the interface is now shared among the writer, the reader, and the computing system itself.

What kind of an interface is writing? In Western culture, writing has generally been supposed to be a window onto the world described by the language. Especially in the age of printing, with the exception of some specialty books, the letters and layout of the text were supposed to disappear. Obviously Excretia is different. Demanding to be seen and appreciated by the reader, Excretia belongs to the tradition represented by Japanese and some Islamic calligraphy and by the illumination of manuscripts in medieval Europe, in which words and images are inextricably joined.

Writing can also function as an interface between the writer and himself. Because the words that we put on a page or screen come from within us, they can tell us in some way who we are. Writing can be a reflective interface, a mirror of the author, although not a perfect mirror because our written identity is different from who we are when we are speaking casually. In fact, we have many written identities, as we write in different voices for different audiences and purposes. Like earlier forms of writing, Excretia is a reflective interface that reveals the author to himself—again, not a perfect or single reflection, but a myriad of refracting planes in the transpositions and changing angles of the letter forms. Excretia reflects a different part of the author's self.

Writing in the Western tradition is usually thought of as an exercise in abstraction. When a writer writes, she leaves her body behind and creates a version of herself that is abstract and reasonable—a Cartesian or even Platonic ego (although Plato supposedly disdained writing). This notion of writing has survived into the computer age. We remember John Perry Barlow and other cyberenthuasiasts who wanted to stake out cyberspace as the realm of Mind. They were thinking of verbal e-mail, chatrooms, and MOOs when they claimed that in cyberspace, people could leave their bodies, their disabilities, and their prejudices behind. But that trick never works. Excretia insists that we cannot leave our embodied selves entirely behind when we enter cyberspace in any of its forms: e-mail, the Web, or even word processing. Along with so much of the digital art that we have been exploring, Excretia seeks to remind us of our bodies, and the self that Excretia reflects is a combination of symbolic writing and imagery—of abstraction and embodiment.

Materiality, embodiment, and the contextual in writing

Excretia is a digital system that insists on the physical nature of writing, because the writer's physical presence also leaves its mark on the writing. Historically, the notion we have had of the writer, especially "great" authors, has been just the opposite. Although they may be dying of consumption or alcoholism, their poetry or plays remain unaffected. Writing was supposed to be removed from such realities, but Excretia insists that we remember them. It insists on the physical contexts of writing. It monitors the writer's own bodily states as evidence of who the writer is at the moment of writing. By putting Excretia in printed form in this book, we also illustrate the theme of remediation: this digital typeface becomes an example of the ways in which new and old technologies can borrow from and refashion one another.

Finally, Excretia combines the two overarching visions of digital technology that we discussed in the first chapter: the computer as symbol manipulator and the computer as a manipulator of perceptions. Excretia does not deny the symbolic nature of writing. The writer still uses visible language to communicate. Instead, biomorphic type adds another layer of meaning to visible language by infusing the letters with a representation of the material and bodily nature of writing. It foregrounds the material side of writing that had been downplayed and even suppressed in centuries of printing and in the first decades of computing.

The reader of a text written in Excretia—whether it is the author or a later reader—oscillates between reading the text in the traditional way and appreciating the letterforms themselves. The letterforms have their own message to convey. This is another example of the oscillation between transparency and reflectivity. Written in Excretia, any text is both a window and a mirror.

Appendix: THE ART OF SIGGRAPH 2000

Aesthetics and Computing Group, MIT Media Lab
The Introspection Machine

(art)^n Laboratory
Townhouse Revisited

Mark Amerika
PHON:E:ME

Laura Beloff and Markus Decker
HAME

Kathleen Brandt
Exclusion Zone

Richard Brown
Biotica

Lois Burkett
MOMENT (#1)

John Chakeres
25 Palmer

Todd Childers
POO3279723

Sarawut Chutiwongpeti
Utopia1997

Stewart Dickson
3-D Zoetrope

Elliott Peter Earls
EYE SLING SHOT LIONS

Fakeshop
Lifescience-Fakeshop

Nan Goggin, Mick Brin, Joseph Squier, and Robb Springfield
Insideout

Hunter Grant
Liberation

Bill Hill
The Black Lung

Rania Ho
Free Range Appliances in a Light Dill Sauce

Tiffany Holmes
Nosce Te Ipsum

Kenneth A. Huff
99.8A

Franklin Joyce
REMEMBER WHEN WE THOUGHT TELEVISION WAS FLAT AND THE CENTER OF THE UNIVERSE

Jeff Knowlton
A Text for the Navigational Age

Mark Korn
A Flinching Mind

Kumiko Kushiyama and Sinji Sasada
Hide-and-Seek

Liz Lee
Identification—Analyze

Jennifer Ley
Daddy Liked His with Heart

Jessica Maloney
The Eyes Grow Dark

Jacquelyn Martino
Hangman: Is There an "I"?

Michael Mateas, Steffi Domike, and Paul Vanouse
Terminal Time

Yasushi Matoba and Hiroshi Matoba
Micro Friendship

Kelly McFadden
Los Hermanos de Destruccion Numbero 6

Conor McGarrigle
Spook . . .

Mark Millstein
Tall Sumac Kite

Bonnie Mitchell
Merging Identity: Exploration of Identity: The Body and Life Online

Marjan Moghaddam
Adoration of the Gas Tank

Norie Neumark, Maria Miranda, Richard Vella, Greg White, and David Partolo
Shock in the Ear

Plancton Art Studio
Relazioni Emergenti

Thomas Porett
TimeWarp-Philadelphia

Rhizome.org
StarryNight

Daniel Rozin
Wooden Mirror 1999

Philip Sanders
NYC Night/Samurai

Jim (Aristide) Scott
Consume 2

Sponge
M3: T-Garden

Jack Stenner
Satisfaction

Andrew Stern
Virtual Babyz

Igor Stromajer
SM-N

Piotr Szyhalski
Die Zeitstücke (Timeworks)

Michele Turre
Neoclassic, From Tired Landscapes

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