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MACHINE THERAPY

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ABSTRACT

Machine Therapy is a new practice combining art, design, psychoanalysis, and engineering work in ways that access and reveal the vital, though often unnoticed, relevance of people's interactions and relationships with machines. Machine Therapy will be illustrated through the construction of several systems including re-appropriated domestic devices such as Blendie, wearble apparatuses such as ScreamBody, and body-signal-based companion machines – Umo, Amo, and Omo – that function through visceral interactions including breathing and non-verbal sounds. These systems will be used to explore themes of human-machine relations in terms of visceral, cathartic, and reflexive expressions and communications.

This work incorporates elements from my technical research in digital signal processing, machine learning, mechanical engineering, and sensor design. Combining these areas of research and practice, I have been able to help manifest new objects and relationships that are unique in some aspects while maintaining quotidian familiarity in other aspects. These apparatuses enable unusual explorations of what we interact with when we interact with machines.

I hypothesize that the answer will turn out to be much more than the machine itself, and will include our sense of self, agency in the interpersonal and political world, and our shared psychological, emotional, cultural, and perceptual approaches to the world. The importance of the parapractic elements and also the therapeutic properties of the Machine Therapy machines will be evaluated in studies of participants' interactive engagements with the machines as well as their affective responses to the machines.

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CONTENTS

Chapter 1

INTRODUCTION

MACHINE WHISPERS

I would wander the city and look for them, listen for them. They were found all over the place, so it was just a matter of finding the right ones – the ones I wanted. Now, as I trust you understand, I can describe openly that I felt a craving for them, for their communication.

These things start at an early age, and in fact for me this likely started before I was born. Although I cannot remember and name the machines around me at that time, I am sure there were plenty – cars, sewing machines, electric pencil sharpeners, vacuum cleaners, trains, hospital machines, elevators, clocks. The incubator after birth surely had a dramatic influence, my machine cuddler, the particular hum of the air system, the familiar 60Hz North American power grid electromagnetism still rhythmically in me as it was before birth.

I would lie on the wooden floor of our small apartment as a child, my ear pressed airtight against the smooth surface, listening to the heating and plumbing, the humming, creaking adjustments, and footsteps and voices of neighbors, all mixed together, a living machine that I was contained by and held by. Flat against the floor leaving no space to fall, it felt safe. Other sounds were louder, harsher, but if I listened to the floor as gravity pulled me deep into it I was calm, things felt connected.

The construction machine attraction became conscious later. I had sung with staplers and crows in high school and college, in folk punk bands and sound ensembles. As I began singing with machines I became reflective about having always been interested in my voice during unusual circumstances only. In regular circumstances I was extremely uncomfortable using my voice. Debilitatingly shy.

In my late twenties I walked past a hole in a main urban road with men inside and all around it. A large pneumatic jackhammer focused their activity. Tethered to a compressor on the truck, it jabber-screamed against the asphalt. This felt interesting, I was fascinated. I sensed what the jackhammer seemed to be expressing and it exactly matched how I felt at that moment. So I screamed with it. I must have been with it for half an hour, waiting in calm exhilarated anticipation in between sessions, letting loose when the jackhammer sheltered me in sound.

The next morning someone was clearing their yard with a leaf blower. Different than the jackhammer, quiet comparatively, and steady, determined in a zen way rather than an anarchistic hedonism. I began to sound with the leaf blower when the person using the leaf blower had their back to me and I knew they would not notice. To my surprise, the leaf blower itself and I immediately were in a sort of an improvised balancing tug game. I would catch the resonance of the motor with my voice and the motor would feel me, pull me or stay with me. It was like singing at the same tine with another person – I could not decipher where the other voice ended and mine began. They were blended and both were resonating in my body. I could be led or I could also pull or push the motor of the leaf blower with my voice by catching it, staying with it, feeling and knowing when it was about to be indecisive and taking over just exactly then, bringing it to meet my sound and taking it somewhere carefully, like carrying sheets of paper ice, a tender and slow negotiation.

In my experiences with the jackhammer and the leaf blower I felt a connection with them as if they were extensions of my body, parts of myself. I began singing with cement mixers and backhoes and ten-story cranes. I visited construction sites in Boston and New York City. In these cities construction projects in public places are abundant. People go about their daily business trying to avoid them, holding their ears. I had found something useful in these sites and sought them out, breached fence borders and made my way into them. I befriended the workers on the sites who would point me to other machines I may like to visit. They would tell me in confidence, "Don't tell the other guys but I sign along with machines sometimes, too," and "I understand what you are doing. I make sounds with the machines, certain machines. Sometimes I do not even realize I am doing it." I began developing relationships with the machines that I would visit. I would visit the same machine everyday and hook myself into it. Having gone days without being with a certain machine I might become depressed and need to go find that machine and hook into it, and have it hook into me.

Befriending a Ten-Story Crane

It was night when I first saw it through the green torn tarp covered fence around a new biotech company's construction site near MIT's campus. I spotted it from far away, over the fence, and then closer through the holes, more magnificent than any machine I had ever seen. Shiny red glossy wet new, holding itself perfectly postured on a brand new wooden deck built just for it facing the inside corner of the L-shaped building going up, it was powerful and serenely gorgeous.

I tried many views through the fence, just to see it standing, but to my frustration as I could not get close enough to see the red surface well, to let it wet my own eyes.

Its apparent calm confidence inspired my own confidence. I rode my bicycle right onto the site the next day when the construction people were there. I waited by the trailer until the foreman came out. I explained that I wanted to, if possible, get closer to the crane. I explained that I was working on a project in which I try to get into vocal resonance with the sounds of machines. I explained that I had found that certain machines are well suited for this and that they make sounds that people can imitate so well that they resonate with the machine. They are led through this connection to make sounds and gestures and movements they may otherwise never make. It was a sort of psychological and visceral experience, I explained. He listened and nodded and knew that it was all very true and serious, that I was not kidding around. He gave me his card and said that I could not go onto the site on a regular work day for safety reasons. But in mornings before the workers all begin, or on Saturdays when there are only parts of the site active, we could arrange for me to come by and he could let me spend time with the crane.

The neck of the powerful crane, pivoting on its axis, carried tethered I-beams filling in the skeleton of the building attentively. Gently it returned and landed in front of me, lifting up its head. The voices of its inner desires and conflicts became clearer, as did my own. As it began to move again I sounded with it to help it along, to empathize. Through this I approached feelings I can not name but that are vitally real, something close to empathy, care, fear and comfort. I expanded my voice and the expansion stayed with me as I left the crane. I visited it from inside or outside of its fence everyday until it was one day gone.

Before my visits with the construction machines I had almost stopped perceiving them, or at least for me they had faded to a murmur and scattered screams. But I vaguely knew this murmur to be indispensable to feeling and being human. It is not only with dry verbal legislation and precise iconic plans that people make and unmake the world.

It was back when I used to sing with the machines that I consciously realized that machines have been intimately, viscerally, subconsciously involved in human making. In this respect it is not the main functions that the machines are designed to carry out that matter most, but rather it is the side elements of their designs and actions that matter to people in deep yet unconscious ways.

MACHINE THERAPY

Alongside the assigned functions of machines and the dramatic roles these assigned functions play in human development, there are aspects of every machine that go largely unnoticed. These largely unnoticed aspects nevertheless are vitally involved in people's personal, social and political making of their worlds. The work of Machine

Therapy is about these side aspects. By helping them to be seen, making them addressable, I hope to reveal their importance and contribute to a reflective practice of machine design and use that is of widening ethical responsibility.

Machine Therapy describes a practice of connecting with machines, especially through their unintentional yet active side elements, in ways that are revelatory and potentially therapeutic for people. Through the development of built projects and performances concerning machine and human interaction, I have shown the vital relevance of the often overlooked side aspects of machine design.

This dissertation describes several projects tied into the development of ideas and hypotheses under the rubric of Machine Therapy. Through this I offer steps towards unpacking what some of our intimate and often subconscious inter-mingling with machines may manifest on personal, social, and political levels.

CONTRIBUTIONS

I am an artist deeply involved in technology. This thesis will be my attempt to jump over boundaries in Science and Technology Studies, Art, Therapy, Engineering and Critical Theory.

In this thesis I foreground previously overlooked aspects of machines. Through new machine making and found machine re-appropriating, I bring elements of subconscious activity in our relationships with machines into conscious awareness. I show how the dance between people and machines has always been one of blurry borders, and that the blurriness is a phenomenal space able to be approached in ways that host a widening of our human sense of self, connection, agency and responsibility. I present the design and making of machines that highlight the vital visceral side-elements of machines that have been iterated over years of machine and human development without our conscious focused attention. This includes, as a first step, especially close attention to sound, infrasound, movement, heat and electromagnetic radiation.

The new machines offered are in response to mass-marketed devices and appliances and companion robots. The machines of Machine Therapy help interrogate the notion of "normal" and the privileging of the most probable outcomes in design approaches. I propose instead to recognize the vital importance of diversity in human and machine making, and for design principles and methodologies that acknowledge the unbounded role played by machines in human and global development. This effort is ongoing and will involve much more work than the small step offered by this dissertation. I hope the contributions offered through this work do help add a little light along the way for others on our contingent processes of becoming human.

In addition to the artistic and theoretical contributions, the physical contributions of this dissertations work on Machine Therapy include:

1. Design and development of a breathing viscerally interactive machine: Omo.
2. Development of a flexible soft rubber QTC sensor skin.
3. Development and open sourcing of a mini sensor informed motor driver board
4. Build and iteration on a signal processing model of machine voices.
5. Design and development of a voice interactive blender: Blendie.
6. Design and development of other art, technology, and design projects including: Boom, ScreamBody, HoldBody, Toastie, Machine Therapy Sessions, (and Umo and Amo – in process).

THESIS STRUCTURE

What may on some levels appear as personal-scale experiences quickly extend to social and political arenas. I begin in the Background, chapter 2, by discussing the making of things and the mappings of people's relationships with each other through what they garner from objects. This comes through distillations of the work of major theorists in psychology and social theory, a look at puppets and automata with a special focus on companion robot design and research, and readings of artistic interventions and performances of critically influential socially active artists.

In chapter 3 and chapter 4 together – The Prapraxis of Machine Design, and Early Projects in Machine Therapy – I develop the main hypotheses of *Machine Therapy* through critical analyses of machine and human contingent relations and through project making and performance explorations.

Main Hypotheses:

1. The visceral side-elements of machines invite vital relations that are often of unmapped significance.
2. Machines play active roles in many areas of personal and political and material world-making in ways beyond what machine designers and users are usually conscious of.
3. It is possible to build machines that heighten or foreground the ambivalence of boundaries in the relations between people and machines. The relationships these machines call forth may not be as completely separate devices utilized by a person, but rather may highlight and make use of a relational dance between levels of connection and separation between the person and the machine, moving back and forth all the time as good *transobjects*.
4. Visceral interaction with machines may facilitate therapeutic exchange as well as extend the concepts of therapy.

The next two chapters, 5 and 6, present a new series of projects. They are in response in part to the growing interest in companion machines. Through the final project series of this dissertation, *Umo, Amo,* and *Omo,* I offer an alternative approach to machines as relational companion objects. Instead of troping whole anthropomorphic others such as nurses, grandchildren and pets, *Umo, Amo,* and *Omo* are able to be experienced by a person as in between part of the person – something akin to a prosthetic or body part – and a separate thing. They are simple relational objects. They demonstrate that by presenting the familiar visceral elements that many machines often do, they may offer therapeutic benefits while critically extending the definition of therapy. Chapter 5 describes these three machines, the motivations for them, and their general designs and technical architectures. Chapter 6 provides detailed descriptions of how Omo was made. Chapter 7 presents feedback about people's early experiences with Omo, including in-depth art criticism and analyses by a panel of experts uniquely suited to evaluate Omo in terms of psychology, art practice, critical social theory, and machine design. The dissertation concludes with a brief preview of future work planned and in progress.

Chapter 2

BACKGROUND: FOUND, LOST, MADE, BROKEN

The following is a map with tracings of theories and projects that have been points of departure and return in my dissertation work. While acknowledging maps as incomplete and assumptive, herein I present my reading of prior work by theorists and artists that have helped facilitate awareness that we exist and move in relation to others, objects, performances, and structures, and that we simultaneously participate in the making of our selves and our world. I am choosing a part of their work that helps clarify and locate the contributions of my recent work presented later in this dissertation.

What is it to recognize something? What is it to have a sense of self? What is it to imagine a loved one? What is it to perceive meaning in a gesture? These are some of the questions addressed by the work presented in this chapter. Later, in the following chapters, we will investigate related questions about what is it to perceive meaning in a mechanical movement, to feel emotion from a machine, and to experience self and non-self in relationships with machines.

OBJECTS

Objects are constructed with consequence. We[1] have been enculturated to experience our world as made up of separable "things," constituent parts, objects and subjects navigable through relational drives, economies, networks, and desires. This under

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1. Here with the term "we" I mean to inscribe broadly all speakers of languages that have elements for describing the world as a set of objects. Less broadly, I am writing from the point of view of an American-born daughter of various intermingling mass and subcultures affected by capitalism, psychoanalysis, art, and various machine seductions and monstrocities.

standing of our selves and of our surroundings has been structured over the course of history through interpersonal, interspecies,[2] social, and political communication and psychical, somatic, cognitive, and cultural mappings imagined and made communicable by people. We are about to look briefly at some significant contributions to our current understanding of the realm of "things" contingent to our experience of being human. This chapter will both place us in our realm of things while also revealing that this realm is always in a state of becoming and remaking. We can and do unmake, break, lose, remake, and find our selves and other things constantly. This point will come to bear, in the upcoming chapters, as our key into re-perceiving and thereby remaking our inter-relations with machines.

Reification and Thingification

When we perceive something, a cup for example, as a whole thing in itself with boundaries, we are thingifying. We could alternatively not see the cup as separable from the field it is in and thereby not be able to thingify it as an it, a thing, and not specifically identify it as a cup. But most of us have the habit of perceiving a cup as separable and it is quite a challenge not to do so. We are also able to perceive our left elbow as a thing, the voice of a child as a thing, and the memory of a kiss as a thing, among other things.

We thingify all of the time. It is how we make our perceptions and ideas communicable. Because we come to everything we thingify from our situated perspectives, we cannot help but always inscribe into our thingifications our own point of view, our own making in a sense of our perception of the thing. When I perceive a cup, I have certain ideas about what qualifies it as a separable thing and specifically as a cup. What I perceive about a cup is guided by what I have perceived and assigned meaning to previously about cups and things in general. Some aspects of the cup will escape my conscious awareness because I am not conditioned or inclined at that moment of my perceiving the cup to notice and consider all aspects.[3] At the same time, I update my category, "cup," with each new encounter with something I choose to include in the category. The weight and boundaries of the many dimensions of what is a "cup" change for each of us individually over time. Every time we thingify – that is, anytime we experience something as an identifiable, knowable thing in itself – we do so non-neutrally from a perspective garnered over our lifetime and situated in

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2. Ethnomusicologist Steven Feld describes in *Sound and Sentiment: Birds, Weeping, Poetics, and Song in Kaluli Expression* sound as a cultural system of symbols among the Kaluli people of Papua New Guinea. Birds, social values, and soundmaking are intertwined. Birds contribute greatly to sounds in language and song of the Kaluli people. Also see the work of Donna Haraway, including *Simians, Cyborgs, and Women: The Reinvention of Nature* and *Modest_Witness@Second_Millenium.FemaleMan_Meets_OncoMouse: feminism and technoscience.* Also see "Deep Play: Notes on the Balinese Cockfight." by Clifford Geertz in *The Interpretation of Cultures.*

3. Sometimes the aspects forgotten, lost, not seen, are of critical importance and our not seeing them is an interesting non-neutral omission that may be of great impact and importance to consider. This point will be the focus of the next chapter.

the moment of perception. Thingification is thereby always, even in these little seemingly insignificant moments like perceiving a cup, a structuring influential act. It grounds how we function and of how we communicate with each other and agree (or disagree) on how to make sense of the world.

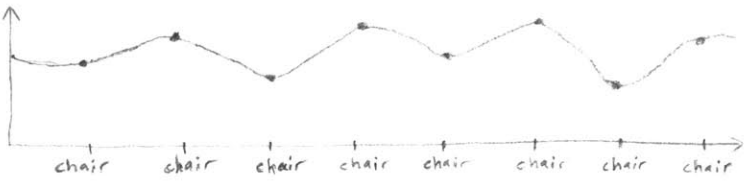

Fig. 2.1 "The name is the time of the object." My quick illustration of Lacan's statement (Lacan 1955, p.169) in relation to how people perceive objects is meant to illustrate what I think is a tie in his statement to signal processing and artificial intelligence. Lacan was in communication with his contemporaries working in related fields including cybernetics. Their cross-influence at times came through in his lectures. This statement and sketch describe how each time an object is perceived, is sampled, it is sampled under the name it has been given. The name is what continues while context and content and other features of the object are not always carried over.

Reification[4] is a form of thingification in which abstract concepts or experiences are treated as if they had a concrete exchangeable existence. As with thingifications, the perspectives and inclusions and omissions of what matters drastically effect what is to be the use and influence of each reification. For example, Karl Marx explains in his analyses of capitalist society how the human experience and all social relations of working in trade guilds and Manufacturing were completely changed by the reifications of capitalists and Modern Industry. Marxist philosopher Georg Lukács explains reification following Marx.:

> *The essence of commodity-structure has often been pointed out. Its basis is that a relation between people takes on the characteristic of a thing and thus acquires a "phantom objectivity," an autonomy that seems so strictly rational and all-embracing as to conceal every trace of its fundamental nature: the relation between people.*
> *(Lukács p.83)*

In Marx, commodity-structure and commodity-relations were revealed as central, structural dominators of all social relations in capitalist society, influencing the total inner and outer lives of people. The full, unbounded meaning of experience and engagement with making and working became thingified into machine processes, and into a sellable commodifiable thing called human "labour-power."[5] This thingification distilled work that was creative, skill-based, abstract, and holistic in experience into disjointed, estranged, exchangeable things. People became dissociated from the making of things and from the products of their making. They lost their own experience of engagement and personal agency within the processes of creating. With reification of what it is to do work, a person's labor becomes something objective and independent of that person, a commodity, which – subject to the laws of objective capitalist society – must go its own way independent of the person like any other consumer article.(Lukács 1971 p.86-87) The perspective from which this reification of labor-power was made and instituted, with the omission of all of the other aspects of human work

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4. re·i·fy v. To regard (something abstract) as a material or concrete thing. Merriam-Webster online dictionary <http://www.m-w.com> (August 5, 2007).

5. "*In Manufacture, the organization of the social labour-process is purely subjective; it is a combination of detail labourers; in its machinery system, Modern Industry has a productive organism that is purely objective, in which the labourer becomes a mere appendage to an already existing material condition of production.*" (Marx 1990 p.386)

that escaped consideration in its formulation, had incommensurable side-effects during the era of Marx's reportage,[6]but these have continued to mutate and multiply, constantly affecting social, ecological and political realms.[7] It occasioned Taylorism and Gilbreth's motion studies. It is contingent with views of the body and the mind made of component parts approachable through mechanistic metaphors. Machines and machine metaphors play underestimated roles in cultural iterations of how being human is understood. Further examples and discussions of this form a unifying thread running through this dissertation.

> *With the modern 'psychological' analysis of the work-process (in Taylorism) this rational mechanization extends right into the worker's 'soul': even his psychological attributes are separated from his total personality and placed in opposition to it so as to facilitate their integration into specialized rational systems and their reduction to statistically viable concepts. (Lukács 1971 p.88)*

> *The transformation of the commodity relation into a thing of 'ghostly objectivity' cannot therefore content itself with the reduction of all objects for the gratification of human needs to commodities. It stamps its imprint upon the whole consciousness of man; his qualities and abilities are no longer an organic part of his personality, they are things which he can 'own' or 'dispose of' like the various objects of the external world. And there is no natural form in which human relations can be cast, no way in which man can bring his physical and psychic 'qualities' into play without their being subject increasingly to this reifying process.*
> *(Lukács 1971 p.100)*

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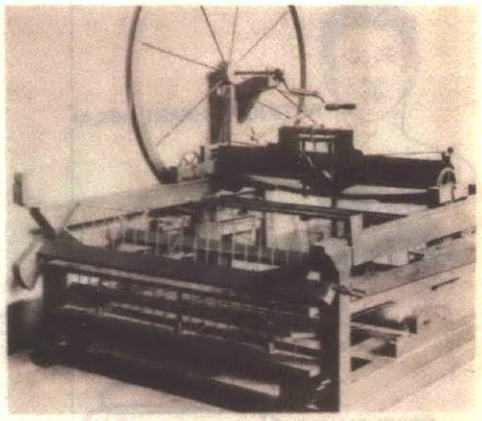
6. Marx describes the methods of Modern Industry as forcibly felt. Human boys under capitalism in the printing industry were turned into machine appendages, then after a few years of becoming a machine part and being a machine part, these appendages were discarded and replaced with replacement parts/appendages, new boys. *"In the English letter-press printing trade, for example, there existed formerly a system, corresponding to that in the old manufactures and handicrafts, of advancing the apprentices from easy to more and more difficult work. They went through a course of teaching til they were finished printers. To be able to read and write was for every one of them a requirement of their trade. All this was changed by the printing machine. It employs two sorts of labourers, one grown up, tenters, the other, boys mostly from 11 to 17 years of age whose sole business is either to spread the sheets of paper under the machine, or to take from it the printed sheets. They perform this weary task, in London especially, for 14, 15, 1and 16 hours at a stretch, during several days in a week, and frequently for 36 hours, with only two hours rest for meals and sleep. A great part of them cannot read, and they are, as a rule, utter savages and very extraordinary creatures.* 'To qualify them for the work which they have to do, they require no intellectual training; there is little room in it for skill, and less for judgement; their wages, though rather high for boys, do not increase proportionately as they grow up, and the majority of them cannot look for advancement to the better paid and more responsible post of machine minder, because while each machine has but one minder, it has at least two, and often four boys attached to it.' *As soon as they get too old for such child's work, that is about 17 at the latest, they are discharged from the printing establishments. They become recruits of crime. Several attempts to procure them employment elsewhere were* rendered of no avail by their ignorance and brutality, and by their mental and bodily degradation." Marx p. 484-485.

7 There are many important, revelatory analyses of contemporary machine agency, among them Andrew Feenberg's *Questioning Technology* and Ulrich Beck's *Risk Society.*



REPRODUCTION OF AN EARLY SPINNING MACHINE
James Hargreaves invented the spinning jenny in 1764, naming this device for his wife. When textile workers learned that it could spin up to 100 threads at a time, fearing competition, they tried to smash it.

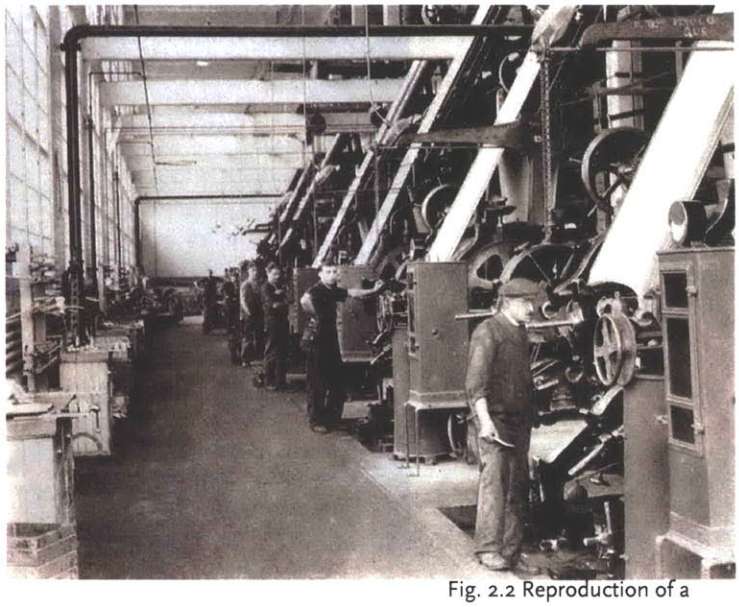


Fig. 2.2 Reproduction of a spinning jenny machine, named after the wife of the inventor, James Hargreaves; invented in 1764. (Year 1957 p.139)

Fig. 2.3 Printing machines in a textile mill in Montreal, early 20th century. (Gelly 2003 p.3)

Our continual remaking of ourselves in relationship with our approaches to machine design, development, and use will be addressed more in upcoming chapters as this dissertation unfolds.

Bodies In Pieces

Within modern industry people saw themselves as parts, multiplied and sold. Of course this did not come out of thin air but out of the situations and ideologies and conceptions of the time, led up to over years and years of becoming human.

While people were reinterpreted into machine parts, their once familiar and intimate tools used for skilled work were being reconstituted by being taken out of their grasp and rebuilt as machine parts by the tens of thousands. Human arms and detailed learned movements were subject to similar distillations into machines.

> *The tool, as we have seen, is not exterminated by the machine. From being a dwarf implement of the human organism, it expands and multiplies into the implement of a mechanism created by man. Capital now sets the labourer to work, not with a manual tool, but with a machine which itself handles the tools. (Marx 1990 p.387)*
>
> *Along with the tool, the skill of the workman in handling it passes over to the machine. (Marx 1990 p.420)*

While bodies have been incorporated as machine parts, machines have also been incorporated into human bodies as body parts.

Our bodies, conceived of as made of parts that do things, can be dismantled and sold and traded and stolen, and they are. What is at stake, as even the definition of death has changed to accommodate the removal and use of the vital organs of people who

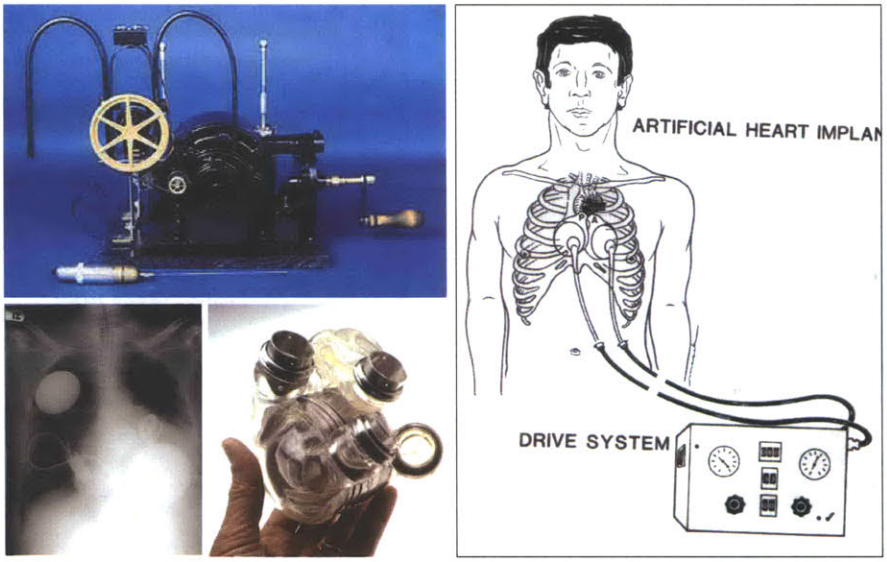


Fig. 2.4 Clockwise from top left: precursor to Hyman invented in 1930 to be used by plunging two needles into chest and turning the crank wheel to produce electricity to excite heart to beat; diagram of Jarvik 7 artificial heart; contemporary artificial heart, AbioCor; x-ray of body with Jarvik 7.

are in comas or otherwise "brain-dead" for example, are our perceptions of what is life. (Fox and Swazey 1992 p.61; Lock 2002) What is life is at stake in what is an object.

Conceptions of human bodies as made up of function-specific parts that can be broken, repaired, replaced, bought and sold, have scripted organ transplant practices and vice versa. In relation to developments in organ replacement, the medical industry has changed legal (contingent with cultural) definitions of life and death.[8] [9]

A replacement part grafted into a person's body carries with it more than the specific function for which it was sought. In cases of living organ replacements, people have reported experiencing other personal attributes of the donator accompanying the

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8. Medical professional Youngner explains, *"They are hardly "corpses" in the traditional sense. Although they are "dead patients," they do not resemble our other dead patients. The expression "brain-dead" is accurate but seems to avoid the crucial issues. Most would agree that these donors are no longer "persons." When the patient is admitted to the operating room, the recorded diagnosis is "beating-heart cadaver" – a term that is offensive to many people. Gaylin coined the term "neomort" 10 years ago, but it has not become popular. Perhaps we will only be able to give these artificially maintained organ donors an appropriate name when we ourselves have made the necessary emotional and cultural adjustments."* (Youngner 1985 p.323, as quoted in Fox 1992 p.62)

9. See *"The ventilator/baby as cyborg--a case study in technology and medical ethics"* by Robert Nelson, in *Biotechnology and Culture* edited by Paul Brodwin. Nelson tells the story of a child who has been placed on a life-enabling ventilator and how taking him off of it would constitute amputation: *"Once Michael underwent a tracheotomy and was placed on a home ventilator, he would remain a patient in the home ventilator program. Thus we come full circle to the notion of the ventilator-infant as cyborg, the machine-human hybrid as embodied subjectivity rather than the machine as external to the body. The social identity of the patient named Michael is a product of being a machine-human hybrid, that is, the ventilator gives life to the body and the body gives life to the ventilator. To contemplate taking the patient named Michael off of the ventilator would be to contemplate amputation--a request that the medical and nursing staff could not and would not honor."* (p.221)

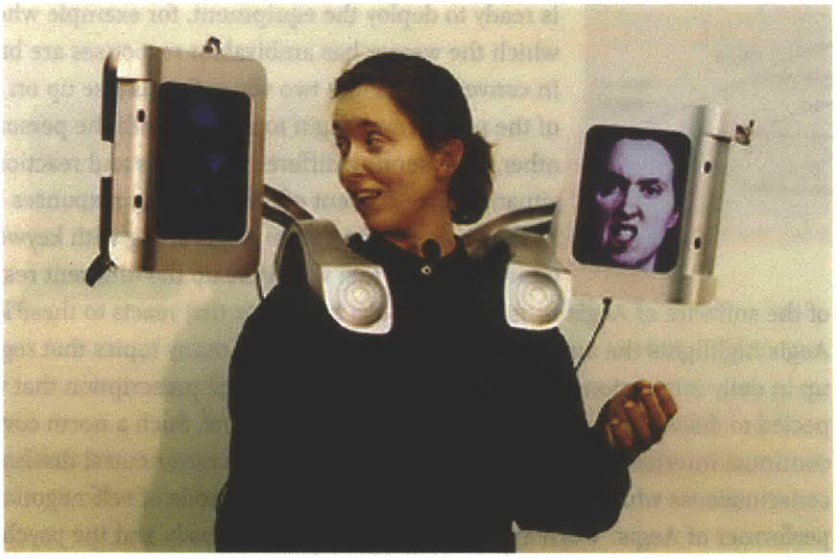

Fig. 2.5 Krzysztof Wodiczko's project, Aegis, worn and performed by the author. < http://web.mit.edu/idg/aegis.html> August 10, 2007).

organ in its new body.[10] In the case of artificial organ transplants, the machines do not simply perform the desired functions but also inscribe in the person's body certain characteristics, set by the machine, that affect more than the area of the implant itself. Artificial heart transplant patients have experienced themselves as fundamentally emotionally altered. The new heart sets their heartbeat (and heartbeat variation) and thereby strongly dictates what levels of exertion they can engage in and also, interestingly, what emotions they describe as feeling.[11]

The conception and design of machines as body parts and extensions reflect and contribute to our social and personal understanding of what matters in human embodied experience. These accompanying elements of emotional and psychical experience are sometimes left as side effects. The technical projects presented later in this thesis, however, manipulate these experiences as their primary function.

Differing from these medical artificial organs, the prostheses and apparatuses designed by the artist Krzysztof Wodiczko are used to address social and psychological issues. With Aegis, a project that I contributed to as a student/collaborator, the psychological negotiation of a coherent locatable self is performed.[12] When the wearer

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10 See Fox and Swazey (1992), online support groups, and Sanal (2004).
From Fox and Swazey p.36: *"...a woman who received a kidney at the same time I did from the same little girl. We have become brother and sister. That is because our kidneys came from the same donor...The transplants have created something between us: brotherly love, or what have you...."*
From a poem by Reed about a cardiac transplant recipient and the heart they "wear",: *"My blood has adopted a child who shuffles through my chest carrying a doll"* Reed (1970)

11 See Sharp (1998), Cohen (1999), Sanal (2004).

12 Wodiczko explains: *"The instrument is a piece of equipment designed to represent dual (and often dueling) truths, those living contradictions that both define, depict, and can sometimes destroy individual existence."* < http://web.mit.edu/idg/aegis.html> August 10, 2007. See also Wodiczko (1999).

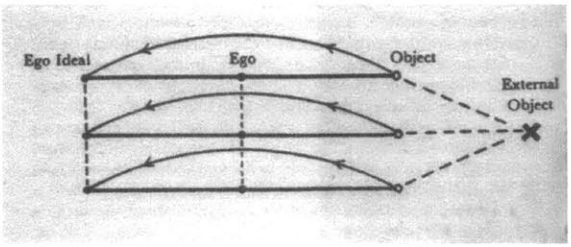

Fig. 2.6 Freud's diagram of the ego and objects.(Freud 1959 p.48).

is ready to deploy the equipment, for example when topics for which the wearer has ambivalent responses are brought up in conversations, the two wings/heads rise up on either side of the person and begin to interact with the person and each other, representing different opinions and reactions to the situation. The content of these various responses is recorded by the wearer and put into Aegis along with keywords of the wearer's choice that will wake up the different responses. Part of the software of Aegis runs a voice-to-text translator that reacts to these keywords. Aegis highlights the ambivalence within everyone on many topics that regularly come up in daily interactions. It calls us to question the social prescription that we are expected to deliver coherent reactions in daily interactions. Such a norm covers over our continual internal negotiations. Aegis both brings this non-neutral dissimulation into consciousness while at the same time offering a new mode of self-negotiation for the performer of Aegis. Worn apparatuses may extend the body and the psyche in ways that resonate with the wearers' relationships with themselves and others.

Object Relations Theory

Object relations theory, pioneered in the 1940's and 50's by psychoanalysts D.W. Winnicott and Melanie Klein among others, postulates that the self exists only in relation to other objects which one finds externally, or makes and carries internally resonating with things found externally. An object, in object relations theory, is something (person or thing) that can help a person make material the negotiations of desire, to figure out one's self in relation to things in the world, to relate to objects as representations of other things.[13] Freud's schemas were mechanical and hydraulic, as doctors during his time viewed the body in terms of mechanisms, of parts and exchanges, influenced by the contemporary work on thermodynamics and homeostasis in feedback controlled mechanical systems. Melanie Klein contributed centrally to object relations theory by further highlighting that object relations could be not just with whole objects or people, such as the mother for a baby, but also with part-objects such as the mother's breast. Attachment, frustration, and rejection are the three affects theorized to dominate object relations. One finds in the objects and people that one interacts with identification and influence that is then mapped into one's always-becoming sense of self.

I opened this work with the story of my experiences with the machines at construction sites in the hope that this story could lend itself to the schema of object relations theory.[14] Within this mapping, my exploration with a machine, facilitated by my

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13. Althea Horner explains: "the precursors of objects relations theory are present in Freud's work. As early as 1923 he spoke of the ego as the depository of abandoned objects. Nevertheless, early psychoanalytic focus on the object was in terms of object choice in libidinally invested relationships rather than as a structure of personality." (Horner 1979 p.3)

14. My understanding of the experience will also be explained in the *Parapraxis* and *Early Projects Towards Machine Therapy* chapters as disturbing, traditional psychoanalytic structures such as object relations theory in a potentially useful way.

harmonizing with its sound and by moving like and with it, can be interpreted as my identifying with the machine, as negotiating my relationship to it and to myself through it.

The main message of object relations theory, for this work, is that each person forms their understanding of themselves by identifying with other people and objects. Identification names the entry of the traces of each and every encounter with the external world into the person. For psychoanalysis, identification defines personal relations, an individual's affiliation to social groups, and the nature of political bonds.

Transitional Objects

Child psychoanalyst D.W. Winnicott proposed the categories *transitional object* and *transitional phenomena* in reference to the infant developmental sequence of experiencing things as parts of one's external reality versus as internal to the self. Transitional objects are a special subset of relational objects that are emotionally robust and therefore malleable as things to figure out elements about the world, others, and one's self with. As Winnicott mapped the negotiative space between an infant and transitional objects, he set defining characteristics to describe the four stages of the life-cycle of a transitional object. Winnicott presents the mother's breast as the primary example of a transitional object, and as, he believed, the first transitional object a baby experiences. He taught that the theory also applies to blankets, thumbs, dolls, toys, and other things that become dear to the child and that follow along the stages of transitional objects. In the first stage (the newborn baby stage), all is experienced by the baby as a sea of sensations (through non-differentiated "touch" points). During this first stage, the baby has no idea yet about it being a self and other things and people being other things and people. In the second stage, the baby begins to comprehend that there is some sort of separation between parts, but that all parts are still nevertheless under the baby's omnipotent control. In the third stage, the child begins to test the objects s/he finds, to aggress them, to attempt to "destroy" them. In the fourth stage, if the object has survived destruction, the object moves from being considered under the omnipotent control of the child to being separate from the child but able to be related to and used when the child needs it. It is a very dear object. At times when the child does not feel as much in need of the transitional object it may end up in a closet or under a bed, but always able to be fetched when the child again needs it.

Fig. 2.8 WInnicott's illustration of the transitional phenomena between a baby and mother. (Winnicott 1971 p.16)

Winnicott explains that the infant benefits from the gradual introduction of frustration. This is how the infant strengthens its sense of self, its ego. A mother (object) that behaves "perfectly," always appearing exactly when the infant desires and always providing exactly what satisfyingly meets the infant's drives, is "no better than a hallucination," i.e., does not train the infant's ego at all. Winnicott, in light of his theory, terms the ideal non-perfect mother the "good-enough mother."(Winnicott 1971)

Transitional objects and transitional phenomena occur in an area of experience that Winnicott tells us must not be challenged. One must not ask of the child, "Is this ob-

ject part of you or is it separate from you?" To do so would be to violate the experience of the transitional object and interrupt the vital negotiation of developmental stages the child is undertaking.

Symbolic, Imaginary, Real, and the *objet a*

The idea of a special status of object that is experienced subconsciously as in-between part of one's self and separate from one's self is further expanded by the French psychoanalyst Jacques Lacan.[15] *Objet a* designates those elements that play into one's sense of self through projection and reflection and identification.[16]

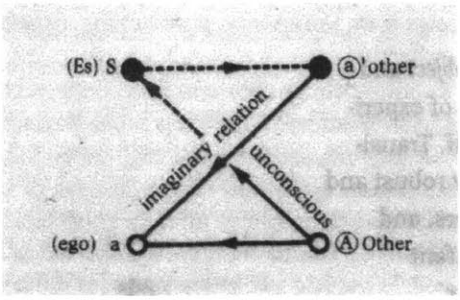

Fig. 2.9 Lacan's diagram *The imaginary function of the ego and the discourse of the unconscious* (Lacan 1988 p.109)

Lacan describes our human experience through the three realms of the *Imaginary*, the *Symbolic*, and the *Real*. The 'imaginary' was the first realm Lacan theorized. It is the realm of the ego (sense of self, image of self) and identifications that the ego has with other things. It is the realm of images, conscious or unconscious, perceived or imagined. It is in the realm of the Imaginary that a person interacts with others and learns about themselves and the world. The ego in Lacanian theory is itself an imaginary object within the experience of the person.

Later, in the early 1950s, Lacan introduced the realm of the *Symbolic*, or the closed order of signifiers, in the sense developed by Saussure and Jakobson. Elements of the Symbolic are in themselves without meaning but acquire meaning in their usage and relationships, and structure our every utterance in the world. For Lacan, the determining effects of the Symbolic on a person are radical. He goes so far as to state that the person is an effect of the Symbolic, that what they say and what they have as their "lot in life"(Lacan 1988) is predetermined by their place in the Symbolic. The symbolic order has "structures proper to it, with its own dynamism, with the mode specific to the manner in which it intervenes so as to impose its coherence, its economy, which is autonomous to the human being and his experience."[17]

I am alerted to how with Lacan, as with Freud, conceptions of how people are to be understood through the influential fields of psycho-analysis are modeled on the machines at play in the thoughts of the psychoanalysts as they construct their theories.

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15. Lacan 1955. In his seminars, which were held biweekly from 1953 until his death in 1981, Lacan returned to Freud through interpretations and expansions of the work foundational to the field of psychoanalysis.

16. The *a* in *objet a* stands for *autre*, the French word for other, the concept having been developed out of the Freudian "object" and Lacan's own elaboration of otherness.

17. Lacan, Book II, p.115-116. This description reminds one of the description of the thingifications of capitalism described earlier. Lacan is interpreting Freud, who himself based the functioning of the person on the machine metaphors available to him in his time. Lacan adds to this more recent conceptualizations about circuits and passing of messages which he also saw in cybernetics and saw their applicability, i.e. observed thought of his time around machines of his time and both described and manifested their application.

Significantly, cybernetics was a powerful concept at this time.[18] Lacan was aware of and influenced by cybernetics discourse. The concept of the Symbolic by Lacan is influenced by circuits and information theory.

The *Real* is the third term and is what is neither Symbolic nor Imaginary. The Real is what is underneath all of our conceptions and signifiers, in the same place whether we are looking for it or not. The Real is without fissure of external and internal. Because it is neither Symbolic nor Imaginary it is foreclosed from the analytic experience. It is inaccessible in psychoanalysis in that psychoanalysis is structured, for Lacan, around speech, on exchange of speech between analyst and analysand.[19] Everything spoken about has thereby been thingified and put into words. As we discussed with thingifications and reifications earlier, there are aspects that escape this transform into the symbolic. When we distill something into a set of words, inevitably we leave some of it out. The Real is not translated and therefore becomes the foreclosed but eliminable residue of all articulation.

> *Speech is first and foremost that object of exchange whereby we are recognized, and because you have said the password, we don't break each other's necks, etc. That is how the circulation of speech begins, and it swells to the point of constituting the world of the symbol which makes algebraic calculations possible. The machine is the structure detached from the activity of the subject. The symbolic world is the world of the machine.*
> *(Lacan 1988 p.47)*

This quote sounds as much like it is describing computer systems handshakes and packet checking, and information theory, as it is describing human language.

I bring up Freud's and Lacan's use of their own "metaphorical" machines to illustrate how truly intertwined machines have been with model conceptions and perceptions of people and society. Indeed, different accounts, or theories, of how people form an identity and negotiate boundaries between self-and-world are deeply informed by the theorists' own [machine-]metaphors of mind.

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18 The influential Macy conferences, where leading scientists from a wide range of fields including information theory, mathematics, electrical engineering, neuro physiology and psychology among others participated in interdisciplinary discussions and exchanges, happened in the years just before and during Lacan's introduction of the concept of the Symbolic. The ten Macy conferences, held between 1946 and 1953, spawned breakthroughs in systems theory and what was later termed cybernetics. Lacan refers to cybernetics in his seminars. (Lacan 1988) Also see Norbert Wiener's book, *Cybernetics: or control and communication in the animal and the machine* which was published in 1948.

19 The analyst is the therapist, the psychoanalyst. The analysand is the client, the patient, the one "in analysis."

PUPPETS AND AUTOMATA

We have been in the practice of extending ourselves imaginatively in order to be represented back to ourselves by other things. Puppets and automata are perhaps the most clear and familiar examples of objects with which we do this. They are human-like but without the hindrances of human self-consciousness and human physical limits. We can therefore imagine possibilities through them beyond what we could expect and perceive in a person. I will argue in this dissertation that people vitally engage in this manner with all machines, not just the clearly anthropomorphic ones.

Fig. 2.10 Marionettes. <http://www.svil.radio.rai.it> (April 19, 2007).

Fig. 2.11 Screenshots of a flying dragon from Second life. A contemporary puppets of sorts, also without the same gravity constraints as people and without the same sense of self-consciousness.

Marionettes

Our contemporary marionettes are often in the form of machines – remote controlled robots and online avatars, for example – and what we make of these is in some way what we make of ourselves.

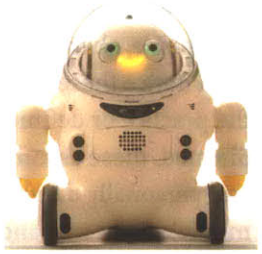
There are two main points about marionettes that will be especially useful as we talk about machines and our relationships with machines.

1. Puppets, marionettes, and automata are especially suited for projecting yourself outside of your own body into their bodies. They are projective devices. They are not far from mirrors in that they present images of familiar parts that we also have – often they have bodies with limbs and a head with eyes and a mouth of some sort. They move and communicate and relate to other things as part of going about their business.

2. Puppets, marionettes, and automata are not tied to the same physical limitations and rules and self-consciousness as people are, and so we can imagine more into/through/from them. We give them more room for what we can fantasize through them. Marionettes have strings that counterbalance gravity enabling them to leap and fly and dance with inhuman grace. (Kleist 1810) Avatars and automata have internal engines of their own and defy our familiar power and movement limits. Because in some aspects they appear to be our mirrors, while in other ways they are able to do things beyond what we can yet do, they are especially well suited for expanding what we can imagine we are able to do.(Ackermann 1996) They inspire and they train us as we identify with them. One need only observe the moral tales for children told through puppets and storybooks with fantastic pictures to witness these affordances.

Companion Robots

Much recent research on companion robots has focused on machines to help care for people in their later years of life. There is concern in the United States and Japan about the rapidly growing number of persons over sixty-five and the relatively limited care provisions socially and medically available for them. Machines designed to look like nurses and animals and children are being designed to aid, monitor, and care for people. In the designs of these machines, some characteristics are almost always present. They tend to have camera eyes that can visually survey the situations they are in. They have arms and bodies and heads and in this sense resemble puppets that in a direct way appear like a person or animal. They tend to have interaction schemas that require sign-based communication such as gesture cues or recognizable verbal cues or other cognitively considered directions and cues. All of these characteristics together suggest coherence in current companion robot research that involves a privileging of information, medication, and docile soothing. The three main points that I will return to in order to offer alternatives in upcoming chapters are:



Top Fig. 2.12 Ifbot, developed by Business Design laboratory Co for elderly people, is currently on the market in Japan. Ifbot is able to respond to verbal commands and enter into dialogue.

Fig. 2.13 Paro the robotic seal developed as a therapeutic robot by Takanori Shibata. Paro has sensors uner its fur and can respond to human touch by changing its sounds and movements.

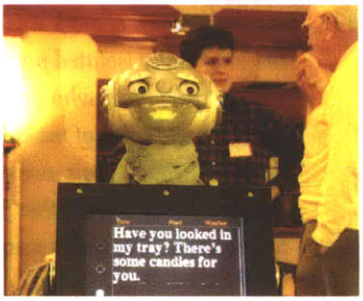


Fig. 2.14 Carnegie Mellon University's robot Pearl during an early test visit in an elderly care facility. Pearl is part of the Nursebot Project. <http://www.cs.cmu.edu/~nursebot>.

Fig 2.15 Pearl with person. <http://www.cs.cmu.edu/~nursebot> Aug 15, 2007.

1. Most recent companion robots are designed to be soothing, medicalizing, and normatizing. They are designed to help a person meet a narrow range of medically defined statistics of health and wellness. They are not meant to present their own anxieties and neuroses but simply to comfort, serve, survey and medicate.

2. The interaction design emphasis for these companion robots has been on cognitive communication protocols that leave out visceral interaction. A person thinks about the gesture and verbal cues that will register in the machine and illicit a response. Vice versa, the machines are designed to use explicit gestures and sound cues to illicit responses from the people. Most of this has stayed in the area of cognitive-based interactions with explicit cues that are intentionally enacted.

3. They are modeled to represent a whole creature or person. Furthermore, they are modeled to represent a whole creature or person that often vacillates between a slave and an authority.

Nearly all contemporary companion robots, whether designed for research or for commerce, share these characteristic. As a result of this homogeneity, it is difficult to even notice these characteristics, let alone address them, as they are so embedded in the practice or definition of contemporary as to become almost invisible. Culturally directed, these assumed characteristics are also significant in that they are culturally and personally directing. As objects to think with, they trope people and animals, mimicking people and animal attributes while actually being machines and offering machine attributes. In upcoming chapters we will return to these points as I propose relational machines that are not tropisms of familiar figures such as nurses or pets, but that nevertheless vitally offer machine elements that are affective with people. Omo, the main technical experiment of this dissertation, is in many ways much simpler than these state of the art robots but in many ways it may be more pertinent to the prospects of machines as companion objects.

> *"It has already been pointed out that the division of labour disrupts every organically unified process of work and life and breaks it down into its components. This enables the artificially isolated partial functions to be performed in the most rational manner by 'specialists' who are specially adapted mentally and physically for the purpose. This has the effect of making these partial functions autonomous and so they tend to develop through their own momentum and in accordance with their own special laws independently of the other partial functions of society (or that part of society to which they belong)." (Lukács p.103)*[20]

Lukács reminds us that for every reification there is that which is left out. As machine designers and users make new reifications through companion machines that specialize in human-derived functions such as caring and soothing, it is important to think about what is actually being made. This requires investigating from many perspectives what is highlighted as care and comfort and what aspects of these, as we have known them, are left out. This is important because as people interact and reflect from these caring machines and soothing machines, people are, in effect, being trained on what is now to be considered caring and soothing. It is a non-neutral enterprise. Our definition of what it is to care may change, as our definitions of what it is to work changed with modern industry as we saw earlier in this chapter. It is also important to consider what else may be present in addition to the planned aspects of the machines. What else may these machines mean for people that may be, for now, subconscious and of unplanned significance? This later investigation will be taken up in the next chapter, Parapraxis of Machine Design.

For now, let's visit previous work by artists who used performance with objects to make workable what were culturally unconscious aspects of personal, social, and political significance.

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20 *"The specialization of skills leads to the destruction of every image of the whole. And as, despite this, the need to grasp the whole – at least cognitively -- cannot die out, we find that science, which is likewise based on specialization and thus caught up in the same immediacy, is criticized for having torn the real world into shreds and having lost its vision of the whole."* (Lukács p.103-104)

PERFORMING OUT OF BOUNDS

"I knew I was going to be either an artist or a criminal."
– Martha Rosler[21]

"I like to reveal the mechanics of the illusion."
– Joan Jonas

As Donna Haraway argues, the issues of agency addressed by the feminist, animal rights, and environmental movements have vital roles in the emergent uses and interrogations of technology, in individual's sense of self and agency in the world, and in political debates, as we all contingently co-evolve in the world. Agency is important because it says who has a voice, who is responsible, and who will be able to be involved in authoring socially/politically/globally powerful conceptions of who/what things, people, goals, and responsibilities are. One's sense of agency, of self and place in the world, is a highly political facility. The recognition of individual agentive reasoning, for example, supported the development of democracy, voting, and public education. Our personal perceptions and negotiations with our surroundings are socially guided, and play into our continually re-made sense of self. How our individual agentive identities are played out effects larger institutions of power in the social and political spheres. Placed in the context of working to comprehend social control, technological production, and cultural change through technological structures, an important and exhaustive contribution has been philosopher of science Andrew Feenberg's extended discussion on technology and democracy.

Feenberg explains technology as not being, in itself, deterministic, but rather as having many unexplored potentialities, as being a site of social struggle on which political alternatives contend.[22] He proposes "democratic rationalization" as a way to describe interrogations and re-interpretations of technology in public realms. He reveals ways in which technological design is a powerful medium, central to the social and political structures of modern society. Feenberg raises negotiations of agency, safety, economy, and social structure pertaining to "public" technologies such as nuclear power plants, large passenger steamboats, and the networks of French Minitel and CSCW.[23] With the steamboat example, he explains the socio-political, and,

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21 Pointing to her radical political activism, see this quote of Martha Rosler from The New York Times interview with Michael Rush, July 9, 2000: *"I knew I was going to be either an artist or a criminal."*

22 See also Latour's description of a "parliament of things," an anything-but-neutral arena through which the continual social construction of things by people, and of people by things, contingently develop and contend for political alternatives.

23 CSCW stands for "computer supported cooperative work." Feenberg, p.91, points out that different conceptions of virtual spaces influence greatly how identity and activity in those spaces are played out. Also see Fernanda Viegas' PhD thesis (MIT, 2005) on this area in which she designs and evaluates different "social mirroring" representational interfaces for the users to navigate data, their email, and online social communities, finding effects of social agency related to different interface designs for the same content.

as I read it, personal identity inscribing, understandings and omissions of what a steamboat is. On steamboats, projections of class and leisure status, experiences with other machines and activities, and other inscriptions influencing desire informed the sensation of riding, of being held and carried by the giant machine. A period of rising popularity of steamboats led a period of debate on safety regulations for their boilers. In the first half of the 19th Century, hundreds of explosions killed or injured over five thousand people, but the popularity of riverboat rides was so great that passengers continued to sign up for fatal trips. High ticket sales meant that ship owners felt little pressure to redesign their boilers. Eventually, in 1852, after 36 years of negotiations, steamboat boilers became the first technology the US Government subjected to safety regulation.(Feenberg p.95; Burke (1972).

The technical code defining what a boiler is was effected by agency of consumers, ship owners, engineers, and politicians seeking regulations for safety, thus responding to the "changing cultural horizon of the society."(Feenberg p.95) Feeberg offers many such examples, tracing a web of social control and desire, spun with technology. The encompassing power structures of large political and institutional organizations (such as governments, corporations, school systems, transportation systems), as well as the more subtle social systems they effect (neighborhood social mores, access to shared resources, health and safety components), are made manifest through assumptions and through events of absence; that is, through perceptions of things and roles as they are taken for granted and through the forgetting or not acknowledging of other things and roles. Feenberg presents a wide range of interrogations of public technologies, revealing their social construction through political struggles of power and meaning structures that are often taken for granted, and through this revealing he makes these negotiations addressable.

Feenberg's arguments are politically and socially informed, insightful and backed up by an extensive bibliography of theorists in the field – including feminist theorists Donna Haraway and Nancy Fraser. Nonetheless, Feenberg is primarily interested in "big" political, social, and legal controversies, and as a result he brushes past "private" technologies such as domestic appliances, personal devices, and other technologies traditionally situated in the home. He mentions in passing the work of cultural studies scholars interested in the "domestication" of household technologies, but quickly dismisses their concepts as "a bit too cozy."[24] He then brings up another pair of authors attempting to extend the theory of domesticating technology by combining it with social constructivist theory and the active role users play in the iterative design process of technological things, but the hope he sees in this hybrid is that they extend the theory to, in their own words, "disentangle it from its location in homogenous and relatively stable, moral economies of households."(Feenberg, p.107; Lie and Sorenson, 1996 p.13). Feenberg questions the viability of their hybrid theory claim to

24 See Feenberg's words on Silverstone et al. p.107-108.

apply to domestication, when it is after all talking about issues as public as chemical hazards in the environment and nuclear power plants. The domestic metaphor brings Feenberg doubt because for him it "connotes the narrow confines of the home however it is reformulated, and thus privileges adaptation and habituation in a way that short circuits the appeal to agency."(Feenberg, p.108.) He reminds the reader that he is not against talking about personal interfaces to technological power structures such as evidenced by his look at medical technologies and computer network applications. Nevertheless he seems to not notice the consequences that other home technologies portend for not only the individuals using them, and the implications that the relationships with these devices convey in their formation of selves, but also for the power structures and democratic rationalizations active on the public scale.

I have attempted to analyze what components are required of a technology for Feenberg to include it in his argument about the centrality of technology design in the social and political structure of modern society. He requires that it 1)carry meaning not inherent in itself but rather implied socially and therefore is socially deconstructable and re-constructable, 2) be involved in an integral part of our existence and relationships in society, and 3) be a site of political negotiation/contention. While Feenberg tends to see these components in large, publicly debated projects like power plants and steam ships, it is my contention that domestic technologies are interesting in precisely these ways. Specifically, we can see these points in the work of a set of artists working during and after the 1960's, a time when the socio-political positioning of women had shifted from previous decades of factory labor and wartime production into the inscriptions of separation and hygiene, objectification, and subordination in the "kitchens of tomorrow."[25] Their analyses, protests, and socio-political actions destabilized the subtle politics of domestic technologies through powerful performances of use, role, and complication. I will later name the net effect of these transformations "dethingification," by which I mean a transgressive act of political revelation. But first, allow me to describe some of these actions.

A woman stands deadpan behind a counter of kitchen utensils, facing the camera like a cooking show host, but without the smile, make-up, and wearing only everyday clothes of an artist in New York and a plain working apron. She demonstrates each device individually in alphabetical order, repeating the violent actions of working with

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25 With hygiene and modernization emphasized, by the 1960s the modernized kitchen was advertised as the centerpiece of a "proper" rationalized home. Claire Duchen shows how home-economic textbooks and women's magazines about the management of the home shamelessly promoted Taylorist organization methods. Women, seen as sexual objects or housewives primarily, were, if housewives, instructed to use labor-saving tools that would supposedly help them reduce unnecessary effort and eliminate "useless gestures." The technologies of the home do anything but eliminate useless gestures. I argue that they are always active sites in our socio-political as well as personal constructions of self, and that they in fact sometimes effect new gestures, as with the case of the presumably unaffecting standard blender that we will return to later in this text.

them in the kitchen: opening and closing a clanking hamburger press, stabbing repeatedly with an ice pick, roughly pushing and rotating a juicer... In her performance of the socially implied semiotics of the kitchen, the grammatology becomes disturbing. Martha Rosler is the author and actor in this video titled Semiotics of the Kitchen made in 1975. The multimedia artist, critic, theorist, teacher and provocateur came of age in the 1950s and 60s (graduated from Brooklyn College in 1965), and has been involved in cultural protests since her early teens. A key figure in the feminist movement, through her work she constructs incisive socio-political analyses of the making of a patriarchal culture. Her video reveals how political ideologies and socioeconomic realities dominate everyday life, and through this revealing she makes these arenas of negotiation addressable.

Rosler's manipulation of the instruments and actions alters the viewer's perception of the domestic technologies. She performs from a psychological/social perspective at dramatic odds with that of common advertisements of the same time. As Rosler goes through the kitchen utensils alphabetically and with deadpan delivery, she repositions these domestic devices, once taken for granted, into animated sites of frustration and subordination of women in the home, the violent gestures and sound making emphasizing the force felt. She demonstrates each implement with the movement and sound repeated a few times, the repetition and assembly line progression mirroring the repressive training, the acts of subordination and control that confined roles of women at the time through cultural implication and political ideology. It's my contention that one of Rosler's key discoveries was that repetition, a method that is practiced to train "docile bodies" in Foucault's sense, can be performed in a subversive way that un-makes training, revealing breaks in what we have been enculturated to take for granted in systems of subjectivity.

> *I was concerned with something like the notion of language speaking the subject, and with the transformation of the woman herself into a sign in a system of signs that represent a system of food production, a system of harnessed subjectivity.*
> *– Martha Rosler*

If Feenberg had seen Martha Rosler's video performance while writing Questioning Technology, he perhaps would have remembered that technologies in the home are not simply domesticated into a neutral coziness (if such a state can even exist), but are rather constantly implicated in negotiations and interrogations of perceptions of subjecthood, gender and proper behavior, and prescribed relations to others, actions, and the performance of roles with implications that extend well beyond the private sphere of a home. A blender, for example, is not a cozy technology. With functions labeled "beat, whip, frappe, pulverize," and so on, and with aggressive sounds that make children cry and cats run out of the room, it has taken training, socialization, and millions of advertising dollars for us to not notice the dramatic subjectivity of a standard blender. Domestic technologies are no less political than nuclear reactors, even if they are generally (though not always!) less politicized.

I believe that the varieties of implements used in Rosler's video clearly meet the requirements of Feenberg's interest: 1) the meanings ascribed to simple kitchen devices are radically deconstructed and reconstructed as sites of gendered subordination and control, 2) the constructing of subjectivity by ascribing women's roles is revealed as working in part through projections facilitated by the kitchen devices, 3) the socially structured uses of, and relationships with and through, the kitchen technologies reveal them as sites of not just preparing food, but of subject formation in a process of social and political negotiation/contention. Implications of what a woman in the home is to be extends to the silencing of women's rights to voices in politics and to work outside the home on equal levels with men. By demonstrating and revealing these social and political battles through the "simple domestic" technologies of the home, Rosler shows just how hidden or deeply positioned our assumptions about things in the world can be. Technologies acting directly as public sites are arenas of political contention, and, more than we tend to realize, so are everyday small personal technologies we take for granted. Perhaps we can encounter more revelations about power and technology and negotiations of agency in the world through feminist analysis.

Feenberg argues that technology in itself is ambivalent; technical codes are active sites of social and political negotiations and alternative potentialities suppressed by the dominant "technological rationality."(Feenberg p87,105). It is through our projections into and from instantiations of technological products that they become sites of symbolic "machinery of consciousness." Extending Feenberg's analysis, I argue that technology of the domestic sphere, and our personal-scaled relationships around it, are vital sites of subject formation, agency negotiation, social inscription, and political action. Performance artists emerging circa 1968 invented effective ways of revealing this. They catalyzed vital forces in the social and political movements of the time while revealing the implications of everyday situations and quotidian design in struggles of agency and place in the world.

Joan Jonas, Pina Bausch, and Lygia Clark are three very different artists who offer work that performs exactly this process of breaking the common assumptions of neutrality of the everyday. They reveal domestic space relationships, technologies, and objects as carrying socially implied meanings able to be deconstructed and reconstructed, that these things and processes are involved in integral parts of our existence, social relationships, and positions of agency, and that they are sites of socio-political negotiation and contention. These artists interrogate assumptions about domestic technologies (and objects and gestures) and reveal the greater social implications played out through them. They call attention to the powerful conditioning roles that personal technologies in fact are emphatically "domesticated" into, and they perform the subversion of these prescriptions. While their works themselves are dense texts with many more facets than these roles I highlight here, I am going to describe several of their performances through the lens of how they describe agency and social contingency. I believe that the works of Jonas, Bausch, and Clark enable a conscious-

ness of the conditions of everyday life, are manifestations of a strong tradition of what I will call "dethingification," and raise interesting challenges to current practitioners in Science and Technology Studies and in product and technology design.

By the 1960s, modern Western societies across the globe were experiencing a crisis that catalyzed a shift in people's willingness to place their lives and positionings in the trust of scientific and political "experts." Whether these experts were defense analysts, Generals, scientists, doctors, or just dominant "men," the various forces of feminism, post-colonialism, and the civil rights movements were effectively challenging a monocultural, patrician formulation of the world.(Feenberg 1999) The movements required new sensibilities, and artists like Joan Jonas offered works of art that destabilized previous inscriptions and facilitated new perceptions.

Within Performance Art and Happenings of the 1960's and 1970's in New York, the barriers of artist and audience were dismantled, combining the psychological and physical space occupied by previously separated groups. The artist's body was immediately reflected as the body of the audience, every body, the socially inscribed body. Joan Jonas, a key figure in the downtown scene in New York, is perhaps most recognized for her performances incorporating the domestic technology of the mirror and its technological equivalent, the personal handheld video camera and monitor. She has used these in performances to deconstruct the socially constructed images of people as separate whole objectifiable identities. Through fragmentation and repetition, her use of these personal technologies of representation that have been traditionally used to help formulate women as objects of desire calls these very subjectifications into question, performing femininity as a construction at a time when gender roles were in political and social contestation.[26]

In Mirror Check (1970), Jonas stands naked in an empty space in the gallery while the audience sits across from her. She slowly circles her body with a small handheld mirror, observing her always incomplete reflection in it. Jonas is not acting, she is not putting on masks of any kind, not even facial expressions. Her face is deadpan neutral, observing the endless scroll of fragments of herself in the mirror while not reacting, not preparing or performing a self unity or identity, but rather performing for herself the observation of there being no such "thing" as a discrete objective self. The audience sitting before the otherwise empty stage contrastingly sees Jonas in her body as a subjective unity. They cannot see the fragmented scroll in the mirror, while Jonas cannot see an image of herself as a solid unity. Jonas brings the incompatibility

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26 The Judson Dance Group, with whom Jonas often worked, gave equal status for men and women colleagues, with women taking on many creative leadership roles. Social and political changes happening in art scene in NYC at this time; dancers and choreographers and visual artists and musicians worked together on collaborative works combining elements, questioning the position and role of art, expressing socio-political concerns, criticizing formal and artificial representation, involving costume and daily movements and life and concerns and negotiations of people in the world.

Joan Jonas, Mirror Check (1970) Performance: Leo Castelli Gallery, New York 1972 (Jonas 2001).

of an objectified image of subjectivity and a direct experience of self as continuous and boundless to attention.

In Lacan's description of the "mirror stage," a young child catches a glimpse of herself in a mirror and is able, for the first time, to recognize this image as being her self with a bounded unitary body rather than a dissociated experience of body parts and feelings. She is forever after in constant negotiation/conflict between this objective self image and the persistent sense of being non-objectifiable.[27] Echoing some aspects of mirrors as sites of objectified self-reflection, mirrors in private spaces such as dressing rooms have been generally portrayed as sites of self preparation and practice/performance of identity as an objectified persona. Jonas' use of the mirror disrupts definitions of mirrors as sites of self unity and practices of coherent identity. Jonas repeatedly circles her body with the mirror, observing her fluid reflection of fragments while at the same time being observed in this process by the audience. Jonas makes it possible for the people present to perceive her action (perhaps previously taken for granted as being a method of negotiating with one's coherent self) with a new interpretation that undoes the standard expected use of the domestic technology of the mirror. From Jonas' perspective in her performance, a whole self is not observed, but rather a scrolling, boundless, emergent self is glimpsed, not ever able

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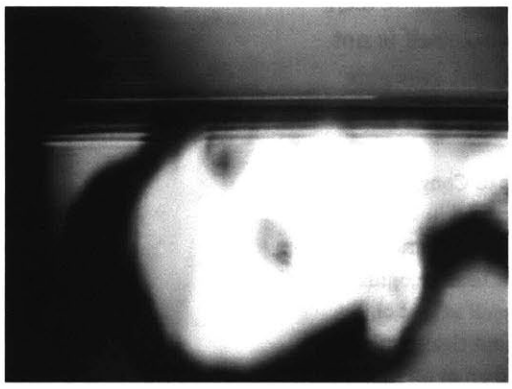
27 Jacques Lacan presented his first analytic paper on 'The Mirror Phase' at the 1936 Congress of the International Psychoanalytical Association in Marienbad. The mirror stage is described in Lacan's essay, "The Mirror Stage as Formative of the I Function, as revealed in Psychoanalytic Experience," the first essay in his Ecrits. The essay describes a very young child who for the first time recognizes herself in the mirror. This moment marks the first time the child conceives of herself as that object, her body contained and whole, instead of as a dissociated mass of body parts without clear borders. It involves the child identifying herself as the external object in the mirror rather than as an internal subject. It also involves the child recognizing her lack of control over her body. This, Lacan theorizes, marks the beginning of a lifelong process of identifying the self in terms of the other. I describe this because I believe Jonas is unmaking it in her performance. She is using the mirror in a different way, unmaking its encapsulating point of view. Other very important readings related to this text are those of feminist theorists Simone de Beauvoir, Judith Butler, and Laura Mulvey. Simone de Beauvoir describes the mirror as a place of preparation of self, to make one's face in, to practice identity.

to be objectifiably unified. Jonas unmakes the notion of a mirror as a device facilitating an ideal objectifiable identity.

In *Vertical Roll* two years later, Jonas performs backstage from the audience while in front of her personal video camera that is feeding to a TV monitor in the exhibition space. The monitor is all the audience is able to see in the live performance; the image on the monitor is what is actually being performed for the viewers. Jonas is wearing an exotic belly dancer costume and sometimes the mask of her seductive alter-ego, Organic Honey. Through her choices of positioning and proximity to the camera, Jonas again, as in Mirror Check, makes her image seen by the image machine into scrolling fragments. Additionally, her image as it is seen on the television monitor in fragments is further disrupted by the instability of the machine itself, presented through the de-synchronization of the image sweep frequency of the monitor. Jonas' partial image is never fully seen (never seen enough to be captured) because a video artifact known as a vertical roll disrupts -- slaps -- the image away just as it is about to complete. Performing the elusive content of this jumping image, Jonas very slowly moves in relation to the camera, so that the image from jump to jump closely resembles the previous image as if repeating, while it is in fact slowly changing. As the image jumps away before complete construction on the monitor, Jonas' body is seen in fragments, jumping out of the monitor. Jonas' body parts are seen slapping by: her legs jump out of the top of the image screen again and again, then torso, mask, face from behind the mask, and her head moving slowly but seen as if banging again and again against the image screen.[28] The video soundtrack is a rhythmic smashing of a spoon against a mirror (which is seen in action for some time in the video) and of two wooden blocks clapping loudly together (this part of soundtrack Jonas added later for the video when represented again for a new audience, no longer as a live performance). These objects are used to vocalize the breaking smack of the image against the edge of the monitor as it jumps repetitively. Jonas engages with the personal video camera recently available at the time of this performance to enable herself to be the narrator, author, performer, and witness of her self image all at the same time -- an agentive empowered position.

Joan Jonas, *Vertical Roll* (1972) (Jonas 2001)



With advertising, popular shows, and the Miss America Pagent, the domestic technology of the TV inscribes political and social roles onto the female body. Fragmented presentation of the female body, as in Jonas' performance, is particularly subversive because there is no longer the expected full image that is produced by massive video production studios and fed to home televisions to be taken as a submissive projection for the fulfillment of a capturing gaze. The inability to rest such a gaze on the now violently jumping image dissects/deconstructs the relationship normally facili-

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28 Jonas often uses masks, alter-egos, in her performances. Interestingly, the video image is another form of mask mediating Jonas in real time.

tated by the image making technologies at the time of Jonas' performance.

"I like to reveal the mechanics of the illusion."
– Joan Jonas

In the 60s the body was the center of artistic interests intimately involved in political and social debates of agency revolving around personal identity and alliances seeking liberation from state and institutional regulation, racial and sexual discrimination, and other socially produced prejudices. Joan Jonas performs transformational uses of domestic technologies, facilitating for viewers a conscious awareness of the structuring of subjectivity and the socio-political battles always at play in struggles and negotiations involving socially inscribed technological devices, even in private spaces.[29] Jonas' works with mirrors, video cameras and monitors, and masks destabilize the reflected image and reveal it as a mirage of sorts, a construction that can be deconstructed and reconstructed constantly. Negotiating a sense of self intrinsically involves struggling with (or accepting) social projections functioning to mold and maintain models of identity. In front of one's own image a person repetitively works through a fluid self in a process that is not simply narcissitic nor a-political, but rather is a critical negotiative struggle of self-conscious agency and social positioning. Jonas emphatically disorients the ongoing constructions revealed as socio-political inscriptions of others, objects, and assumed roles of personal technologies. By confronting the structuring agents that function to determine elements of gender identity and other aspects of one's sense of self, Jonas recognizes and destabilizes identifications that are ideologically determined.

Pina Bausch's work with the dancers of her Wuppertaler Tanztheater also describes constant incompleteness, searching, fragmentation, and the ideological contingency of personal experience. Socio-historically, the German Tanztheater (dance theater), of which Pina Bausch is a leader, originated in the cultural and political situation of post-war West Germany in the 1960's. The 1968 upheavals associated drastic changes in German drama theater, as young artists took over the positions of power (directors, curators, stage designers) in the theaters of Germany. The power take-over was facilitated by the new language of performance that the artists changed drastically alongside the personnel changes. The declamatory theater of the 1950's was thrown out and replaced by a more chaotic, highly physical and visual theater that directly involved the audience and ties to everyday life. As with the Surrealists of the 1920s, who in response in part to the insanities of war queered objects as a crucial process of negotiation with the world as it failed to be found as expected, the artists of Tanzthe-

29. Jonas quoted on p.61 of Hatje Cantz (ed.), Joan Jonas: Performance Video Installation 1968 – 2000, 2001: "(P)erformance is not a space separate from the ongoing activities of daily life. My own performance came from trying to transform and communicate this experience to my audience – my community."

ater in the 1960s questioned reality as it was in a moment of unacceptability.[30] [31]

A personal body is at the same time a socially constructed and socially controlled body; the physical and emotional body of an "individual" is a site of repetitive environmental and social mappings.[32] Pina Bausch leads her Wuppertal Tanztheater dancers to remember gestures, sounds, movements and relationships from their everyday life experiences and, through reconstruction via repetition in rehearsals and performances, they expose these gestures, sounds, movements and relationships as not stably defined but rather in flux and having extremely potent personal and socio-political consequences/implications.

In Für die Kinder von gestern, heute und morgen (For the Children of Yesterday, Today and Tomorrow) 2002, Bausch's female actor-dancers appear onstage holding push-broom ends and the audience laughs. Bausch builds on this comic moment as the dancers begin using the broom ends to brush their hair. They continue this for a long time, roughly and repetitively brushing their hair with the gigantic broom ends. They begin brushing one another's hair with the broom ends, and then brushing the hair of some audience members. This performance is a personal and social dismantling: the hairbrush and broom are dramatically pulled from what had been their taken-for-granted meaning, frenzied, changed and re-perceived. The once separate spaces of audience and performers are mixed. The hairbrush is usually thought of as

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30 Surrealist artists in the 1920s began with a reality deeply in question and employed an aesthetic that makes use of fragments, parts out of their place, strange juxtapositions, bricolage. Machines, made as orchestrated fragments of human body parts and movements and natural power taken from people, had made people's own parts and functions alien to themselves, outside of themselves. Surrealists, and everybody, could find displaced parts/selves/bits in the machinery. The Surrealists worked with social, political, and personal concerns in ways that helped others question the existing power structures' authority and re-open a process of re-making their conceptions of themselves in the world and charged political/social sphere.

31 Also influential in the history of German dance theater from whence Pina Bausch emerged is Bertolt Brecht. His theater theories and practices involving personal-as-tied-to-social politics, and audience implication, are influential worldwide still, particularly at times of political change and upheaval. He invented a theory of theater called "epic theater," "wherein a play should not cause the spectator to emotionally identify with the action before him or her, but should instead provoke rational self-reflection and a critical view of the actions on the stage." Brecht's concept of "Gestus" emphasized a disorienting performance of complex body actions and words as "socially significant gest, not illustrative or expressive." With these actions and their effects, Brecht's epic theater provoked the spectators' recognition of daily situations and facilitated their actions and decision-making toward change. Pina Bausch is less directly associated with social revolution, but she too is nevertheless opening up and changing our social body maps and roles. She, too, accomplishes this through gestures and sounds taken from daily life and revealed to be potent - through many repetitions of single gestures in performance they are moved into another dimension, re-experienced, and reconstructed.

32 According to Lacan, an ego, a sense of self and body image, is formed by the successive internalizations of images found in the world.

a neutral grooming device. The broom a simple cleaning tool. However, combined in this unusual hybrid use by these female dancers, both apparatuses are radically changed. Later they part their new hair with their high-heeled shoes, which were simply shoes a second ago. Bausch explores and exposes everyday interactions aesthetically, psychologically, and socially through their fragmentation, reinterpretation, and repetition. Nothing is irrational or impossible.

For part of a scene in Auf dem Gebirge hat man ein Geschrei gehort (On a Mountain a Cry Was Heard) 1984, two male dancers dressed elegantly in black suits and white shirts stand near to each other, shoulders almost touching. One of the men begins making loose round movements with his hands and arms, propelling himself forward, faster, and then, as if he is reaching out for someone, his arms are before him searching. The other dancer puts a chair in front of him. The first dancer finds the chair, places his hand gently on it, looks to the audience, pauses, then continues running, circularly moving, searching, until the other dancer puts this time a table, later a piano, a blanket, a handkerchief, in front of him. The running searching dancer seems to be looking for another being to connect with. He does not find the other dancer, but rather the domestic objects provided by him. When he finds a chair, a piano, a blanket, and so on, he takes pause, considers the new acquaintance, then continues searching. Whether part of a conscious plan or as a side effect of functional design, the characteristics of every domestic object facilitates people's identifications and relationships with it. For the searching man, each finding of the object is intermittent with the running and then touching and looking at the audience for recognition of the strange exercise he is finding himself in. He is searching for the other, an object of desire that would complete him, and this is an impossible task. The objects, the others he finds can never completely satisfy/fill him, can never make him no longer searching for completion.

We, as subjects with egos, create different stages of objects; objects themselves seem to mature as what we reflect onto them matures. I may find expressive energy through the sounds of a blender, for example, and although this domestic technology will never be entirely it, fulfilling my every desire/search, it will certainly play a non-neutral role in my development of voice, engagement, and sense of self in relation to the world.

Bausch's dancers explore, in practice and on stage, the symbolic nature of their body maps -- how they picked up gestures and relationships to everyday objects in their lives, through repetition. Repetition at first disrupts the dancers movement in a narrative, but then, through continued repetition of the fragment over and over and over, a new continuity is revealed, another dimension which is that of the negotiation of that gesture or object relationship. By repeating fragments of movement and speech again and again, both for the performer and for the audience, preconceptions of the gestural relationship in the world are at first confirmed (we think we know what it means, we laugh in easy recognition), then negated (we suddenly are without a grasp on what it means), and taken apart completely (we are lost, we too must find the meaning,

we too sense the process of constructing meaning as transitory signification). Repetition erases preconceptions of "correct" forms or ideas, thereby subverting the use of repetition to discipline into repetition to open up. Bausch's dancers perform the self-consciousness of subjectivity with a body as both thingified into objective entirety and as in constant negotiation having the experience of desire and search for connection rather than cohesion. Self and relationships are in constant transformation.(Wright p.119; Fernandes p.10).

From the 1960s to the1980s, Brazilian artist Lygia Clark facilitated performances/ sculptures/situations connecting people and quotidian objects in intricate webs making tangible the hidden connections and contingencies existing intrinsically, biologically, psychologically and socio-politically. Through the personal technologies of eyegoggles, suits, gloves, masks, and found material web constructions, Lygia Clark deconstructs the everyday ways in which we are all individualized. The enduring crisis that Clark's work continually addresses is what she calls the "empty-full," the experience of the cartography of life as differentiated -- although we are all connected, we are addressed/perceived as separated. The objects and clothing in her situations, that allow the discovery of connections rather than implying boundaries, become means for sensations to transfer between people. The participants discover themselves as socially and psychologically produced by the structure of the connecting assemblage and the collective disposition of the network. Some collaborative projects with students included physically assembling and moving within connective webbing that allowed the movements of all in the network to be felt in some way by all the others at all times. Focusing on inter-subjective body politics, she realized her later works in forms that are echoed in the designs of connecting clothing and inter-personal architectures and technologies today.[33] Because conceptions of subjectivity and of connectivity to others in our social and global networks are integral to our sense of responsibility and agency in the world, the domestic devices and associated perceptions in the work of Lygia Clark have far reaching effects.[34]

Two participants stand facing each other but do not see eye to eye in the usual way. Instead they see reflections of themselves and each other and their surrounding space in the connected double-sided mirrors of the goggles they are wearing. The participants must together physically negotiate the rotation and position of the two sets of double-sided round mirrors that attach, and are attached to, their goggles. By rotating the mirrors on their axes and approaching and distancing from each other, the participants fragment their visual perception of themselves, each other, and the surrounding space in order to establish a dialogue. Diálogo: Óculos (Dialogue: Eyeglasses) 1968, are among Clark's relational objects as haptic interfaces for communication. They are similar in some ways to other domestic devices of communi-

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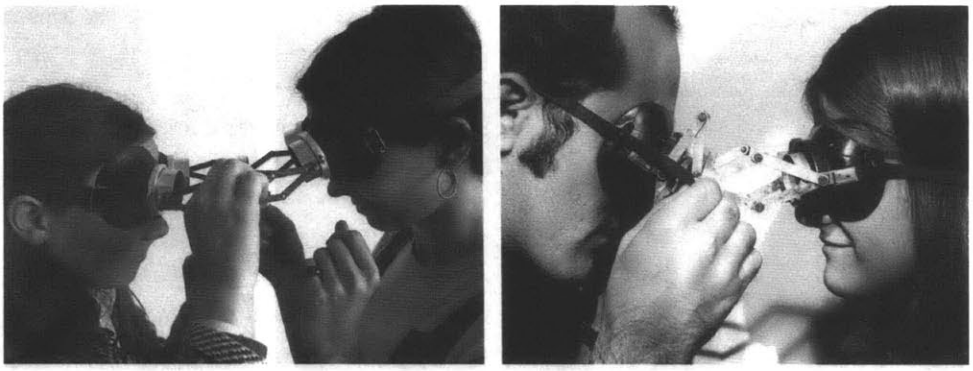
33 See the work of Lucy Orta, and Krzysztof Wodiczko's wearable apparatuses.

34 See, among others, Ulrich Beck's notion of "reflexive modernity," in his book Risk Society: Towards a New Modernity (1992).



Lygia Clark, Diálogo: Óculos (Dialogue: Eyeglasses) 1968 (Clark 1994).

cation in their choreographing of inter-subjective negotiation. With telephones, for example, the mouths and ears between two people are connected, and their dialogue is performed partially through their successful negotiation of vocalization and position in relation to the apparatuses. More dramatic than this is the very implication of the other by the caller – via the telephone ringing in demand of a welcoming "hello," the caller "implies" the receiver of the call.(Ronell 1991) Any technological apparatus used between people for communication aids and participates with one user calling forth or implying the other user. Likewise, any apparatus used by a single user itself implies that user. The positioning and design of these personal apparatuses play a designating role in a person's acquisition of a sense of self and role in larger social realms; what type of user that these devices imply, and rather that they imply a "type" of user at all, reveals personal devices as not neutral.

Máscaras Sensoriais (Sensual Masks) 1967, sharpen perception by affecting sensory experience. Each mask in the series of masks is of similar construction, but for each mask different attachments and inserts at the eyes, nose, and ears provoke different sensory stimuli for the wearer. The masks have two orifices at eye level with goggle constructions sewn in attaching different sight altering apparatuses. Various herbs and seeds characteristic of each mask are deposited in the elongated nose-pieces. At the level of the ears, materials are sewn inside the mask to produce sounds and integrate to the sensorialities of the rest of the mask. A participant wears a mask and experiences sensations that go from integration with everything around her to an interiorization and isolation. Groups of participants wear the masks and go out in public, walking in the streets, mixing in with crowds. Isolated but closely connected with the other people, these participants make visible/recognizable/perceptible this everyday experience, performatively interrogating the very notion of independent isolation while trying to obtain it.

Clark's interest in group-dynamic processes led her to building bigger networks of people and objects as well. In contestation of the individual partitioning of everyday life echoed in clothing, she designed and built pieces of clothing to be made and worn by groups of people. Social contingency is physically performed as the participants move through the city in their connecting garment. Visually the work's appearance is of people within a flexible structure that is itself made and animated by the

Lygia Clark, Máscaras Sensoriais (Sensual Masks) 1967 (Clark 1994).

gestures and movements of the participants. For the participants themselves, over time it is a becoming one body, the extended body, the social body connected in every movement and sensation.

Thingification[35] is a means towards representation and social discipline. Through thingification and repetition we find (or we are given) our bearings as subjects in the world. Our incessant act of perceiving the same things, of repeating our perceptions of objects, people, ideas, and places, is how we construct our worlds as knowable and navigable. Through this very same socializing practice, Foucault argues, we become subjected to power structures and control.(Foucault 1975) Whether this control is state, social, or personal, it often goes unnoticed and unquestioned while it guides and implies us into becoming a subject of its power. Repetition produces "docile bodies," as in military prisoners, industrial workers, and ballet dancers for example, but can also, through repeating expressions by these same bodies, be used to deconstruct and dismantle functioning power structures. For example, the repetition of gestures by Pina Bausch's dancers break time and open up another dimension of experience,

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35 See Georg Lukács who explains well that rationalism, when it is the dominant method of knowing, works to thingify and reify the whole of experience into systems of presumably knowable entities. To thingify and reify is the action of thinking something abstract into a tangible state, an exchangeable, communicable, signifiable thing that we can then pass around as if we know what we are doing.

the movement out of time, repeated again and again until made unfamiliar, reveals the elusive meanings projected into the movement as learned and able to be reconceived.

Performance art emerges as a process of destabilizing and de-thingifying by subverting assumed understandings of things and engaging experience in processes of searching and desiring. Repetition is practiced in these works not to train subjects, but to uncover breaks, potentialities, and take apart socially and politically imposed structuring of subjectivity and agency in the world. Because every thing and every culture is inescapably ambivalent in its formation, every thing and every culture is always potentially de-thingifiable and infinitely re-thingifiable.

It is not without significance that animals, plants, clothing, movement, domestic spaces and personal technologies were included in the counterculture revolution machine that rocked the world in the 1960s, and continues to shake it up today. Not only do people seek and find meaningful and formative connections to other people, but to all things, domestic technologies included.

We cannot not thingify – it is how we communicate, perceive, even desire. However, as Andrew Feenberg proves through historical analysis, and Martha Rosler, Joan Jonas, Pina Bausch, and Lygia Clark prove through performance, we can practice being more aware and more responsibly reflexive in our making of our machines and thus our selves. I am guided in my own work, presented in the upcoming chapters, by ideas encountered through experiencing work of these artists and theorists.

Chapter 3

THE PARAPRAXIS OF MACHINE DESIGN

The making of machines affords dramatic new perspectives on how we constantly make ourselves and our worlds .

We build ourselves alongside, and relative to, the invention of machines. The cross contingencies are literal, physical, psychological, social, and political. From the machines of modern industry that distilled and extended what an arm could be and what to work could mean, to companion robots that call us to ponder what caring may become, we map what we are, and how we are to behave towards others, via our conceptual and material machine designs and interactions. Our machines have vital and critical roles in our becoming human.

As the last chapter showed, the unintended side-effects of machines have had profound influences on identity. In our day to day experiences we are, for the most part, unaware of the incredible significance that the side elements of our machines hold for us. Machine Therapy proposes a contemporary practice in response to the mass modeling of machine interpretation. Machine Therapy destabilizes what we have all learned to take for granted. It disrupts normative practices in ways that are productive, illustrating the importance and possibility of different approaches. In this chapter I sketch out the main ideas and theories of Machine Therapy. In the next chapter, which can be read in parallel with this one, I describe some of the machine building that has been part of the development of these ideas. Finally, in chapters 5, 6, and 7, I present a project combining what I have learned in this work to date.

PARAPRAXIS

What Is The Parapraxis of Machine Design

I borrow the term *parapraxis* from psychoanalytic theory, where it is used to denote unconscious desires and repressed motivations often revealed through slips of the tongue or other unintended elements of conscious action.[1] In the current work, I make use of this term to talk about the unarticulated motivations and unconscious desires and identifications active in machine design and use. Though frequently overlooked, aspects such as sound, movement, and heat among others are foundational to our experiences with machines. Both the basic elements and patterned interactions of these and other elements over time are sites of found meaning for people. People become mesmerized by some machines, made anxious by others, form crushes on a few, respect the authority of some and release responsibility to many without ever necessarily making a conscious decision to do so. People learn about themselves through interactions with machines. Though we have been in the habit of approaching machines as functional things that do assigned tasks that we are aware of and are ultimately in control of, machines are more complicated than that. There is much about them we do not yet comprehend.

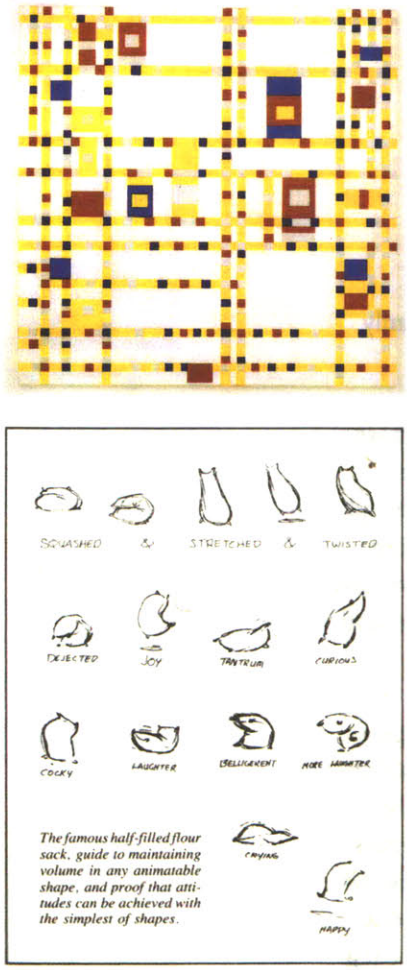

Fig. 4.1 Examples of abstract shapes that elicit interpretations of human qualities of liveliness and emotion. Top: Piet Mondrian's painting *Broadway Boogie Woogie*. Bottom: "half-filled flour sack performing emotions (Thomas and Johnston p.49)..

Our ability to relate with and incorporate reflections from others we encounter in the world is so flexible, so effortless, and so adaptive that we engage with things that are not seemingly very much like other humans at all in order to constantly learn about ourselves. We reflect intention, meaning and emotion even from abstract shapes.

We reflect intention, meaning and emotion from the most standard and utterly non-human machines. I have been investigating this phenomenal adaptive space in relation to the psychoanalytic and social theories covered in the previous chapter. What I have found has moved me to introduce new hypotheses and a set of terms under the rubric of Machine Therapy. As a response to Lacan's Symbolic that structures perceptions and conceptions, I posit that people often engage in vital reflection through non-symbolic communications. A purr, warmth, and electric shocks, for example, are experienced directly and with consequence in the body without conscious or symbolic resonance. What is going on in this, before and without symbolic significance, is part of our world-making. These visceral experiences can be translated into symbolic registers of language and meaning, but these translations are not predetermined by the sensation. The translations are found and made.[2] They can be personally, socially, and politically mapped and remapped. It is

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1 *parapraxis* etymology: *para-* (beside, alongside) and *praxis* (act, action) A minor error, such as a slip of the tongue, thought to reveal a repressed motive. From The American Heritage Dictionary:

2 See Elaine Scarry on the political power translation of visceral effects of torture in *The Body In Pain*..

difficult to sustain a state of experience without becoming conscious of it and thereby translating it, or accepting prescribed translations. We thingify and reify at the moment we become consciously reflective. The vital unconscious experiences do last for at least moments, while some are not ever translated into consciousness. These experiences are of critical and vital significance. We significantly and vitally rearrange ourselves and our worlds in the unconscious areas of experience intertwined with the machines of our everyday lives.

These experiences may contribute to later translations and effects that are personally, socially, and politically significant.

In the projects of this dissertation I am exploring this making of ourselves in relation to our machines. Five projects are outlined in the next chapter. These can be looked at back and forth with this chapter. My work in making these projects and in thinking about our relationships with and through machines has been a combined process.

The first hypothesis of Machine Therapy came at the start of my sounding with machines as described in the Introduction of this dissertation and presented further in the first section of chapter 4.

First Hypothesis:
The visceral side-elements of machines invite vital interrelations that are often of unmapped significance.

Fig. 4.2 Images of recent projects that have been part of the development of ideas in this dissertation: *ScreamBody*, *Machine Therapy Sessions*, *Blendie* and *Boom*. See more and read more about these and otehr projects in Chapter 4: Previous Work.

Unintentional Affordances of Machines

As revealed in the Background chapter, things are never absolutely apart. Technological objects and machines are always made from collected elements and influences, with past lives, and mixed up and continually reinterpreted. They are influenced by everything from capitalist relations of production to newborn individual desiring. It is important to pay attention to how people influence machine design and how people are influenced by machines so that we can be aware of what we are making when we make our machines. We are making ourselves-- we are remaking what it is to be human. This is not something to take lightly, to think about afterwards, or to think about without also experimenting and remaking..

By overlooking or denying the human relations embodied in the machines we produce, we not only disengage our responsibility in relation to them, but we also reproduce personal and political ideologies in guises of innocent uninvolved things.

Some aspects of machines' influences on people are known and socially acknowledged. For example, individuals' relationships with their cars are known to be viscerally active (revving engines to show power/aggression), visually celebratory ("tricking out" cars), and personally meaningful and culturally performative throughout popular narratives (*Grease, Crash, Herbie, Christine*).

Another example is that while people enable machines to recognize patterns that people feel are meaningful, such as gesture and voice recognition through digital signal processing, machines also help people form new perspectives. Machines can make material and workable the terms through which people understand fractal, swarm, and networking patterns in biological and social phenomena. Machines and natural systems and humans appear to manifest these patterns and the terms and conceptions are shared.[3]

A different example of machines influencing people is one I have learned within my own family. My father and two grandfathers and maternal grandmother were machinists and mechanics for a large part of their lives. My childhood unfolded in an environment in which machines and machine parts were active agents, and in which language was intermixed with human voiced mimetic machine sounds that had been picked up and translated into everyday (or, for the more extreme ones, occasional) meaningful expressions. There are vocal expressions in my family that are affective and communicative but that are not verbal. My research in the past few years has supported my hypothesis that different sounds of machines are interpreted and reproduced by people in largely understandable ways.[4]

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3 See Kevin Kelly's *Out Of Control* and Albert-Laszlo Barabasi's *Linked;* also see online social networking sites such as MySpace and FaceBook..

4 Also see birds as agents in human movement and sound in Steven Feld's *Sound and Sentiment: Birds, Weeping, Poetics, and Song in Kaluli Expression.*

In addition to these examples, there are many situations in which we take on characteristics of machines without awareness that this is happening. We socially, interpersonally, individually, and politically reflect and practice machine-like gestures, behaviors, languages, expressions, priorities, expectancies, and requirements.

In the Background chapter I began to foreground the parapraxis of machine design through past examples of the unintentional relational and conceptual renderings of personal products (blenders, PDAs), factory machines (Modern Industry examples), and public machines (trains, telephone networks, steamboats, construction machines, power plants). I introduced some concepts from psychology, social theory, and cultural production that help tie into and unravel some of these effects. In my contemporary machine making work, I am highlighting possible vital influence that people are contemporaneously involved in through the parapraxis of machine design and use.

The Blender

The Osterizer beehive blender of the mid-1940s has a body that is curvaceous and inviting to the touch, with ridges spaced for fingers to follow and one small toggle to set it into ecstatic action. One wants to turn it on, to hold it, to put things into it and drink from its smooth lipped spout. Some designers designed this blender to be soft and clean and chubby yet strong and with a funny little "belly button" to toggle by following their own intuition and experience. Blenders after the 1940s offered multiple levels of command control via specific settings chosen with knobs and buttons and executed by the machine seamlessly. This control structure reflected desires in other areas of the culture at this time and also reflected back to the user of the machine something about her/himself in the world.

Yet each of these smooth, controllable blenders also has a violent nature.[5] The blender pulverizes anything inside it. Its motor growls to whip its blades producing a contained tornado storm of matter while moving shattering sounds throughout the living space that it is in and throughout the other bodies nearby. Babies immediately scream and cry when they hear it. Cats jump, startled, and dart under the bed to hide. The person using the blender usually pays little conscious attention to the sound because they are busy perceiving the blender as just a machine mixing up a nice drink or pudding.
The physical violence, the implicit energy and indeed danger of the blender, so

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5 A person interacting with the machine simply has to press a button or turn a knob to set the violence into action. This is not unlike war technologies being developed around this time and influencing the design of domestic appliances and thereby reinforcing models of distanced control and dissimulated agency through everyday machines.

elegantly dissimulated by its physical design, escapes as a scream.[6] This scream is a parapractic element. I intentionally foreground it in Blendie, a vintage beehive blender altered to require a person interacting with it to make with their own voice the sound the blender makes. Blendie will respond to a person's voice only if the voice actively presents the rough growling or screaming sound of a blender's motor in action. Blendie will then empathize with the person by adjusting its own motor speed to match the dominant pitch and power of the person's voice.

In Blendie, a seemingly benign tool for joyful food preparation is revealed to contain side elements of uncanny visceral relevance. From the curvaceous inviting body of the base, to the buttons that read, "pulverize," "whip," "liquefy" and so on, to the tempestuous action visually located within the jar but acoustically inscribing passionate chaos throughout the living bodies nearby, fields of inscriptions and interpretations are available. Yet we have learned through advertising and social experience to consciously experience a blender as just a friendly counter top machine for making drinks and sauces. Blendie is an entryway into a wider arena of machines with elements that are present yet hidden.

One broad aspect that Blendie brings up is how easily interfaces can facilitate a disjunction of people and their action. As people can now tele-robotically control remote garden hoses, pet feeders, and missiles, it is imperative that we seek to understand what conceptual and psychological affects temporal and spatial dislocation may facilitate. We know that the distillation of situated interaction into signals and symbolic actions aids in the distancing and disengagement of the person initiating actions from the effects of those actions as evidenced by the incessant coinage of military euphemisms for killing, such as collateral, termination, or to "take out." Elaine Scary describes this at length in *The Body In Pain.*(Scarry 1985) This relationship was proven experimentally by Stanley Milgram in his classic experiments on obedience and authority conducted in 1961-62 at Yale University.(Milgram 1963) The use of buttons that launch bombs that destroy vast areas and countless lives is learned in military training. A visceral awareness of the action enacted could inform a human being's conception of such machines in a different, fundamental manner. By finding and critically investigating possible psychological, physical, social, and other affects of these factors, we will inevitably find out things about ourselves in our machine relations and discover ways in which we are shaping the world through means we

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6 Jean Baudrillard writes in his 1981 essay *Simulacra and Simulations*: "To dissimulate is to feign not to have what one has. To simulate is to feign to have what one hasn't. One implies a presence, the other an absence." p.167 He uses the term dissimulation to describe how images and outward signs of things mask some of what is present, what is *the real* that they are referencing at the same time as they are hiding it. This relates to our perception of machines. With a blender, for example, the outward physical and visual pleasures and smooth interaction tropes of the blender dissimulate the violence and the scream of its action and affect. The designed signifiers imply an ideology of command control communication while masking other aspects of what is manifested -- such as the scream.

have not yet considered. As machine designers and users, as we learn to be critically reflective about aspects of actions via machine design and use, we may find ourselves in positions of greater influence than we knew, wider moral agency, and with responsibilities reaching farther than we have been accustomed to consider them.

Second Hypothesis:
Machines play active roles in many areas of personal, political and material world-making in ways beyond what machine designers and users are usually conscious of.

Designers' and Engineers' Consciousness

Design methodologies are beginning to include considerations of what were once sidelined elements of manufacturing and product making, including long term environmental factors[7]. Some of the visceral side elements that in the past escaped the consideration of machine designers have since been consciously debated, utilized, refined, and celebrated. For example, the sound of different engines in cars and motorcycles, first mostly incidental outcomes of the mechanics of the systems, are now fully integrated considerations in the making of many motorized vehicles.[8]

I am asking for a next step in reflective practice. What is going between human bodies and machines with such sounds to position the sound experience as pleasing and patent-worthy? And what are some effects in human psycho-social development that some of our machines may be modeling/representing/trying on for us?
It is not easy to predict most side-effects of things. It would have been very difficult to predict the response to the danger of the steamboats illustrated in Feenberg's example covered in the Background chapter. Likewise, it would have also been very difficult to know what would happen when telephone operators' bodies were inserted physically into the new signal switching processes of the telephone network switchboards.[9] Based on the observation that unpredicted things have occurred in the past, we can expect that unpredictable *somethings* are happening presently and will happen, and we can develop some methodologies for finding out what those somethings may be and how to reveal and consider them. While there will always be much more to find out, in this thesis I hope to make some offerings and to hint at directions for future research. If certain elements have been found to occasion interactions on subconscious

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7 See, for example, the trend in electronics companies to move towards environmentally friendlier production and consideration of the full life-cycle (biodegradable parts over toxic garbage) of products at < http://www.greenpeace.org/international/campaigns/toxics/electronics/how-the-companies-line-up > (August 19, 2007).

8 Ferrari, Harley-Davidson, and other car companies have patented the sound and infrasound that their motors produce. The patenting of sound design of cars also extends to the shutting of the door sounds..

9 Friedrich Kittler describes in *Discourse Networks: 1800/1900* the neuroses developed in the bodies of telephone operators in the early work situations as they were inserted into the fast switching positions as the switches themselves... the sensory effects lasted past their work periods.

levels in the past, for example sound elements that were incidental to the purposeful design of a machine, then we may want to look for effects of these elements in relations with other machines that make sound. And, as drastic social and psychological remappings have occurred in the past contingent with new machine developments, it behooves us to pay attention to what we may be inadvertently presenting to ourselves in current machine designs and use scenarios.

Parapractical Elements Addressed in This Dissertation

It is beyond the scope of this dissertation to approach an exhaustive list and analysis of the parapraxis of machine design and use. The goal of this dissertation work is to convincingly illustrate the reality of the vital relevance of our interactions via the side-elements of machines. I will demonstrate some of the meaningful relevance of these factors of our relationship with machines. Many side-elements of machines have reappeared through iterations and manifest vital effects, yet they have been out of our conscious consideration for a long time. We will work with small subsets of these side-elements as examples. There will always be more side-effects and side-elements that we have not yet made tractable, so the work of Machine Therapy in finding and revealing aspects of the parapraxis of machine design and use is continuous.

The small subset of parapractical elements that are revealed in the projects of this dissertation includes ones of visceral and human body-based interaction significance. Our always-active but rarely-conscious negotiations through the visceral elements of sound, infrasound(vibration), heat, movement, and electromagnetic radiation are highlighted.

BODY-BASED INTERACTION AND MEANING

By focusing on the viscerally and sometimes autonomically engaging side elements of machines as an interesting subset of active and influential parapraxis, we also underscore the importance of body-based interaction and meaning. Human-computer interaction, artificial intelligence, and human-computer cooperation models have focused on designing and building machines that can access and interpret and find meaning in our human actions. However, as we work to build machines that understand enough about us to be able to discover, reveal, synthesize, and improvise with us, we must strive to also understand as much about them, and ourselves in relation with them.[10] This includes researching what meanings and feelings we perceive and access subconsciously in their properties and behaviors.

We must notice the importance of the often non-cognitive aspects of the machines and systems we make. These visceral aspects may at first appear as incidental side-

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10 In this there is resonance with the work of Donna Haraway(see Haraway 1991 and 1997) and Julia Kristeva (see Kristeva 1991).

elements of functional design, but in many cases they will reveal themselves to be physically, psychologically, and socially significant. Certain ones lend themselves to human body extension and identification, and they may even be utilized to produce dissolution of presumed boundaries.

Visceral Side Elements

With cars, it is not uncommon to hear angry drivers revving their engines as an expression and release, even when at a red light and not at all moving. Car engines, though they resemble growling, could not have been a form of emotional expression if they weren't a constant, instrumental part of our lives. Machine sounds become part of our expressive palette, as when La Monte Young refers to the hum of the power lines outside his childhood home in Idaho growing up as the most influential sounds he has in his head. The hum became part of the music he invents, the way he expresses himself.[11] Even when not consciously accessed, sounds, vibrations, movements, electromagnetic radiation, and tactile forms among other side elements of machines, are never neutral but rather are always active in human-machine relations as reflective and negotiative elements.

These elements are utilized by people in exchanges of influences with machines, often without conscious awareness. For example, laptops are warm as a side-element of their design and this warmth is something that helps people become endeared to their laptops. Some low frequency sound and infrasound of machines have been found to cause anxiety and lack of focus.[12] Others are calming and relaxing as evidenced, for example, in the use of car rides to help infants fall asleep.

Autonomic Communication

Much of the communication that happens at the visceral level is subconscious and involves the autonomic part of our nervous systems. The autonomic nervous system is made up of the sensory and motor neurons that innervate the viscera and aid in regulation and homeostasis in the human body. It helps control cardiovascular, digestive, and respiratory functions among others. Many of the activities of the autonomic nervous system are involuntary and happen without our conscious awareness. Some activities, breathing for example, can be in part consciously controlled. Breathing does more than oxygenate the blood. It also allows most people to smell, to blow, to talk, to sing, to make sounds. Its rate and patterns are both reflective and formative of

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11 "The Second Dream of the High-Tension Line Stepdown Transformer" from *The Four Dreams of China* by La Monte Young, reviewed by Douglas Leedy. *American Music*, Vol. 11, No. 1 (Spring 1993), p.126-129. La Monte Young is one of the first and most celebrated minimalist composers. His works are among the most important and influential post-WWII experimental avant garde music.

12 See Leventhall (2003) and Gavreau (1968).

our physical and psychological/emotional states.[13] Other elements of the autonomic system are linked to conscious parts of the nervous system, as in the example of breathing. No strict delineation is possible between conscious and autonomic subconscious. The crossovers are where many of the projects in the next chapter of previous work focus, as they highlight the visceral significance of machine interaction.

People react and interact with other people through autonomic signals and body communication without full conscious awareness. When close together, people may match each other's breathing without thinking about it. Hearts in close proximity often entrain in rate. Heart entrainment is explained by the electric impulse that excites heart muscle cells to relax and contract. Even cells removed from hearts and placed a few inches from each other in a Petri dish entrain.[14] Researchers have found that the periodicity of the lower-amplitude higher-frequency signal carried on human heart's interbeat electric signal, that is the small signal carried on the larger pulse of the heartbeat, is itself a descriptor of stress versus states of calm meditation. And they have found that this smaller signal is potentially transferable from one person proximate to another person.(McCraty 2002)

If subconscious communication through small sounds, movements, and electric signals are transferable in body-based meaningful ways between people, and if our bodies are naturally adept at finding and synchronizing with other bodies, it is not a far jump to hypothesize that machines – themselves bodies of sorts often with sound, movement, and electric signals – will affect the bodies of the people in close proximity with them. The pacemaker, described in the background chapter, is an early practical use of the realization that machines and people can interact in visceral subconscious ways.

Machine Therapy is different. It is grounded on the realization that human-machine integration has always been the means through which we have found and made machines – and has been critical to how we understand ourselves. Influence between people and machines is autonomic, physical, conceptual, social, and political. The mappings are often subconscious but are always vitally present and active. I would like to add to La Monte Young's story by pointing out that the 60 Hertz of his Idaho high tension wires were in his body before he was born as well as after. It is the signal that has literally been inscribed physically and electrically and acoustically in his existence since conception. When he was born it was one of the few signals still holding

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13 See, for example, "Unsteadiness of breathing in patients with hyperventilation syndrome and anxiety disorders" by Han, Stegan, Simkins, Cauberghs, Schepeers, Van den Bergh, Clement, and Van dee Woestijne; in *European Respiratory Journal*, 1997; 10: p.157-176.

14 See, for example, "The development of beat-rate synchronization of rat myocyte pairs in cell culture" by Jongsma, Masson-Pevet, and Tsjernina in Basic Research in *Cardiology*, 1987; Vol.82 No.5: p.454-464. And see, "Changes in the fluctuation of interbeat intervals in spontaneously beating cultured cardiac myocytes: experimental and modeling studies" by Yamauchi, Harada, and Kawahara, in *Biological Cybernetics*, 2002; 86: p.147-154.

him and held by him, as his mother's body signals were then intermittent at times of closeness. Splices are not needed for the human body to be tied to the machine. Bodies and machines are already viscerally connected in many ways, including electromagnetic ties, temperature, vibration, sound, movement, and action. Our boundaries are not as simple as that of the boundaries of our image in a mirror. Machine boundaries are not as clear as their specular images either. We are within each other at every pass.

MACHINE/SELF UNCLEAR BOUNDARIES

Metaphors and inscriptions of meaning and concepts of self and agency also are at play in human-machine relations. Through the discussion in this dissertation, it should be clear that boundaries are not stable or clear cut but rather are performative and in constant negotiation. Territorial borders between groups, medical definitions of organs and death and kinship, electro-magnetic extension of physical bodies, personal sense of identity, moment to moment perception of one's own bodily functions – across scales, nothing is stable or set or autonomous acting alone. Borders between people and machines are 1) unstable – for example, what is a machine in one perspective is a person's fully integrated vital body organ at another; and 2) constituted such that there are such cross influences and contingencies that to say things are separable is to miss the details as well as the widest view.

Machines as Self Extensions and Reflections

Machines as extensions are much more than expressive aids. They are used by people to build themselves in the world. Some examples make it easy to perceive the fluidity with which machines and other objects move between being separate from a person and part of a person – examples we've addressed include a blind person's walking stick, artificial hearts, and prosthetics.

This fluidity of state seems to happen with machines that are not physically worn or attached to the body. An example is the personal digital assistant (PDA) taken on as an "auxiliary brain" in which memory and intention are in the machine[15] . Laptops with which people experience a work flow in which they do not think about the material separation of the machine illustrate the idea as well. In these cases, the slippage between part-of-the-person and separate-from-the-person is evident when a person is having a flowing thought in words and is able to fluidly subconsciously type that thought flow into a laptop without thinking about the machine, its keys, or the interface – but rather just thinking about their thoughts becoming manifest in

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15 In Sherry Turkle's colloquium series in 2004, a major network news producer described her dependence on her PDA this way. She would not remember where or when to pick up her children without it. Once it became lost. This caused feelings of incapacitation and depression, she reported.

this experience of their extended self.[16] We could call this thought space allowing flow and reworking of textual thoughts a slippage of boundary between the person and the machine. The slipping of boundaries may also happen in the realms of feeling, proprioception, body sensation and body space. These visceral modalities of slippage of boundaries may actually heighten the ability of a person to blur their perception of the machine as separate from the self versus part of the self. The laptop and PDA have heat and light and sound and electricity and these elements among others may mean that they communicate with their users' autonomic nervous systems. One can imagine machines for intentional use such as these incorporating well-designed, autonomically-active elements to aid in the ability of people to more readily find them as body extensions or mind extensions.

Machine Therapy works in the space of all machines as neither stably separate from nor completely dissolved into being part of a person's sense of self. The project ScreamBody, discussed in the Previous Work chapter, is an example of working in this space.

ScreamBody is worn on the body and serves as an auxiliary lung to hold a person's breath-into-voice when they want to let it out but do not feel able to so without the safe space. One of my goals in making that machine was to facilitate a safe space for people to vocalize, to scream if needs be, and to learn to feel ok about doing so. It follows the theory of the transitional object in that through use it can help train the person to feel more comfortable expressing and eventually it may be put aside as separate and rarely needed. But it does not follow the transitional object's stages of development. It does not begin as experienced as part of the self by the person and eventually, through the person's testing and development, end up a usable but separate thing. It starts out perceived as separate, an object presented to or found by a person, and it moves back and forth along levels of being part of the person or separate without a developmental direction or end goal. What makes it useful for an adult in situations where they sometimes desire a bit of an auxiliary lung and body armor is that it can move in both directions.

Also in the example of Boom, the performances of sounding with the construction machines at the Big Dig, I explored how we learn from machines not just by analogy and mimesis, but by actually experiencing attachment and merging and becoming physically linked, inseparable for brief moments, and then letting go but remembering.

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16 See Porter (2007) on writing itself as a reflective self making: *"What if writing offers the writer something profoundly different, even far more essential, than self-expression? There's a catch to the idea of writing as a vehicle for self-expression: it assumes that the writer's self is solid and distinct enough to be expressed. This is clearly an issue for child writers, caught up as they are in the roil of their own development, but I believe it applies just as much to adults. To be a writer means, perhaps, exactly this: surrendering the defined, expressible self to the wider possibilities of the page. It means giving up the belief that you know who you are, in exchange for a chance at discovering who you are, again and again; after all, the self that jumps up at you from your writing might exceed anything you had previously imagined."* The medium and means of the writing would be part of this experience.

In Machine Therapy Sessions I helped facilitate a relationship between a person and a machine in similar ways in the private set-up of the soundproof studio.

Transobject

To Winnicott, transitional objects and transitional phenomena occur in an area of experience that must not be challenged. As mentioned previously, one must not ask the child, "Is this object part of you or is it separate from you?"(Winnicott 1971) To do so would be to violate the experience of the transitional object and interrupt the very vital negotiation of stages the child is taking with it.

We have discussed how sometimes a machine is be perceived as part of the self and under the omnipotent control of the person with it, as with a body extension. Sometimes the machine is perceived as being on some other level, towards separate and autonomous, but still in communication with the person. The experience of machines as sometimes separate, sometimes part of the person may afford a relational experience for the person that can help the person develop their sense of self and ego in an immediate, playful way. This would be an all-ages version of a transitional object.[17] I am interested in this, but I am more interested in an alternative interpretation and use of this relational space. I am interested in looking at the ambivalence of the relationship of a person with a machine in terms of oneness versus separation, and at what this ambivalence may afford and facilitate beyond building one's ego.

I would like to propose a small alteration and define two new terms to help us talk about the space of going the other direction and back again in a dance. This dance does not promote ego development as the ultimate goal, but rather balances ego development with inclusion in the self of the ties one always has to others. Proposing these new terms, and thereby these new "word machines" to think with, is a social and political move.[18]

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17 When Winnicott describes the four stages of transitional phenomena, the first is the experiencing of everything as part of the self. The fourth and final stage is being able to experience every thing that is not within one's physical body limits as separate things in themselves, not part of the self but able to be related to as an other. The ego learns and strengthens itself and its ability to relate to others as others. It has learned to externalize the others.

18 I have a story that is a bit of an aside but it is relevant so I will tell it. I once was riding the Green Line T in Boston and was at the Government Center stop. I was leaning back in my seat totally exhausted from too much working and not enough resting and I was half aware watching people get on and off the subway car I was on. Then I had the awareness that they were all part of me, that we were all somehow the same thing. And I began to feel complete appreciation and care for every single person coming on and getting off and sitting and standing and moving on the train. People I would have at other times been annoyed by, or even disgusted by, were at this moment all completely welcome and cared for and part of one big organism whose boundary I did not consider. Then I realized what I was experiencing and thought that it was quite important and tried to sustain it as long as possible. What are the ethical implications of asking anyone at any age if someone or something is part of the person's self or not part of the person's self? What may be the ethical and political and social influences if we take the psychoanalytic mappings of the theories covered in this chapter together, that is, if we recognize that we are all in a sense always part of each other and vice versa?

If we privilege the ability to transgress borders and feel connection and responsibility in our terms and in our approach to understanding human nature and human experience, perhaps we are making a little step towards a way of being together on the planet that is a worthwhile step to take. I propose *endo-exo dance* to talk about the movement back and forth between experiencing things and others as part of the self and then non-self and then back again. I also propose the mirrored term *transobject* to talk about things that make this dance possible, through which (hence the *trans-*) this experience can happen. It is sometimes an object at one side of the dance, and at the other it is dissolved and within.

Along with Freud and Lacan, I thought of these concepts in relation to machines I am working with.

3rd Hypothesis:
It is possible to build machines that heighten or foreground the ambivalence of the subject–object relations between people and machines. The relationships these machines call forth may not be directional as with transitional object relations, but rather dance between levels, moving back and forth all the time as good transobjects.

4th Hypothesis:
Visceral interaction with machines may facilitate therapeutic exchange as well as extend the concepts of therapy.

BEHAVIORAL PRESCRIPTIONS

Normative Versus Non-Normative Behavior and Machines

The very concept of normality is, by design, a thought impediment. It is a design impediment. There is no absolute standard. I am interested in questioning our conceptions of normal. They will be consciously disavowed in the development of the design principles presented in the next section.

Most machines normatize in that they are designed and socially positioned through advertising and access for the most probable and prescripted uses and interpretations. PDAs help extend memory, a socially valued and widely marketable trait. Kitchen appliances for good housekeeping prescribe how to be a good housekeeper in a given culture. Companion robots that are designed for use in hospitals and homes to aid people, survey, regulate and calm, imply to the people through their interactions a standard of normal health and behavior. Prosthetic devices that simply try to mimic and make up for missing a "normal" part of a human body are only answering a call to match what is most probable. While a typical prosthetic limb may allow the amputee to appear normal, it may at the same time further marginalize their condition of existence.

People can address with the same set of tools and technologies some non-normative or less-probable needs and desires and also make room for an appreciation and

acknowledgement of the vital importance of uncommon unassumed approaches to becoming human. The possibilities are far greater than what is seen in the most probable set of standards.

Alternatives to Normative Design

Normative design refers to things that imply normal behavior, normal use, normal performance of self in relation to the world. Normal is not neutral – it is socially and politically constructed and is utilized to apply social, political, and economic influence and control. When each person is urged to be like everyone else, to be the same, to be normal, to comply, their sense of self and agency is being guided, formed, streamlined to fit the norm. This implicit call not only affects personal performance of self but also effects social control and political persuasion.

The call to be like *x* is designed into all sorts of everyday things and places – architecture designs normal movement through space and use of space while, along with furniture, clothes, accessories and tools, it designs normal body positioning, functioning, and use. Personal computing with individually owned machines and keypads and mice and the internet imply body positioning and use and idea exchange and communication protocols. Today what we call the "alternative[19] scene[20]" is neither. Today marketed subcultures have their internal calls to be like *y* or else you are not part of the subculture, and the music industry and television industry and fashion industry take great economic and political advantage of the alternative scenesters' compliance.

The unusual machines of Machine Therapy, and the unusual behaviors of machines (that we will see more of in the later chapters) are purposefully designed to implicitly disturb and call into question what people, including machine designers, may have been taking for granted as most appropriate in general because they are most common.

MAIN IDEAS

Main Points of This Work

1. People use machines as self-extensions and reflections. A machine can be experienced at varying levels of being part of one's self to being a non-self thing. Investigating what this ambivalence of state may invite is a critical alternative to orienting towards a strong separation of self and other. Ambivalence of self versus non-self opens important creative space.

2. The parapraxis of machine design manifests critically relevant affordances/elements. The side-elements that we tend to not design into machines consciously

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19 different than the mass-marketed

20 a sphere of activity

on purpose are nevertheless reiterated and are a huge part of what matters in human-machine interaction, relationships, and co-development. These aspects should be taken into consideration when making and adopting and adapting to machines because they have been demonstrated to affect people in terms of self perception, social perception, comfort, ability to concentrate, and psychological and emotional state. Some of these elements can be accessed and related to on conscious as well as subconscious levels of experience. Among these are sound, vibration, movement, temperature, and electro-magnetic radiation. Projects that foreground these elements in some machines can facilitate the awakening of awareness of not only the particular highlighted elements of the specific example machines but also by extension similar aspects of many other machines.

3. Autonomic subconscious body-based interaction is as important to look at as the more attended cognitive-based interaction. Autonomic and visceral aspects of machines need to be recognized as important. Well designed visceral aspects promote play in the space of betwixt and between and help manifest evocative relationships with machines in ways of relating that are often overlooked but meaningful. This space of betwixt and between is the vital space where perception is not yet set and therefore able to be negotiated in pre-symbolic arenas.

4. Beyond normative design and use of machines is vital. There is a symbolic inscribing that occurs through mass-marketing and most common machines and this must be countered by other machine practices to help celebrate and explore human creative diversity and adaptability and possibility.

5. There are therapeutic possibilities in the use of the parapraxis of machine design. Some of the parapractic elements of machines, besides being clues into our own continuously contingent processes of becoming human, can be perceptually repositioned to offer channels of expression that may appropriately be termed "therapy."

New Concepts and Terms:

1. *Machine Therapy* Machine Therapy describes a practice of connecting with machines, especially through their unintentional yet active side-aspects, in ways that are revelatory and therapeutic for people. Autonomic interaction may bring about both physically and psychologically therapeutic effects, for example. Some of the subconscious elements of our mental and bodily states, personal identity, and social constructions interrelated with machines are made conscious and workable in Machine Therapy.

2. *endo-exo dance* The movement in experiencing something as separate from one's self to as connected fully together is the endo-exo dance.

3. *transobject* An object that a person sometimes experiences as a separate thing and sometimes as non-separate. A transobject is very good at going back and forth between being part of someone and separable from them – an excellent endo-exo dance partner – and supports this experience for the person. Examples are comfortable prostheses, tools that a person experiences as body extensions, a virtuoso's musical instrument[21], a writer's laptop, and many various objects and machines.

Design Principles

Engineering and design methodologies can include guides to help uncover what may otherwise be elements of parapraxis and to reveal and make workable how these elements may function outside of consciousness. Acknowledging the unbounded role played by machines in human and global development, these methodologies must foreground aspects of personal reflection and critical social agency and responsibility. This is an ongoing practice by very many people. Through the work of this dissertation I hope to contribute to this pedagogical and practical reflection.

Below I outline three contributing methodologies that I have worked out through the process of physically making the projects and describing the ideas of Machine Therapy.

Machine Therapy Processes/Methodologies:

1. Foreground previously dissimulated aspects of machines. Bring the aspects of a machine that would otherwise tend to be subconsciously active to the forefront of the interaction with a person, bridging into conscious awareness what is often subconscious yet at the core of our relationships with machines and with ourselves and each other through them. In order to do this one must become aware of these side elements. If there are visceral factors – sounds, vibration, smell, touch, movements, electromagnetic radiation, heat – one can begin with those. One tries to find what the machine is doing besides its prescribed functional duty. This practice enables a remaking of our perception of our relationships with machines, in turn informing a remaking of our relationships to the ways in which we use and make machines.

2. Blur the borders of self and other in useful ways. Build machines that highlight the vital interchange between people and machines. Some ways of doing this involve machines as body extensions and border crossers. By doing so we will also highlight the vital interchange between people and other people and other things, and our sense of agency and connection and responsibility may thus widen. With this process we can disrupt psychoanalysis in a useful way. Instead of tracing a map of human development centered on an individual building a strong healthy ego with impermeable defenses, we can instead rethink human

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21 "Violin Taken In Subway Is Reunited With Owner," by Eric Konigsberg, *The New York Times*, Section B, p.1, 1194 words; July 5, 2007.

experience as always connected vitally and meaningfully to "others" including the machines we help make. This expands personal awareness.

3. Build machines that are beyond normative.[22] Interrogate the very concept of "normal." Normal is a social construct. It is not arbitrary as it carries all sorts of political and personal directions. It can be either sustained or questioned and destabilized by the people and things that live in its range. To help escape the rule of unproblematized inscriptions, build machines that address needs and desires that are not addressed by mass marketed products. Reveal these unaddressed needs and desires and expressions as full and central to human experience and important to acknowledge.

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22 See the work by members of the MIT Media Lab's Computing Culture Group < http://weblogs.media.mit.edu/compcult/ > for some examples of non-normative technologies that extend social and political agency and address issues ranging from violence against women (Whiton 2007), ethnic stereotyping and discrimination (Bdeir 2006), sexual identity (Shustermann 2006), and governmental action (McKinley 2003). Also see work by the Interrogative Design Group < http://web.mit.edu/idg/>.

Chapter 4

EARLY PROJECTS IN MACHINE THERAPY

In this chapter I will describe five recent projects that have been important in developing the ideas of Machine Therapy.

BOOM

I opened this dissertation with a story from my experiences sounding in resonance with massive construction machines. Years ago, when I was first at MIT as an artist in the Visual Studies Program, I performed some experiments in which I would go to the Big Dig and try to vocally sound with the construction machines. At the time everyone in Boston was busy trying to shut out the intrusion of the Big Dig in their lives – holding their ears and holding their breath and basically being very annoyed.

Fig. 4.1 Sounding with construction machines.

Having the experience screaming with the jackhammer and singing with leaf blowers and lawn mowers, I was wondering if maybe people could approach the Big Dig in another way that might be somewhat useful – to subvert the sounds and other elements into an unusual personal and social performance arena. So, I went to try to empathize with the machines and to get into vocal resonance with the machines. I discovered that if I made sound with my body's vocal apparatus that was in resonance with the sound of a machine that I then could not separate my own voice from the sound of the machine. I viscerally felt the machine's sound in my body and felt my voice moving into its structures and resonating within them. When I could make the same sound as the dominant pitch of any of the machine's motor, there became an in-between space where I wasn't sure where my voice ended and its sound began. Through this visceral link it would pull me to make sounds and to make gestures even, and to experience things that I otherwise wouldn't have. Sometimes I would feel like it was guiding, pulling me along, causing my voice to sound, and at other times I felt that I was in control, driving its motor with the power of my voice. These performance experiments were interesting for me in a provocative, visceral and emotional way. They fundamentally changed my experience of being in the proximity of these big machines. My sense of voice and embodiment altered. I moved away from the normal relationship of a person in the city, namely being against the disturbing sounds of the machines yet passive and begrudgingly submissive, to a relationship in which through moments of appropriation and commingling at the visceral and experiential levels, I remade my conceptions and connection with the machines and their affects. This project can be described in terms of object relations theory, but it also begins to disturb the psychoanalytic structure in ways that are elemental to Machine Therapy.

Endo-Exo Dance

Though we are of radically different bodies and drives, I was able to forget this at times, moving back and forth between being self consciously aware to being able to experience the machine and myself as linked and as operating as a continuous shared boundary-blurred association. Through this back and forth I negotiate not so much a sense of self and other but a sense of contingency. We are linked then separated then linked then separated. It is a dance of sorts through which I move into previously unexplored dimensions of my voice, agency, sensitivity, and power.

The Big Dig was a contested space, the site of intense social, economic, and political debate. I did not ask the people about the politics directly. I was not a journalist or a spy; I was hardly even a researcher to them. I was just a somewhat unusual but strangely familiar person curious about the inside experience with the machines. I rarely directly asked the people about their ideas and feelings about the machines they were working with, but often I was offered their thoughts without my asking. Because the construction workers saw me doing this, they often individually confided in me about their own experiences sounding with the machines. I learned I was doing something that they have found themselves doing, but never really thought about or talked about, even with each other, before. On some sites some people would join in and we would all sound together with the machines. The construction workers, who spend most of their days working with these machines and are the experts when

it comes to relating and communicating with them, welcomed my work with the machines. They knowingly smiled in appreciation of my discovery through this uncanny method of something they deeply knew, I knew that I was not just being strange. I knew I was finding something important. I wanted to share these experiences with other people. Many of the projects in the work that I am going to present in this dissertation have been informed by this early experience.

Voice as Transobject

I project power, fear, desire, and a myriad of ideas and feelings on and through and from the machines. With certain machines, I miss them if I do not visit them for a few days. If they have moved to another site I need to go find them, to sound with them. Psychoanalysts would be tempted to treat this story as that of an invention of symbolism by myself through the language-unconscious. In that structure one could map the use of one object (the machine) to symbolize another, absent object (the mother, for example). But I want to underline another interpretation that Freud and his followers miss yet is implicit in this story and central to the experience. With the machines, my voice is in action in the world. Each machine is an "other" with which I let my voice, as a bridge, extend from its sensation origin in my body out into the world and back again. The motif of the songs may be anxiety, fear, control, love, joy, but it is always my voice mixed with the machines "voice" as a resonant, harmonic, relating force interplaying with my controlled and imagined relations with the movements of the machine.

SCREAMBODY

> *"It is always true to say when reviewing one of this patient's sessions that if she could scream she would be well. The great non-event of every session is screaming. It is of course of no use whatever encouraging this patient to scream, and it would not be valuable to introduce something frightening or hurtful to provoke crying. The patient usually knows that not screaming is the subject matter behind all the material that she produces, but how can she alter this state of affairs?" – Winnicott p116 (Winnicott 1989 PAE)*

The case of needing to scream may be one particularly well addressed by some of the projects of Machine Therapy. Talk therapy may be also useful in the case of needing to scream, as it may get at the underlying causes and verbal interpretations where this need arises. However, while to scream at all would be a ``great breakthrough," talk therapy alone is in comparison rather indirect, as it takes a round-about route to something that in conjunction with Machine Therapy may be accessed more directly. One way could be through sounding with machines. My experience at the Big Dig and with other loud machines supports this idea. Machines making sounds and inviting people to make sounds with them provide a safe space for free vocalizations. I developed this further in ScreamBody and later in Blendie.

ScreamBody is a wearable portable space for screaming or practicing other vocalizations that one may otherwise be afraid to let out. When a person screams into ScreamBody their scream is silenced, but it is also recorded for later release where, when, and how the person chooses.

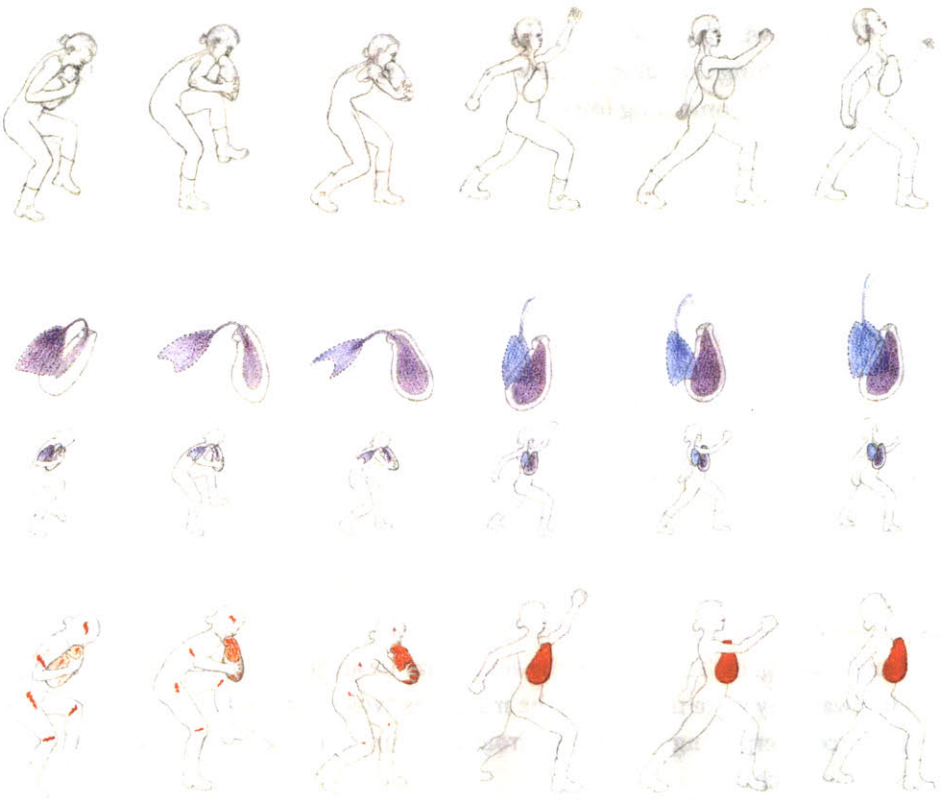

Fig 4.2 ScreamBody illustration.

Fig 4.3 Photo of ScreamBody's component parts: open-cell polyeurathane foam, latex, conductive plastic, copper mesh and perforated foam squeeze sensors, Pic-based microcontroller circuit, ISD voice recording chip, microphone, speakers, battery.

It is worn as a frontpack. It is made of open-cell polyurethane foam, latex, and faux fur with its custom designed electronics contained within. I designed the body of ScreamBody to be a squeezable interface. A person can squeeze it while holding it to their mouth and the scream will be silenced and recorded for later release. To enact the release of the scream a person can squeeze the device again in the same general place they squeezed it to record.

When I designed ScreamBody, I was thinking about Winnicott and the transitional object. I thought to extend this use of an object to adults in situations where they perhaps could use what the psychoanalysts think of as ego strengthening. If someone feels unable to scream, perhaps some sort of in-between object providing a safe place to develop the skill of screaming could help.

I designed it to be both cozy and armor-like in worn experience for a person. I made it visible, rather than hidden as so many personal digital assistants are today, so that it would become part of a critical performance. To see people with ScreamBodies in shared private and public spaces would be to announce the

Fig 4.4 Photo of ScreamBody in Central Square, Cambridge (photo by Toshihiro Komatsu).

need for such apparatuses.

Below is an example from D.W.Winnicott about his patient who needed to scream. In his talk therapy psycho-analytic work with her a scream was never found. She never found "wellness" in that she never found the ability to scream. Apparently she had lost the ability to scream in childhood in reaction to an unsatisfying response to her screams, and so she sought after the rekindling of the ability to scream via psycho-analytic sessions. She made a great breakthrough when she *dreamt* of screaming and that was some progress.

> *"...that the non-event or the not screaming is in itself a negation or a blotting out of one of the very important things which link the psyche and the soma; that is to say crying, screaming, yelling, angry protest. It is possible already to predict that this patient on becoming able to scream will have an immense strengthening of the psycho-somatic interrelationship and a lessening of the need to employ the somewhat artificial experience of psycho-somatic interplay ...*
>
> *The question naturally arises, does the patient really need to scream in the analytic session? The answer might be yes, but already this patient has had a dream in which screaming took place. Alongside this dream came clinical relief in the waking state; that is to say before reporting the dream she reported that she had been able to sing in a community situation, something that she had not been able to do for years, and also at the same time in her behavior in the transference situation she had been able to make a noise and shout and protest (in a civilized way as it happened) when I was late for the session and she feared that I was ill or that I had forgotten her. The key to the situation therefore is the dream. But the dream only becomes possible as a result of the analysis, in which hope about screaming returns and is recaptured from the time before she became ill when the good pattern changed into the bad pattern either at a*

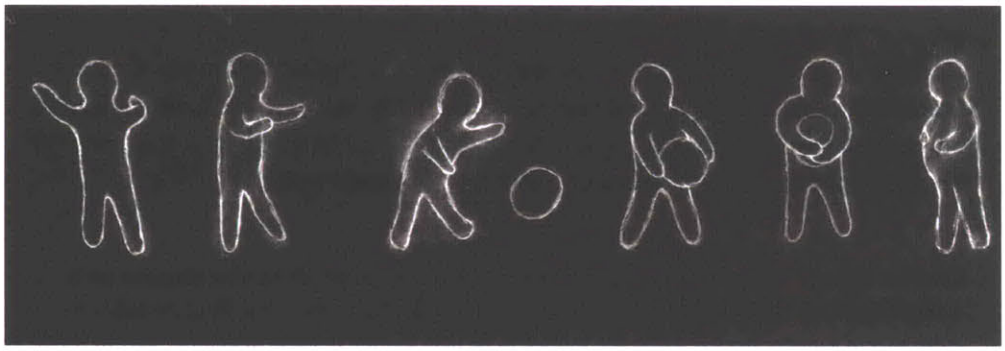

Fig. 4.5 My illustration of a transobject and a person, can be read right to left as well as left to right.

Fig 4.6 Illustration of Wearable Body Organs.

certain moment in her babyhood or spread over a period of time.

Clinically there appears along with these changes towards psycho-somatic interplay an enhanced interest on the part of the patient in the shape of her body and in the texture of her clothes. It will be direct evidence of success in this area of the analysis if the patient becomes able to relax in bed and in her waking life to exist in the here and now instead of in a gap between the past and the future. {Winnicott p117-118}\ cite{Winnicott_PAE}

Perhaps if Winnicott had a ScreamBody to lend her for a while until she no longer needed it and could again scream on her own she could have actually refound her scream.

Wearable Body Organs

ScreamBody is the first in a series of Wearable Body Organs. Also a public performance based series, WBOs are designed to be visible and worn and used in public (as well as private) everyday life. Their visibility and use in public becomes something of a personal performance that announces the very needs they address, questions the situations we are in that result in such needs. This form of acknowledgment represents the needs through a material, tangible form that can be negotiated with and through.

HoldBody is a self-administered hugging jacket. It looks and feels very cozy but also strongly containing. It has an internal architecture of air bladders designed and seamed out of vinyl on an ultrasonic welder. This air architecture becomes filled with pressurized air when a hug is sent to the person and the person decides to accept. The most common use was for people to send themselves hugs. When inflated, HoldBody restricts the movement of a persons upper arms as well as putting pressure all around the persons torso.

This project is influenced by the work of Temple Grandin and Wendy Jacob.[1]

CryBody is third in the series and is in progress now. CryBody addresses the resistance of emotional and physical pain to expressibility. Many people have been culturally trained to not cry, especially men in my culture. Interestingly, it is men who told me they wanted a WBO of this sort. For them I am making this.

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1 See the Squeeze Chair Project by Wendy Jacob at <http://web.mit.edu/vap/workandresearch/workfaculty/work_jacob.html>. Wendy Jacob collaborated with Temple Grandin, who built an apparatus to squeeze herself when she wanted to be held but the holding of another person would be disturbing. (Grandin 1996).

I used the word "organ" in wearable body organs, and in ScreamBody even went so far as to sculpt the form to appear as a surrogate set of lungs worn by a person, as by calling up the reference of body organs they call into dialogue the idea of body boundaries and body extensions and the exchange of body parts. People can exchange these organs with each other. When they do, something of themselves may be exchanged, carried by the organs. It was also meant to bring up the questions raised by the partitioning of body parts as covered in the background chapter. These include issues of body organs as personally tied to individuals or exchangeable. When organs (artificial, biological, or wearable) are exchanged they carry with them something besides the functionality of the organ as machine.

Wearable Body Organs were conceived of as prosthetics for everyday life – the personal and the social body extended. They communicate via languages of body organs. They are visceral. If my organ feels something from your organ I feel it primarily in a non-cognitive way. This is interesting because non-cognitive communication is important lately in device design although we tend to ignore it.

Though not yet implemented, I am interested in networking many ScreamBodies, and many WBOs, and being able to extend our voices and body based experiences to other bodies and spaces.

MACHINE THERAPY SESSIONS

To help make experiences like those I had with the construction machines accessible to people I brought people to the construction sites with me and I also began holding indoor Machine Therapy Sessions in a private soundproof music studio in the Media Lab. I began each session by introducing the machines to the person and telling the person a bit about the machines' histories such as where they were before, what kind of work they used to do before this, who took care of them, what they have experienced, etc. I invited the people to empathize with the machines. They vocalized with the machines, moved like them, interpreted sounds to be emotionally meaningful, identified with aspects of their shape and gesture, and tried to influence them. To give the people more freedom to explore I would offer to leave after a while so they could be in the space alone with the machines and not be watched. In almost every session when I returned after half an hour the people were immersed in what they were discovering and did not wish to stop. They came to future appointments.

I was interested in investigating personal scale situations with machines because we so often interact with machines on that scale. I had a sense that the domestic scale area of our interaction with machines, especially products designed to capitalize on and propel dominant models of subjectivity is where a lot of the vitally significant

Fig 4.7 HoldBody.

negotiations about selfhood and agency and voice take place, as discussed in the Background chapter.

People were invited to bring their own machines. I also brought a bunch of machines that had particularly evocative movements and expressive sounds. One was an electric drill with a pressure sensitive trigger to allow smoothly varying speeds and sound. Many people's favorite was an old electric cast iron and ceramic mortar and pestle from a chemistry lab.

These sessions were unlike talk therapy sessions in important ways. They were focused on non-verbal interaction with machines to reflect and find issues and ideas of importance for the person. I would be a third party there just to introduce the person to the machines and to help the person approach the machines in ways not based on the functional design of the machine but on what else the machine was doing. In this way these sessions relate to many people's current situations of being in proximity to, if not directly interfaced to, machines that implicitly instruct us in very directly influential ways that we have up until now been mainly not noticing, passive, and uncritical about.

One person, Michael, a very shy person who signed up for as many sessions as he could, told me once when I asked if he would like for me to leave the room so that I would not make him nervous,

> *"Oh, it doesn't matter. You can stay or go. Anyway, it is not you I would be shy to vocalize in front of but this machine. Its sounds are so full and complete, who am I to interrupt..."*

Another person, Saoirse, when introduced to the repetitive old mortar and pestle machine identified empathetically with its Sisyphusian situation. Together we three rocked in repetitive arcs and hummed the sounds of the machine. She then watched the machine attentively. She said, "I want it to stop moving in the same spot. I want

Fig. 4.8 Machine Therapy Session.

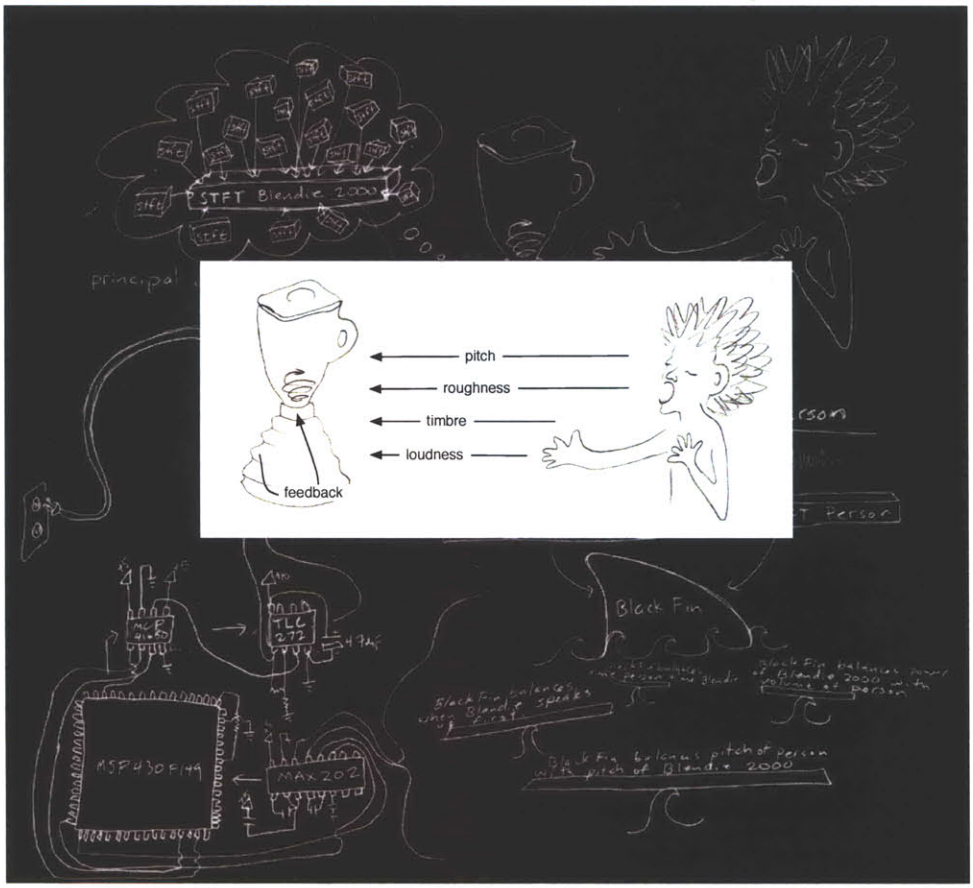
to throw something in to change it. ... Maybe I could just break the machine." When I asked her why it bothered her so much that it was moving in the same spot she became very thoughtful, sat back, and after a pause said with introspective intrigue in her voice, "I don't know." She enjoyed trying to figure it out and revisited the machine on several opportunities after this session. She became very fond of the machine. With this machine that made such full sounds and had such an evocative movement, just about everyone who met with it was fascinated and developed some kind of connection with it.

BLENDIE

As we saw in the Background chapter, domestic scale objects and devices are active in our developments of personal agency and social meaning and political positioning. Blendie requires aggressive, loud, vocalizations rather than lady-like gentle pushing of small labeled buttons while not paying attention to the violence and noise that ensues.

Parapractic, Blendie is a modified mid-1940's Osterizer blender that foregrounds the guttural sounds of a blender in action. I have installed this project in about a dozen different sites: the lab open houses, dinner parties, a bar, and exhibitions internationally. I have noted that people may be hesitant at first to try to make the sounds required. They are a bit scared or shy to make the unusual sounds required to access Blendie and get it to move and sound itself. But in almost every case, when the per-

Fig. 4.9 Blendie in use.



son does try and makes a sound that Blendie reacts to, the person wants more. They have found something engaging and evocative in their exploration. They start making more sounds and freely excitedly encourage others nearby to try.

Blendie works by taking in the sound of a person interacting with it through a microphone and processing that sound on a computer running custom software written in C++. The program computes an STFT (short time Fourier transform) to detect dominant pitch, and an FFT (fast Fourier transform) of this STFT to look for time-domain frequency modulation. If it detects modulation in a range that has been predetermined as a close human approximation to the rough guttural sound of the blender's motor, Blendie then is given the correct amount of power to allow it to spin at a speed that will produce the same dominant pitch of the person's voice. The power is adjusted using PWM (pulse width modulation) of the AC (alternating current) line supplying power to Blendie. The proper PWM for a given pitch is returned from a large lookup table in the software custom made for the blender. The software can tell a human voice from a blender sound, and thereby can keep Blendie from forever feeding back on itself, because a human imitation of a blender is very different from the sounds of the blender itself.

Fig.4.10 Schematic of Blendie's circuitry and a visual diagram of how Blendie works.

Voice in Psychology

Machines share some expressive elements with people and harbor meaning and emotional material that is affective but often unrecognized by people. Machine Therapy, an alternate to traditional therapy and akin to art therapy and music therapy, utilizes the sounds of machines as relational elements for people to vocally connect with. These unconventional vocal expressions can facilitate access to a human's own personal sounds and linked psychological states.

MACHINE VOICES

The core technology of Blendie could be extended to other machines. Research has shown how dramatically the reactions of objects add meaning to the interactions with them.(Ackermann 2005). Machine Therapy sessions could potentially take place in a room full of Machine Therapy machines that are responsive as Blendie is. Each machine could be different, each with different affective possibilities, voice, movement and so on. A step in that direction was made with the building of a model to translate between human and machine sounds, in collaboration with Dr. Brian Whitman and Professor Daniel P.W. Ellis, (Dobson and Whitman and Ellis 2005)

A person could try to engage with any particular machine. For this situation, knowing that machines and humans can not make the same sounds due to very different mechanical and physiological apparatuses, we needed a way to detect what machine a human was vocally imitating so that that machine could respond and empathetically sound with the person. To make it extendable, we needed a way to detect human vocalization of machine sounds that could generalize to new machines. Given a new machine, we would like to detect a human imitation without training. And given a human imitation of a machine, we wanted to be able to distinguish the specific machine they were imitating without training. We approached this problem through machine learning algorithms and built a model that links machine-generated sounds and human imitations and generalizes to new machines and new human vocal imitations. Our process is described in Figure 4.10.

We chose to focus on five auditory features for each short-time of the input audio. We chose a fundamental frequency (fo) estimation, aperiodicity (the residual from the fo estimation), a power estimation, spectral centroid and `modulation spectral centroid,' the centroid of the Fourier transform of the magnitude envelope along time of each frequency channel in our initial short-time Fourier transform (STFT). Our intuition for detecting modulation in the spectral bands is that often the machines have high roughness content in the upper modulation bands, while human imitations can only to try to approximate these sounds in lower bands.

Our problem was to estimate the quality of a particular person's imitation of a machine, taking into account the innate limitations of the sound `gamut' that that person, or people in general, can produce, and also the specific acoustic dimensions that the person is aiming to reproduce. Ideally, we wanted to find the appropriate

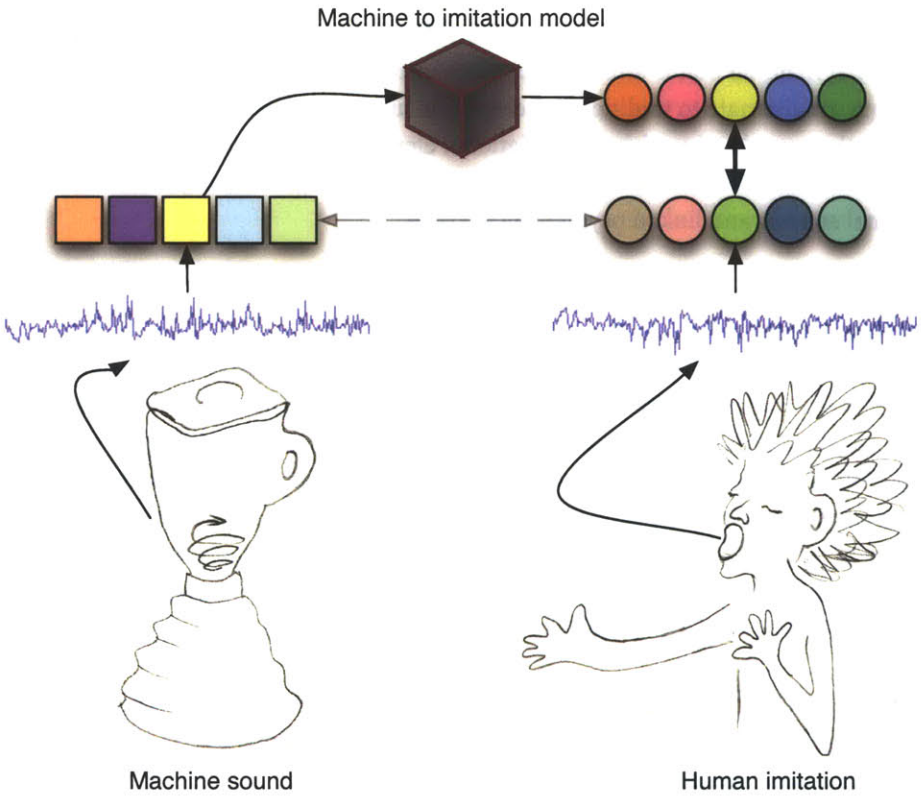


Fig. 4.11 For Blendie, the software directly computed similarity between the features (shown as the faint dotted line.) This approach worked well for one machine at a time. I wanted to move from this approach to a more universal approach by designing a generalized auditory model inclusive of all machine sounds and their projections into human vocal space and vice versa. We learned this model (the black box in Figure 1) by regressing the feature dimensions of the machine sound against the feature dimensions of the human imitation. Then, new machine sounds can be projected into 'human space,' with better accuracy in the similarity task.

representational space that captures all the significant aspects of variation in both machine voice and human imitation, and to learn optimal mappings between human and machine sounds – mappings which will vary between subjects, but which will also share a common core.

To learn the projection between machine sound and human imitation, we used a multi-dimensional regression learning technique with support vector machines (SVM). In our work we trained a single set of regression models (one for each dimension in feature space) instead of separate models for each machine. If we trained one machine's model at a time, the regression problem could overfit to only predict one type of machine. By forcing the regression to consider all types of machines and their corresponding imitations, we hoped to create a model that would work well for new types of machines.

Sounds of five machines and seven subjects were recorded for this study. The machines included an Osterizer Blendor kitchen blender, a Dewalt portable power drill, a Hoover Commercial Windtunnel stand up vacuum cleaner, a Acorto 2000s espresso maker and a Singer 20 industrial sewing machine. The subjects included three females and four males with different backgrounds and various primary languages.

The model was demonstrated to predict correctly 60% of the time (compared to 20% without the model). There is a large amount of future work to fully understand the

problem and increase our accuracy. We want to perform studies with more machines and more subjects, as well as learn a parameter mapping to automatically control the functions of the machines (speed, torque, etc.) along with the detection.

Chapter 5

UMO, AMO, OMO

This chapter introduces the most recent projects incorporating the lessons learned through the Machine Therapy work to date. *Companion Projects* are a series of three different organically shaped transobjects centered on visceral interaction through modalities that have been found to have salient side-effects, including affective significance when they have been present as side-elements (elements outside the conscious functional design) in other machines.

COMPANION PROJECTS OVERVIEW

As people begin to pay close attention to aspects that they have been acculturated to not notice, as machine designers people may also use this perspective to aid in carefully and responsibly making new machines.

The remaining chapters document and explain the most recent projects of Machine Therapy. With the background understanding that subconscious body-based interaction is vitally relevant in machine use, I purposefully designed new machines from scratch, intending to facilitate visceral effects as their primary function.

With these latest projects of Machine Therapy I am, in part, responding to the growing research area of companion robots and its dominant concerns, mimeses, and agendas. Omo, Amo, and Umo are critically alternative takes on what companion machines can be.

While most companion robots are designed to look like whole anthropomorphic creatures, Omo, Amo, and Umo offer a different type of strong relational appeal due to their appearance as simple primordial relational blobs. As sensory-motor relational objects that try to communicate directly with a person's body, each of Omo, Amo, and Umo moves somewhere between a part of the self and a discrete whole other.

Omo, Amo, and Umo are designed to function similarly to transitional objects:[1] they are designed to be experienced as being betwixt and between part of one's self and and other-than-self. They move back and forth between being projected out as separate from oneself and being an incorporated viscerally connected part of oneself.

Many technologies are designed to replace or extend a part of a person. Devices like PDAs (personal digital assistants) and artificial organs may be said to be surrogate organs for memory or blood flow. But while they may be called functional equivalents, the broader picture of what they are doing is different than the organ or function they replace. For example, artificial hearts limit activity by inscribing rates of exertion onto the whole body and influencing physical and psychological states. PDAs offer a form of memory space that has occasioned reifications and alterations of what we conceive of as memory. I have designed Omo, Amo, and Umo as relational companion objects that can entrain with and influence a person, but that are separable enough to be easily put aside. They do not replace a function. They may be taken on as temporary reflective and influential body extensions. They may entrain to one person and then be passed to another person. They are not intended to simulate and replace people, animals, body parts, or touch, but are rather intended to communicate on visceral levels in performances that are able to highlight how all machines interact with people in non-neutral, experientially significant, visceral ways.

Omo, Amo, and Umo may seem in some situations at some times to behave like organisms, creatures, sympathetic friends or pets or partners, but they are designed intentionally to not be stably so. They are not employee machines in the way that nursebots, carebots, and domestic helper bots are designed to be. Unlike most companion robots, Omo, Amo, and Umo are not designed to always be soothing and subservient. They are designed to act erratically at times, to have breakdowns, to exhibit irrational jitters that may call on the person nearby to empathize and comfort them on their terms rather than vice versa.

> *"I can't always obey, because I'm betwixt and between."*
> *–from The Jungle Book by Rudyard Kipling*

Overview and motivation

Object relations theorists explain that people use other people, parts of other people, and objects to reflect from and learn more about themselves. All accessible aspects of these other people, and parts of people, are potentially significant relational elements. Domestic-scale technologies are used by people for performing intended functions, but they also function as relational signs and suggestions about self and agency in the world. Though this additional function is often peformed by the designer, machine, and user below a designer and user's conscious level, machines are nonetheless

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1. See Winnicott 1971 as well as the discussion of transitional objects in the Background chapter of this dissertation.

influential via these side-elements. It is therefore important to acknowledge and be concerned about side-elements and their possible side effects when designing new things and machines.

Current companion robots that are being designed to help take care of the growing elderly population are mainly perceived and designed to be like whole humanoid or animal-like creatures. They have eyes (often containing cameras), ears (again, often containing microphones), a body, limbs of some sort, and a head. They are designed to remind people to take medication, to sleep regularly, to eat well, to exercise[2], to feel loved.[3] This companion robot research was the initial impetus for the work of Omo, Amo, and Umo. I am curious what the side effects of these design choices may be. I am concerned with the implications they have for people, through their presence, embodiment, vocabulary of verbal and action-based language and attention, and interaction. If they are to be always soothing, medicating, perfectly behaving whole sentient humanoid companions, do they not thus imply this set of characteristics as ideal in a companion, and imply thereby that people in general should be as soothing and sedate as these machines are aimed to promote? I am curious how relationships between a person and a companion machine could be different if the machine is not clearly a whole creature, but rather a good "transobject," able to fluidly move between being perceived as, at times, a part of the person and, at other times or even in the same breath, separable. This interest informs the design of Umo, Amo and Omo as organically shaped body-based relational machines. In this chapter I will describe their designs and the early investigations.

While AI (artificial intelligence) and HCI (human-computer interaction) specialists have been making important discoveries on how best to enable interactive machines to perceive and decipher meaning from people, Machine Therapy investigates the inverse direction. My research aims to discover how people perceive and reflect meaning from machines. Other researchers and I have found sounds, movements, and electromagnetic radiation to be among elements salient for people in relation with machines, even though these elements were not intentionally designed as the purposeful functions of the machines.[4] These side-elements can nevertheless carry machine affect over to people. Following this, Umo, Amo, and Omo are designed to

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2 See Fong et al (2003). Also see recent companion robot projects including described by Litke (2006) <http://abcnews.go.com/Technology/story?id=2623174&page=1> (August 20 2007).

3 Highly charged borrowings, such as eyes for example, aid in promoting slippages described by Breazeal as promoting social interactions. (Breazeal)The full range of what may accompany this borrowing of these deep signifiers to aid in human emotional response is important to consider. How may people's understanding of themselves be effected is a question Sherry Turkle is engaged in looking at. Through her *Technology and Self* series, Turkle helps facilitate looks into what we are making in addition to the machines themselves when we make "evocative objects." See also "First Encounters with Kismet and Cog: Children's Relationship with Humanoid Robots." by Sherry Turkle, Cynthia Breazeal, Olivia Daste, and Brian Scassellati (Turkle et al 2005).

4 See some examples in Berglund and Hassmen (1996), Dunne (2005), Dobson et al (2001).

purposefully embody these aspects of machines. Specifically, Amo involves electromagnetic fields, Umo involves sound and low frequency vibrations, and Omo involves cycles designed to mimic and interact with human breathing.

Real versus faux emotions

Researches of caring machines ask what is it that machines need to present to us to give us the impression that they care.[5] Researchers ask: How can a computer convey emotional intelligence and empathetic content to a person? and in what ways will a person accept those cues? These researchers have strived to make human – subtle yet deeply meaningful – emotional interaction explicit, to make it algorithmic so that computers can be programmed to pretend to have and understand emotions as people do. People have emotional interactions all the time without being explicit or even conscious about it. "What are we doing and how are we exhibiting emotion when we interact with a machine?" could not have been asked until machines existed. This question invited its counterpart, "What are we doing and how are we exhibiting emotion when we interact with other things and people?" To help answer these questions researchers are decoding the interpretion of human social and emotional communication cues in efforts to design machines that perform as if they care. Such an approach requires reifying the subtle, full, creative, imaginative space between a person and that with whom that person is communicating. With any reification there will inevitably be residual elements that do not make it into the representation. As we reify caring to make it machine deliverable, some of what is caring gets left out. I believe it is of vital importance to deeply investigate and pay attention to how the reification of caring may influence how we may evolve our understanding of our relational selves.

One difference in the emotion performances of anthropomorphic machines, when compared to the emotions of people and other animals, is that the emotions of the machines are always faux emotions. Some of these machines may approximate convincing emotional bonding by simulating human or animal emotional responses and actions, and by receiving and processing emotional cues from people. They can iterate learned models based on human emotional intelligence. However, no matter how convincing the performance may be, and no matter how much a person in the relationship feels the emotional display of the machine to be sincere, it is not real. The machine does not have an imagination and cannot care and cannot love. It only

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5 Bickmore, T. and Picard, R., "Towards Caring Machines," Conference on Human Factors in Computing Systems; ACM Press, New York, NY; 2004. And, Libin, A. and Libin, E, "Robots Who Care: Robotic Psychology and Robotherapy Approach." In Caring Machines: AI in Eldercare: Papers from the 2005 Fall Symposium, ed. G. Timothy Bickmore. Technical Report FS-05-02. American Association for Artificial Intelligence, Menlo Park, California. Also see Taggart, W., Turkle, S. and Kidd, C., "An interactive Robot in a Nursing Home: Preliminary Remarks (2005).

operates via signs and signals, in the Symbolic.[6] Faux emotions coming from companion robots also are not always earned. A robot that says it loves you, that cuddles up with you and purrs as long as you say hello or stroke it in the right direction, is not how real human and animal emotions – the referent of the signifiers that companion robot designers borrow – come to be. To this researcher, this screams of parapraxis. I am very concerned with what companion machine designers are doing, besides offering temporary comfort, when instituting these kinds of caring machines for people who need care. They may be changing the definition of caring. They may be changing people's own perception of human and animal emotions, as people begin to see these emotions in reified reductions in relation to the machines that will teach us again what caring is.

While researchers and roboticists practice increased vigilance in the design of caring anthropomorphic machines, they may also consider a different approach to companion machines. As I have revealed thus far in the work of Machine Therapy, there are visceral elements of machines that people connect with, and reflect meaning from, and may find comforting.

Machines have qualities that support autonomic interaction. Without mimicking a whole person or animal, a machine can provide elements of visceral connection and experiences of being held that in some ways are akin to experiences with another person or creature. From performances with construction machines to wearable apparatuses to domestic devices, machines can be useful reflections and extensions of experience. As creative people, we find resonance and empathy in even very simple things.

Umo, Amo, and Omo support the "endo-exo" dance. This may be relevant to caring without troping a whole person or animal and without inviting all of the unpredictable side effects that such a specific and non-neutral troping may bring about. Of course Umo, Amo, and Omo are troping other things. But they are not so clear what they are, and they thereby afford people lots of room to imagine and re-imagine.

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6 This use of "the Symbolic" refers to the discussion of Jacques Lacan's *Symbolic* in the Background chapter of this dissertation.

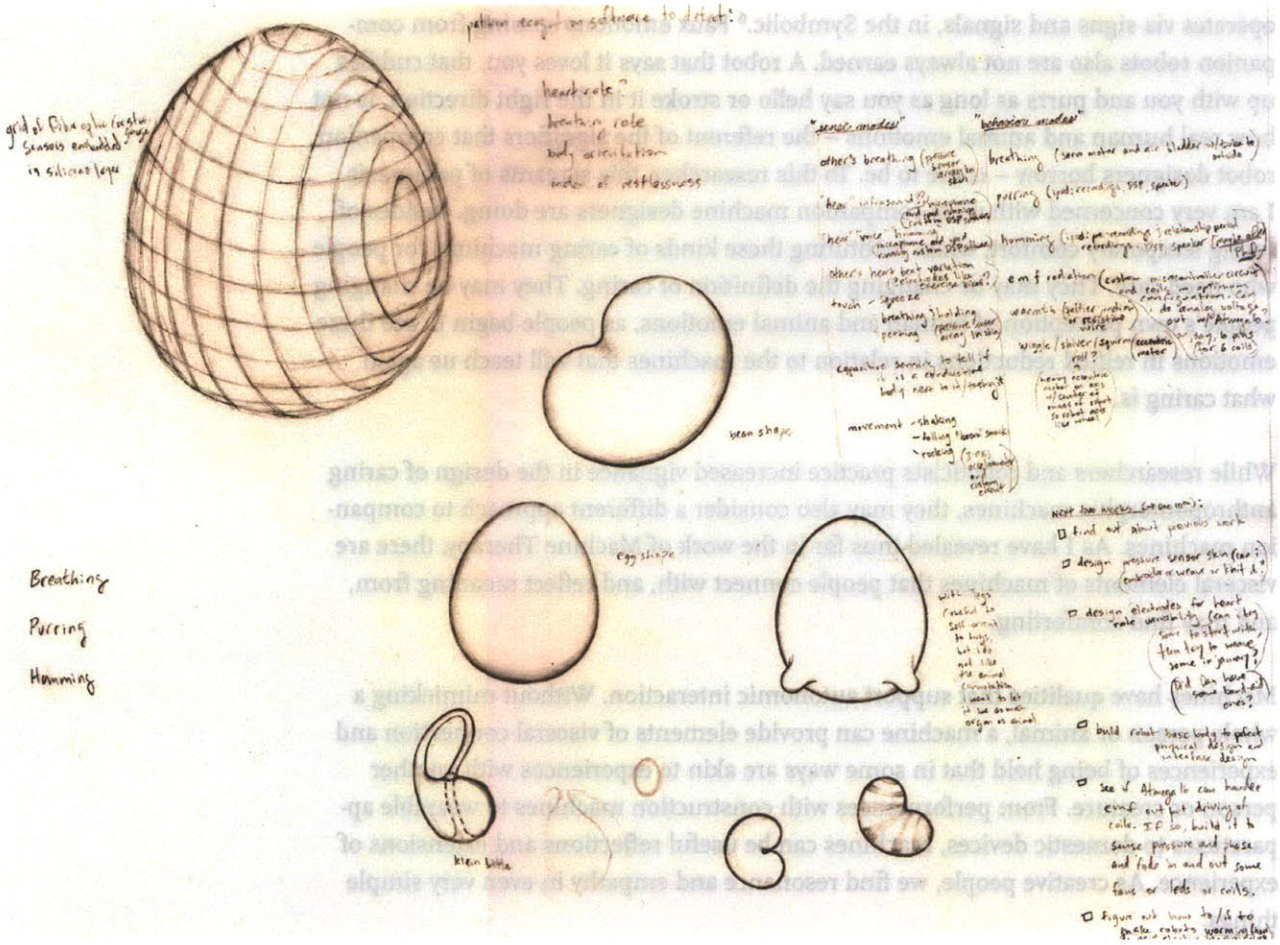

Fig. 5.1 Sketches of possible forms for Umo, Amo and Omo. As I made these sketches I was thinking about elemental forms – eggs, beans – and theoretically interesting forms such as a Klein bottle. The lines on the shape in the upper left are denoting possible fiberoptic bend sensor configurations for sensing touch and indentations of the surface.

Early Design and Scenario Sketching

Omo, Amo, and Umo are designed to communicate viscerally and, at times, non-cognitively, rather than communicating in ways that are consciously negotiated or information-based such as verbal communication and sign language. Rather than signaling and speaking in coded languages that a person must think about, however quickly, and consciously prepare and deliver a coded response to, Umo, Amo and Omo are designed to be reflexive and interact at the level of the autonomic nervous system.[7] They are sensory-motor creatures able to tune in to our own sensory-motor being. The interaction could take place completely without a person's conscious attention, or could be the focus of conscious reflection. For each person, and each period of time spent with these machines, there will hopefully be moments along many different levels of conscious and subconscious, and of cognitive and autonomic.

7. The autonomic nervous system is mainly responsible for subconscious homeostatic regulation of the human body while the central nervous system supports conscious action. Systems such as breathing and heart activity, in part regulated by the autonomic nervous system, are tied to not only physiological physical states but also to emotional and psychological states.

Fig. 5.2 Early models of Umo, Amo, and Omo. I sculpted these out of wax. The process of making them was very tactile and through it I could reflect and explore about the feelings of holding these forms. the forms evolved in this process.

Fig. 5.3 Early scenario sketches with Umo, Amo, and Omo.

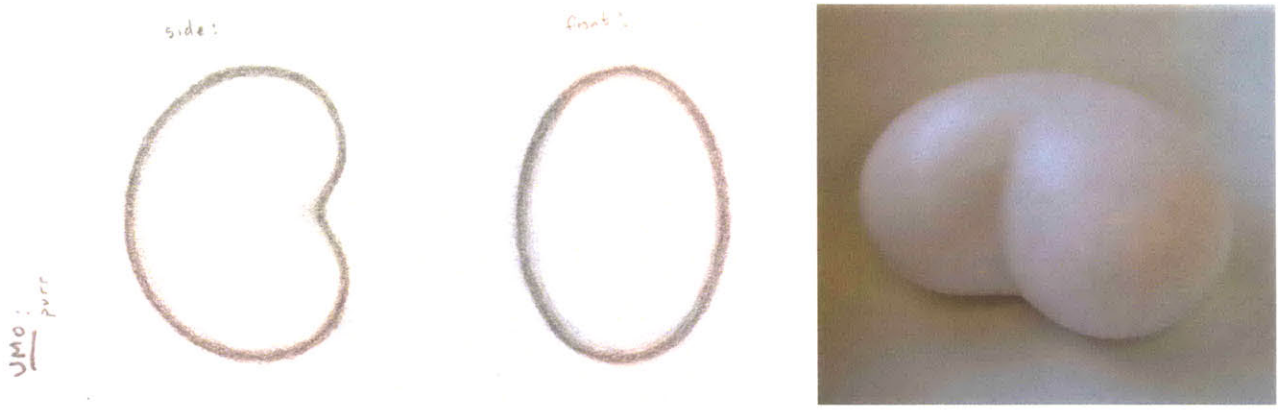

Fig. 5.4 Umo sketches and wax model.

UMO

Purrs were chosen as the expression of Umo because of their soothing affective qualities. Interestingly, cats purr in many situations, not just situations of contentment. They purr when injured, for example, possibly as a way to help themselves be calm and heal. Cats heal faster than dogs, and the frequencies dominant in cat purrs are in the range of frequencies found to stimulate bone, muscle, and ligament growth in other animals. People usually find purrs very soothing. And there are some machines that people describe as purring and that people sometimes seek in order to experience the purr. Parents sometimes take their baby for a ride in a car or place the baby carrier on a washing machine or dryer to soothe the baby, for example. I know people who go to Laundromats to do homework. People use fans and other noise makers at night to help them sleep. Umo is a way to investigate some of the aspects of human-machine-animal communication.

Umo continuously develops a purr over time in relation to the sounds of people (and animals and machines) nearby. Umo samples the sounds in its proximity and processes them to look for purring elements. It then uses these gathered elements to evolve its own song. Its purr has some aspects of coherence as well as irregularities and emotional clues.

Signal Analysis and Purr Sounds

In order to better model a purr, I have begun to construct a model of what a purr entails and what differentiates a non-purr from a purr. This entails talking with people about things they enjoy the purrs of, and gathering recordings of the purrs themselves. I have been using digital signal analysis to look for correlations among purrs.

To begin, many purrs from two subjects [feline] were recorded, as well as sounds of nine subjects [mechanical] that people often describe as soothing, humming, and purring. I looked at seven features: fo estimation, power estimation, aperiodicity, spectral centroid, time-based modulation (o – Fs/8) time-based modulation (Fs/8 – Fs/2), and modulation spectral centroid. I gathered some observations from this initial investigation that will be important in making Umo. Purr dominant frequency

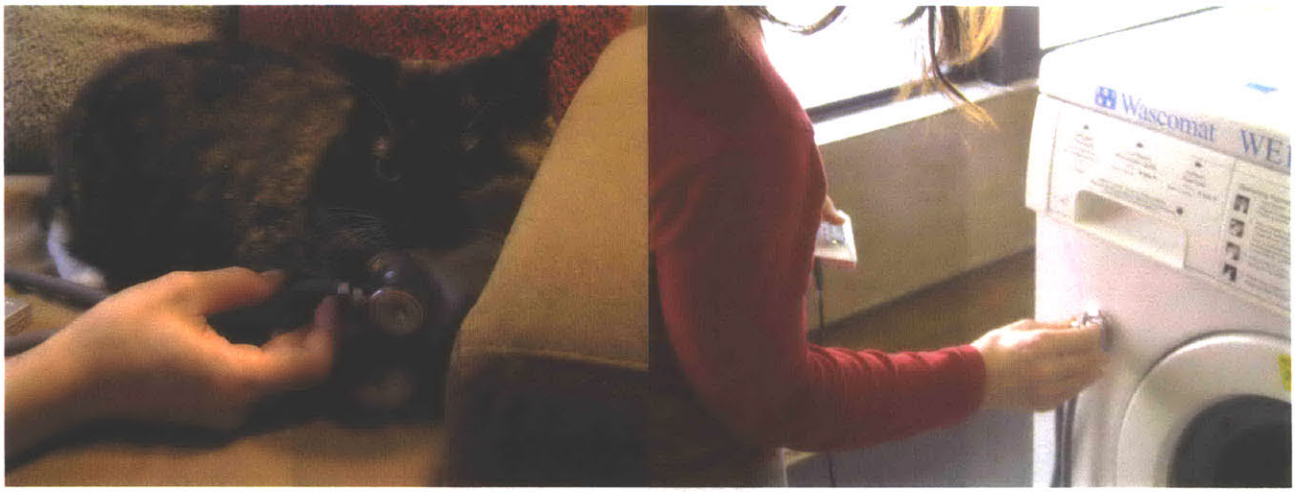

Fig. 5.5 I built a stethoscope microphone by carefully press-fitting a small electret mirophone (that could pick up frequencies as low as 20Hz) facing the bell end of a medical stethoscope. With either a signal gain circuit or a recorder that provides gain, this microphone works well. I used a Sony Minidisk recorder to record the sound samples.

is independent of purr rate in cats, I found. A certain cat has a distinct spectral purr fingerprint that is present on different days and at different purr rates. In Umo, I may therefore want to control purr rate independently of pitch.

In the spectrogram and fo estimation plot of a sound clip from Sofie the cat, we see two alternating dominant pitches associated with the purr out and the purr in. We can see the harmonic bands associated with human voiced sounds for the area of the purr with the 110Hz dominant pitch. Umo will adjust its purr characteristics in correspondence with the audio and breath input patterns and rates of change sensed from the person holding Umo.

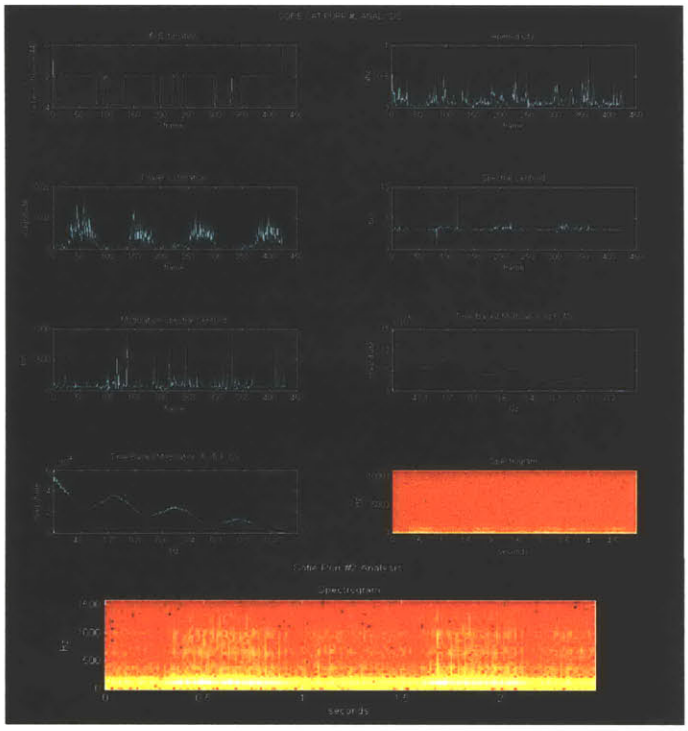

Fig. 5.6 Signal analysis of the purrs of Sofie the cat.

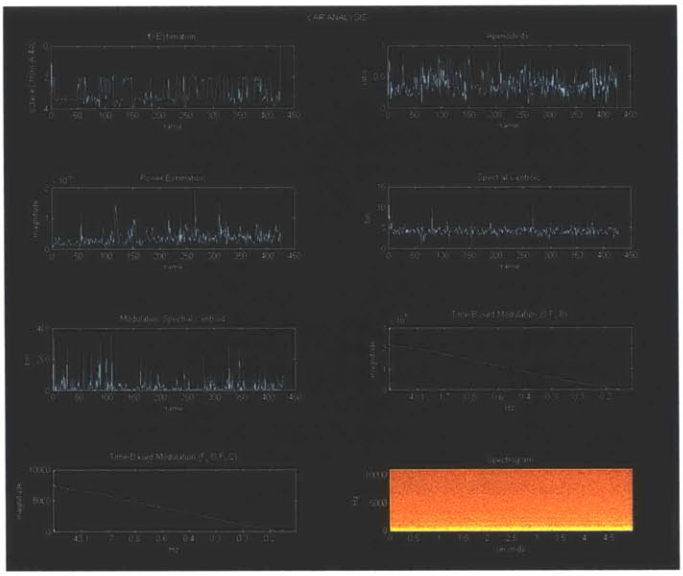

Fig. 5.7 Signal analysis of one of the car subjects.

The cars' fo estimations vacillate between about -2 octaves from A440 and -3.5 octaves from A440. Their spectral centroids are likewise very similar to those of cat purrs. Of course, cars do not have the nice breath rate of cats and their synchronized-to-breath purrs, so we do not see the time-based modulation in the power plot or the bumps indicating slower-than-roughness time-based modulation in the time-based modulation analysis. These very close similarities in fo characteristics and spectral centroid are also present in the clothes dryer subjects.

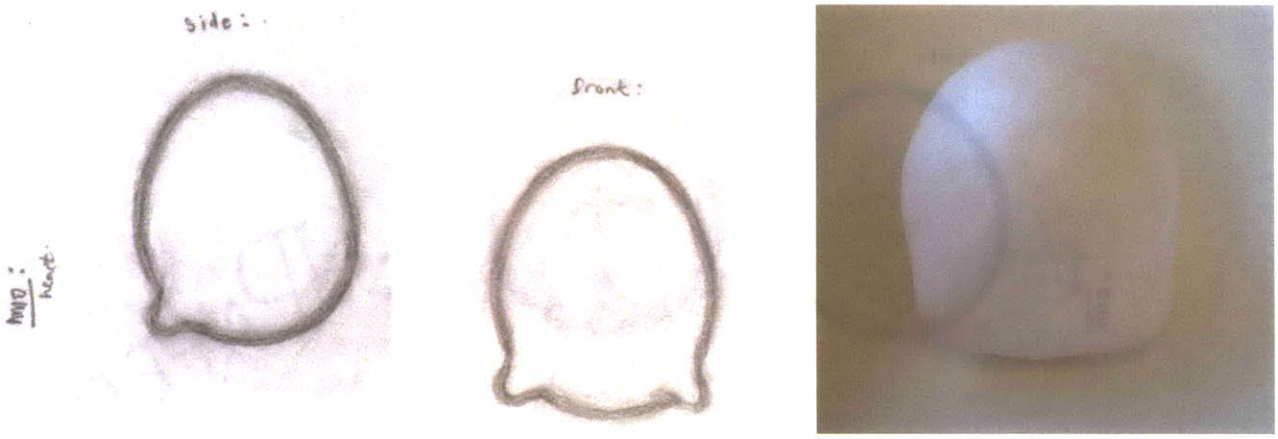

Fig. 5.8 Amo sketches and wax model.

AMO

The conception of Amo is informed by the evidence of electromagnetic radiation of machines present in people's conductive bodies, by my interpretation of La Monte Young and the high tension power lines, and by the work of other artists and designers and theorists such as Fiona Raby and Anthony Dunne on the electromagnetic significance of products. Amo is an electromagnetic relational companion machine. Amo is modeled to emit electromagnetic radiation in patterns like those of a human heart. It reads in the blood volume pulse from a person holding it and can synchronize its period and phase to that of the person's heart. Some research suggests that the mood and psychological state of a person is represented by the electric pattern of their heart activity, specifically the small high frequency signals that are carried on the lower frequency beat signal. In theory, the electromagnetic radiation of Amo will lightly register in the electric fields of the person and may register in the small-signal interbeat electric activity of their heart and may affect the person. If this does happen, it will dramatically demonstrate the possible significance of electromagnetic factors in our relationships with other machines.

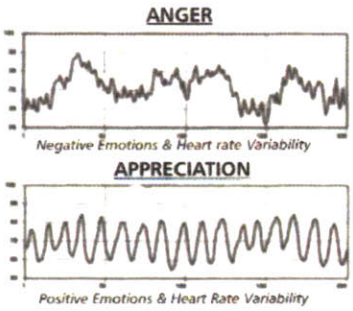

Fig. 5.9 Graph from McCraty (1998).

"...suddenly B.'s heart is in my heart."
- Georges Bataille[8]

8 Bataille quoted in Jean-Luc Nancy, *Being Singular Plural*, and *On Touching* (p.111).

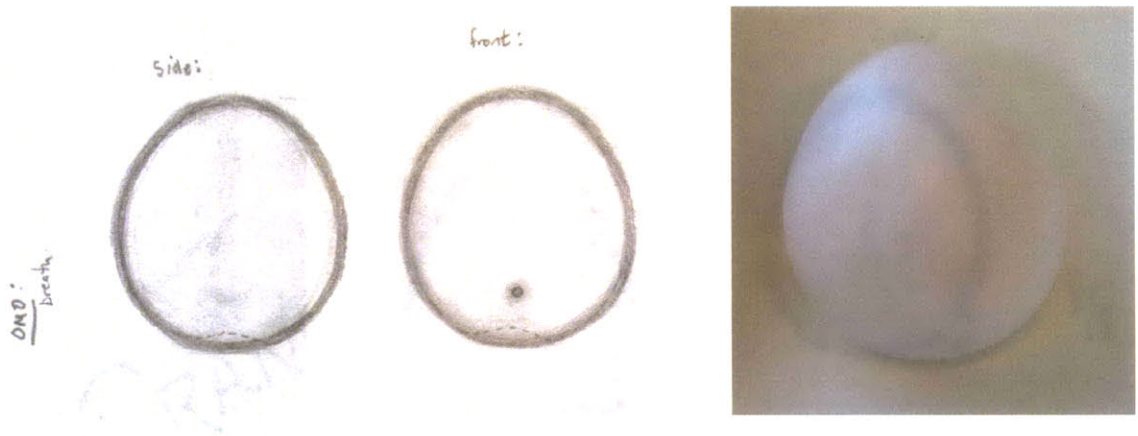

Fig. 5.10 Omo sketches and wax model.

OMO

Breathing-like behavior of machines, from iron lungs to the fan cycles of contemporary computers, influence people. We are very adept at interpreting breath, and our own breath is influenced by the breath of those around us.[9] Two people in close proximity will often, without thinking about it, begin to breathe in sync. The shortness of breath of another person is recognized and easily empathized with. Breath is also a major factor in our physical and emotional states. Involuntary emotional factors such as fear, anger, and excitement change our breath regularity. Yogic breathing exercises help people to practice voluntarily controlled healthy breathing patterns. Some breath pattern exercises help calm the mind and body. Some help raise energy levels. Others balance emotions and quiet anxieties. Omo senses the breath pattern and phase of a person holding it, and can synchronize its own breath pattern and phase to the person's. It may then slowly change its own, slowly enough so that the person naturally changes with it and stays in sync. By presenting breathing activity to entrain to, Omo may influence a person's breathing and, relatedly, their physical and psychological states.[10]

The building of Omo is presented in the next chapter, and interactions with it are discussed in the chapter following.

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9 Even the "breathing" Macintosh computer LED carries significance.

10 See Wegner's discussion of the emphasis on breathing and emotion in the work of Konstantin Stanislavsky (Wegner 1976). Also see Fried's *The Psychology and Physiology of Breathing.* "Unsteadiness of breathing in patients with hyperventilation syndrome and anxiety disorders" by Han, Stegan, Simkins, Cauberghs, Schepeers, Van den Bergh, Clement, and Van dee Woestijne; in *European Respiratory Journal,* 1997; 10: p.157-176

Chapter 6

MAKING OMO

In this chapter I describe the steps leading from the early design sketches and wax models to the fully functioning Omo. I begin by briefly outlining the intentions and methodologies for Omo overall, and then go through each factor in detail.

For a person holding Omo, I intended for Omo to be able to be experienced as moving between being part of the person and at other times being a separate thing. A smooth, simple, lap-sized form seemed appropriate. This form was also well suited to invite holding against one's front torso either in the lap or cradling in one's arms, the ideal interaction to enable Omo to pick up the pressure pattern of the person's breathing. The weight of Omo is designed to be around seven pounds, a substantial weight. The breathing is sensed via the pressure of the person's expanding torso against the very sensitive sensor array within Omo's skin. Omo is designed to sense and actuate in relation to the person's breathing, whether or not the person is paying conscious attention.

Fig. 6.1 Omo.

Figure 6.2 Sarah Lucas, Lion Heart, 1995, cast brass and cast lead; approximately 2 in x 2 in x 1 in. For Omo, I thought about a form more like an organ as if borrowed, like these lion testicles, but decided on a less grotesque design and metaphor for the first prototype.

I had considered making Omo a less smoothly symmetrical shape and instead more as if it had been removed from something and wanted to be reattached to something. This was a bit grotesque and in the end I went with a smooth simple shape for the first prototype.

I decided to design the look and feel and behavior of Omo as simple and organic, even perhaps organ-like, but not like a cut organ from a body or a part persistently missing its body. I chose this approach because the smooth organic simplicity I believed would support the possibility of the visceral machine being able to be used as a good transobject. The machine may sometimes, effortlessly and smoothly, seem a part of the person holding it, and at other times the person may perceive the very same machine as a separate object, as its own being. Omo is designed to sometimes act in synchrony with the person and facilitate subconscious entrainment and communication.

Omo is designed to, when left alone, breathe almost imperceptibly, so slowly and infrequently that it is hard to see or hear. The tiny movement and almost imperceptible sound would likely not be noticed by a person nearby unless especially attentive to Omo. This was intended to emphasize the communication/attachment initiated when it is eventually picked up. When someone picks up Omo it begins a more recognizable "breathing pattern." Omo is designed to deduce a person's breath envelope, rate, and phase if a person holds it so that the person's torso breath movement is against the surface of Omo. Omo can then adjust itself to actuate its own breath in a synchronous pattern.

Omo doesn't just mimic – it can lead. It can start with whatever breathing pattern it has synced to and can then smooth it out and alter the breath envelope and change the period, so slowly and attentively that if the person stays entrained with Omo it may influence the breath and thereby the physical and emotional state of the person interacting. It is not predictable and is not designed to only soothe. Omo may at times calm its holder. It may at other times excite, disturb, or otherwise affect them. This relates to the elements of people's own bodies expressing emotions without their selves having conscious control. People blush, they get goosebumps, they sweat, they hold their breath, breathe rapidly, or find themselves short of breath at times without their conscious control. Breath is not just a mirror of a person's inner state but also can be both subconsciously and consciously affective. Different conscious breathing exercises can help to awaken or calm a person.

In people and animals, physical and emotional states are closely linked to breathing, with breath envelope and breath amplitude and breath rate as components both portraying and inducing discernable affective characteristics. A long, even inhale followed by a longer, also even exhale is a calming breath. Rapid, short exhales are an

alert and energizing breath. Sighing, a fast exhale followed by a pause before a slow inhale that tapers off near its completion, is sometimes a sign of a depressed state.[1] Omo can recognize these patterns in a person's breath and can also express these states through its own breathing. We influence Omo's breathing state and it influences ours.

CONCEPT SKETCHING OMO'S MECHANISM

Omo is designed to take in and expel air by expanding and contracting itself. I initially imagined Omo with an elastic rubber interior air bladder. I designed this bladder to contain air independent of whatever material made up the outer layers, as I was not sure what material I would use for the outer layers and did not know if they would be airtight. The inner bladder connected to the air outside through an air tube that wraps within the thick skin before emerging as an orifice to the outside. From the earliest mechanical drawings, I worked on designing this tube in a way so that it would produce a breath-like sound as the air was suctioned and pushed through its corrugated curves. This separable inner bladder, indicated in orange in the early design sketch of Fig. 6.3, persisted in the design until the final stages. In the final version of Omo the inner air bladder is attached as the innermost layer of the thick skin. The air tube remains similar to its design in these earliest drawings.

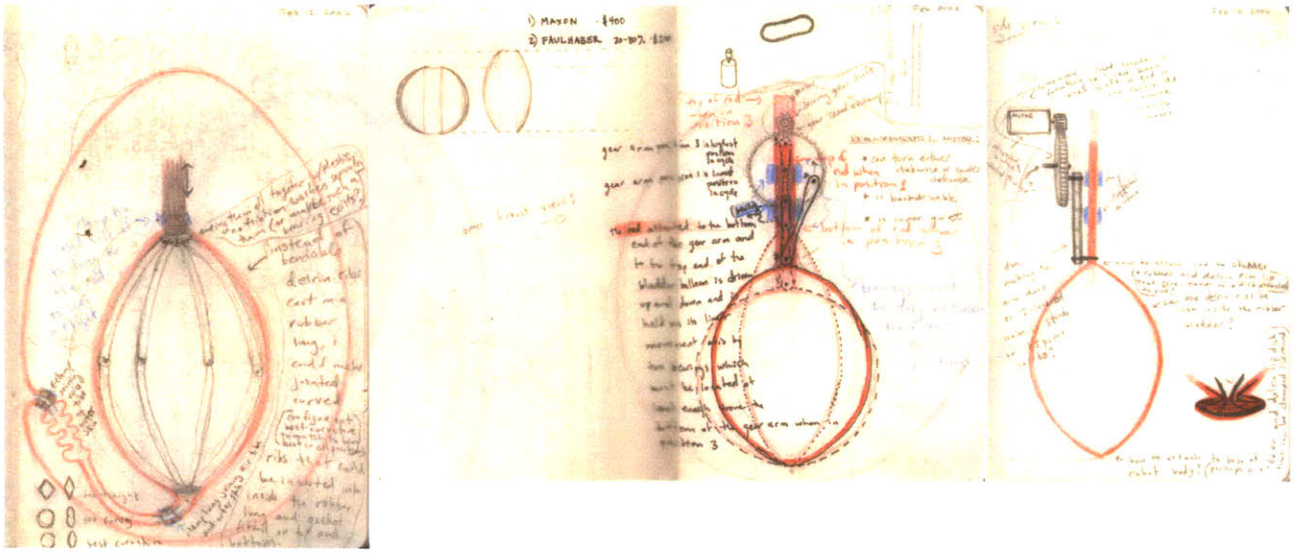

Fig. 6.3 Early sketches towards the breathing mechanism of Omo. This inner gear and arm assembly was not used after all, but the rubber breathing bladder did survive iterations of the design.

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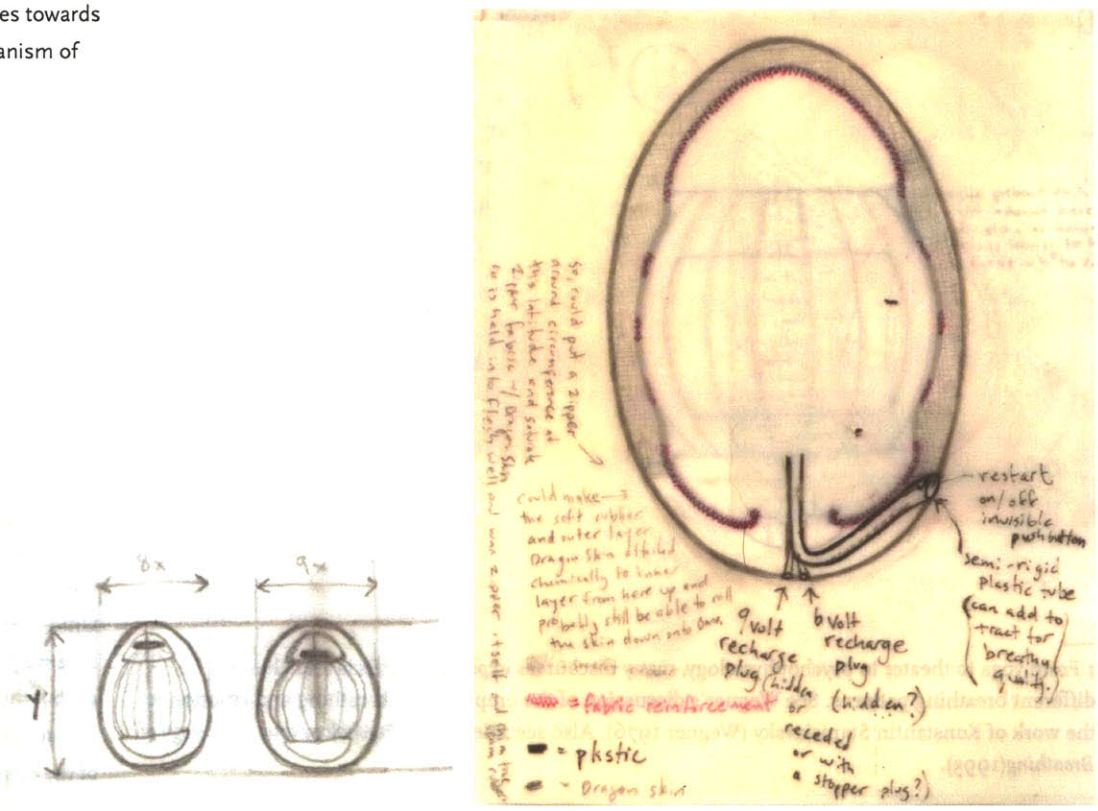
1 From yoga to theater to psychophysiology, many discourses explore the effects and clues of different breathing patterns. See Wegner's discussion of the emphasis on breathing and emotion in the work of Konstantin Stanislavsky (Wegner 1976). Also see Fried's *The Psychology and Physiology of Breathing*(1993).

In designing the mechanism that would push out and suction in air, I thought of the simple geometry of an elongated sphere. The more oblong a sphere becomes while maintaining its longitudinal curve length, the smaller its internal volume becomes. I worked on designing ribs that could provide a controllable structure for the air bladder. These ribs needed to be strong enough to expand the rubber bladder and to support the pressure of a person squeezing Omo. They each had to be flexible enough to themselves bend in a two dimensional arc as Omo breathes in and out. I modeled the vessel to be one of constant rib length that can be elongated and rounded by the action of ribs curving and extending. This is seen in the concept drawings and mechanical sketches.

One sketch for a mechanism that would bend and extend these ribs involved a multiple-jointed mechanical arm. This arm, in concert with gearing, would translate the turn of a motor in Omo into linear motion raising and lowering the top end of the rib mechanism. This would in turn cause each rib to bend and then extend as the motor turns forwards and then backwards. I changed the design for the simpler mechanism very roughly sketched in Fig 6.4 and developed in figure 6.5. This second design requires a faster motor and requires several turns of the motor to move the ribs the distance that the other design could move them by turning ninety degrees. However, this second design is simpler and more robust, with three mechanical components translating the motor's turns to ribs bending, rather than about nine in the first design. In the newer design, the motor has to be faster but is required to provide less torque.

Fig. 6.4 Early sketches towards the breathing mechanism of Omo.



DETAILING THE MECHANICAL DESIGN

Upon settling on a general design for Omo and having figured out the specific overall size and shape through sketching and building very rough models, the next steps were to design detailed mechanical parts and to choose an appropriate motor.

Finalizing the Design

The breath cavity and mechanical movement were worked out in the design sketches. The mechanical design challenge was to figure out how to best elongate and contract an almost spherical air volume. Before working out the motor attachment and lead screw assembly details of the mechanical design, the motor had to be chosen. And the choice of motor depended on the detailed mechanical design. The motor needed to fit within the rest of the mechanical assembly and to have a gear transmission that would allow it to function across the range of speed and torque required for Omo.

Choosing a Motor

The final design of Omo required a small DC motor coupled with a gear train assembly able to fit inside of Omo and rotate the linear screw to expand and contract the ribs and air chamber. It needed to be able to rotate controllably at speeds between one rotation per second up to at least twenty rotations per second.[2] I tried out two motors that closely fit the requirements and chose a S-series Maxon brushless DC motor with a 100:1 ratio gear assembly. This motor and gearing easily handled the torque reuirements, with well under 0.25 Amps even at max speed and pressure. It also met the speed requirements, although it was on the slow side of ideal. This I made up for in the mechanical design by using a lead screw that essentially translates one motor turn into four turns in terms of travel. This is described in detail in the lead screw section below. This motor runs with between 2 and 18 Volts. It fit well within Omo. I found these Maxon DC S-series motors surplus for $67 each.

SolidWorks Modeling

Some of the parts for Omo were purchased, others were machined by hand, and eight of the parts were 3D printed from stereo lithography files created in SolidWorks software. The hand drafts with precise measurements worked out were translated into SolidWorks, each feature being constructed one parameter at a time until the entire form was built. SolidWorks facilitated visualizations of parts moving together and it allowed me to refine parts and test how well parts lined up with each other.

The motor was attached to the inside top of the inner shell with a rubber gasket and three screws. The shaft of the motor was attached via the flexible shaft coupling to the lead screw. The other end of the lead screw was held in a bearing that was press fit into the inside center of the upper shell. This bearing secured the upper end of the

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2 I started out searching for a motor that could turn about five times faster than this, but because I found these nearly ideal Maxons for low cost, I simply used a faster lead screw (more starts per turn) to make up the difference.

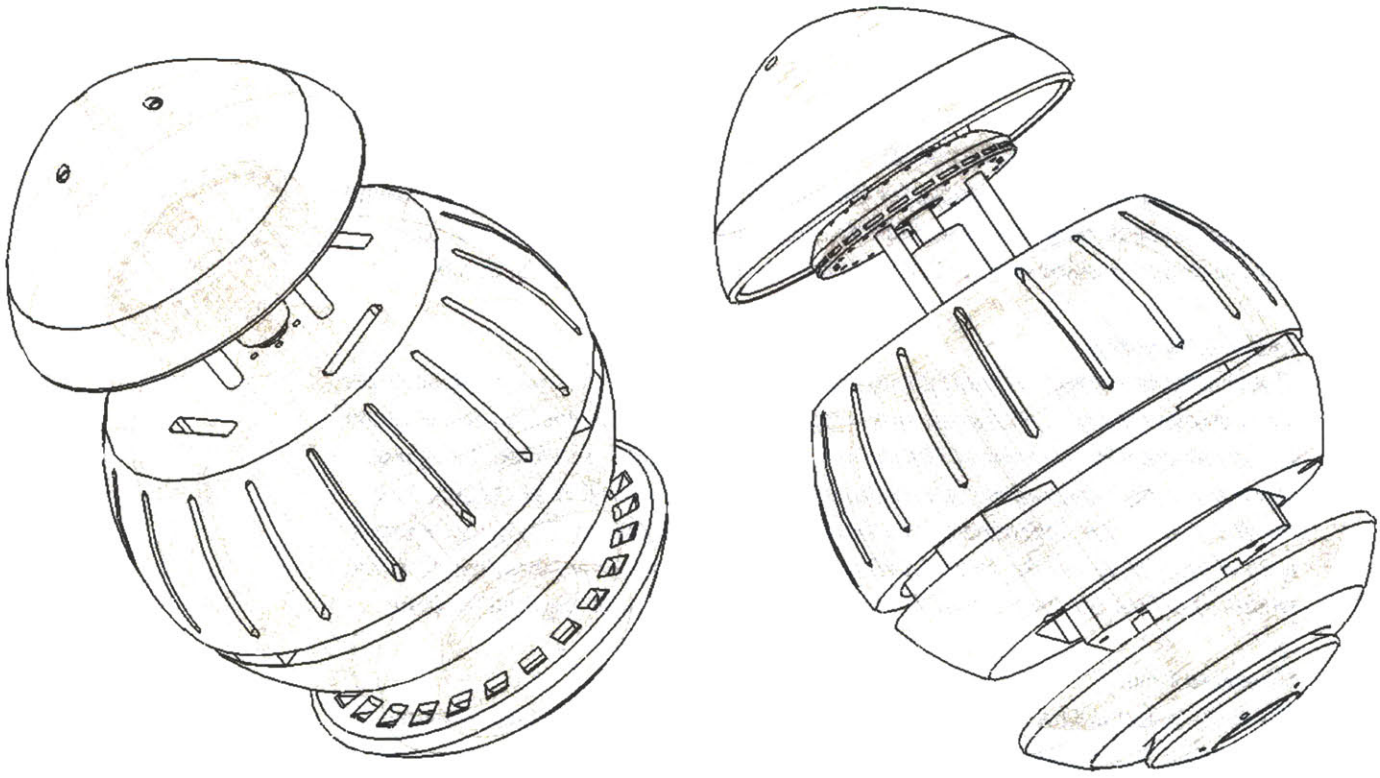


Fig. 6.5 Solidworks model of Omo's mechanical assembly.

lead screw and allowed it to freely turn without wearing the upper shell. A nut rides up and down on the lead screw as the lead screw is turned by the motor. This nut was press fit and screwed into the top rib socket. The top rib socket has three bearing holes allowing it to maintain alignment while gliding smoothly up and down on the three structural positioning rods. The top rib socket holds the top of every rib. The bottom rib holder holds the bottom of every rib and was itself secured in place in relation to the upper shell by the three structural positioning rods. These rods were press fit and screwed into the upper shell at one end and the bottom rib holder at the other end. As the motor turns backwards and then forwards all of the ribs are curved and then straightened by the movement of the top rib socket. The ribs expand and contract in relation to the centerline of Omo.

MAKING THE COMPONENT PARTS

1. Upper Shell

This top piece provides shape and structure. It was printed with a Stratasys stereo lithography printer out of a thermoplastic plastic. A recess in its inner uppermost area is for a bearing to be press fit to provide a strong and friction-free upper connection for the lead screw described below.

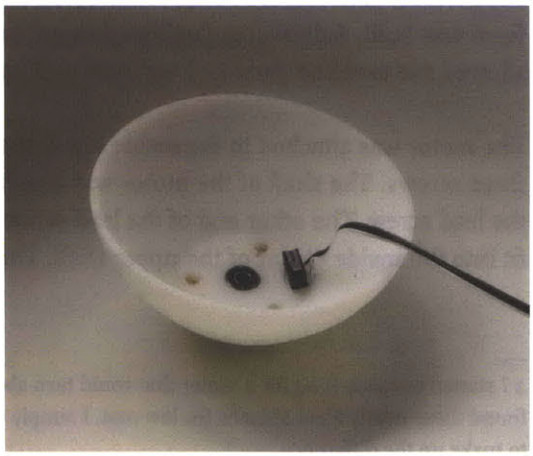
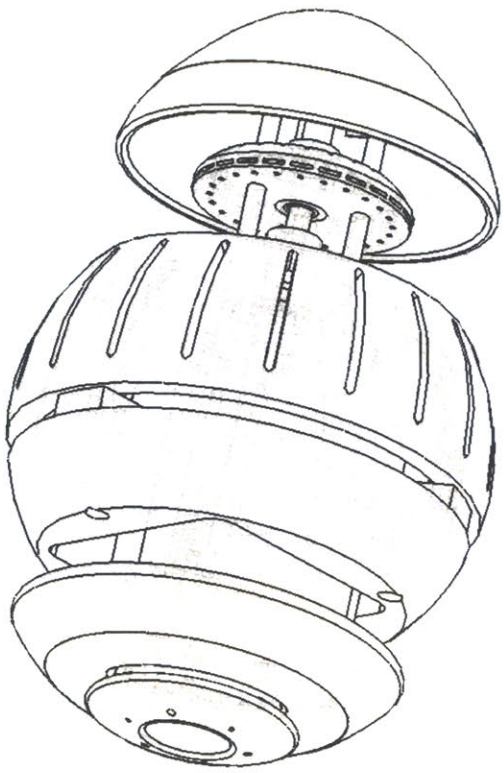
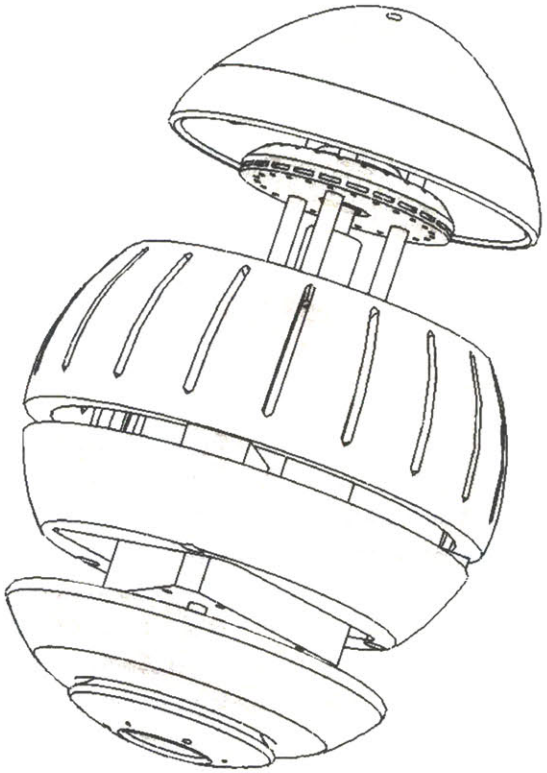


Fig. 6.6 Upper shell with bearing press fit in center recess and with the upper contact switch attached.





2, 3, 4. Three Structural Position Rods
These three stainless steel rods were designed and machined and attached to provide structure and alignment to the stationary and moving parts of Omo. They were made out of stainless steel rod 0.3125 inches in diameter. Using a lathe, I machined these rods to their precise lengths. I then drilled out their centers one inch deep at each end and threaded these holes to fit 4-40 screws so that the rods could be attached to the upper shell and bottom rib holder by being press fit and screwed in.

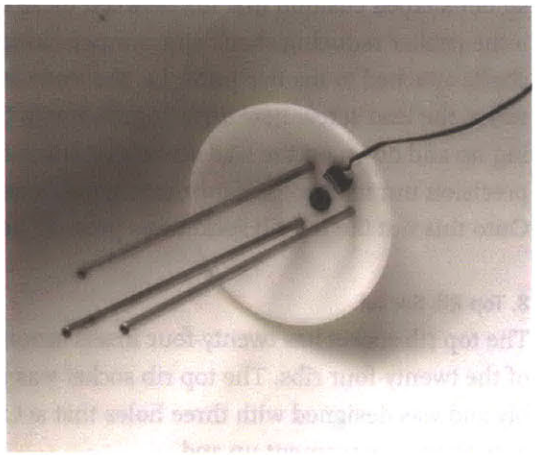


Fig. 6.7 Three structural position rods; the three rods in place in the upper shell.

5, 6, 7. Lead Screw, Nut, and Flexible Shaft Coupling
The lead screw was machined from miniature Acme threaded rod 0.216 inches in diameter, with 4 starts, 5.2 turns per inch, and 20.8 threads per inch. The reason I chose to make the lead screw out of rod with four

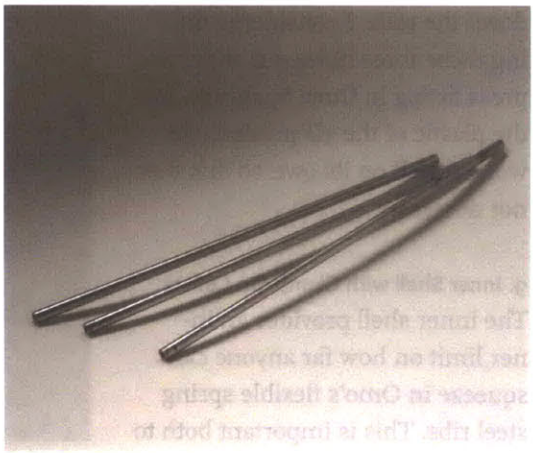


Fig. 6.8 The three structural positioning rods.

starts is so that the nut would travel further per motor turn than with a regular single start rod. Using this screw and nut assembly with four times more travel per turn made up for the motor gear transmission assembly being a bit on the slow side.

Fig. 6.9 Lead screw, nut, top rib socket, and flexible shaft collar.

I machined this threaded rod stock to the precise length needed and then turned down both ends. The top end of this screw I turned down on a lathe to smooth out the threads and to let it fit perfectly into the bearing that was itself press-fit into the upper shell. The bottom end I machined down to smooth over the threads and then cut a flat side to accept a set screw. This bottom end fit into the upper hub of the flexible spider shaft coupling and was secured with the hub's set screw. The flexible spider shaft coupling has a top hub that, in this design, attaches to the lead screw, and a bottom hub that in this design attaches to the motor gear transmission output shaft. These two aluminum hubs are connected by a rubber spider-shaped cushion that fits between these two hubs. These three parts fit together – the rubber reducing shock and compensating for slight misalignments of the two shafts attached to the two hubs, i.e. the lead screw and the motor. When the motor turns, the lead screw now turns together with the gear transmission output shaft. Riding up and down on the lead screw as it turns forwards and backwards is a miniature precision nut made of self-lubricating polyacetal and with a load capacity 25 pounds. Onto this nut the top rib socket was press-fit and secured with two screws.

8. Top Rib Socket

The top rib socket has twenty-four insets around its circumference to hold the top of the twenty-four ribs. The top rib socket was press fit over the lead screw assembly and was designed with three holes that act as guides and bushings to allow for easy aligned movement up and down the rods. I considered drilling these three holes out wider and press fitting in three bushings, but the plastic of the 3D printed part worked well on its own so this was not necessary.

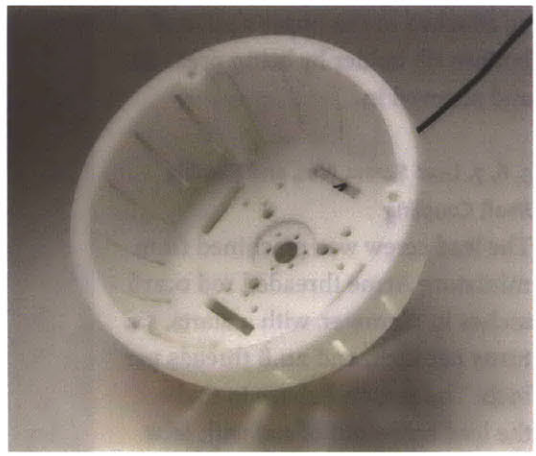


Fig. 6.10 Inner shell (with contact switch wire visible).

9. Inner Shell with Clamp-On Collars

The inner shell provides an inner limit on how far anyone can squeeze in Omo's flexible spring steel ribs. This is important both to

keep the ribs from popping inside out in their curvature and also to protect the hardware mounted under the inner shell. The motor was mounted to the top center of the inner shell with rubber washers for vibration dampening and three screws. The three structural position rods were passed through holes in the inner shell and then clamped in place at the right points along their length by three two-piece clamp-on collars that were in turn attached by 4-40 screws to the inner shell.

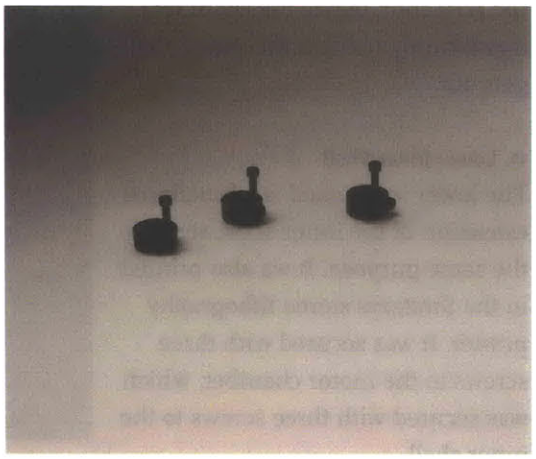


Fig. 6.11 The three clamp-on collars.

10. Motor Clamp

In the first trial I made this clamp cut on the laser jet cutter out of acylic sheet. This piece simply held the motor around its girth and was screwed into the inner shell at its three extended arms.

10.1 Motor Silencing Chamber

As small motor assemblies with high torque tend to be quite noisy due to their gear transmissions, I was presented with a challenge in terms of sound design. When it became clear after putting together Omo for the first time that the motor was perhaps a bit too noisy I went back and replaced the simple motor clamp with a sound blocking motor chamber. This chamber was attached over the motor and to the inner shell with a rubber gasket and screws with rubber washers. The motor wires ran out of its bottom hole that was then sealed with rubber to make the chamber nearly airtight and very sound dampening. I wanted to be sure a person holding Omo hears the soft breathing of Omo rather than the motor sounds. This 3D printed motor silencing chamber worked very well. In addition, I designed and cut rubber gaskets to provide acoustic and vibrational isolation (rather than coupling) and these were installed at all contact points between the motor and the inner shell. This was to avoid the violin effect of the sound reverberating through the main Omo structure. I could have achieved some sound dampening by simply wrapping the motor in a sound absorbing foam rather than constructing this case, but it was best to put the motor in the closed chamber because

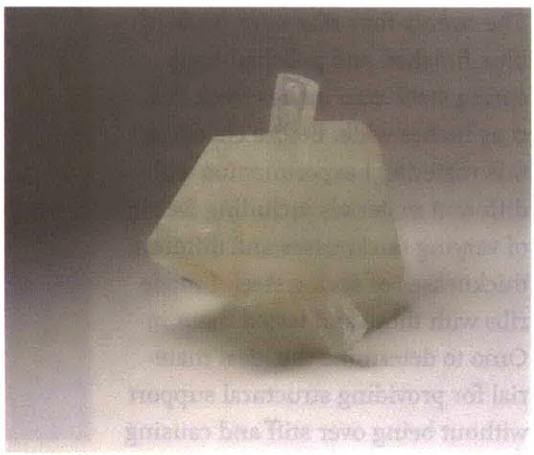


Fig. 6.12 Motor silencing chamber.

the refraction inside the chamber significantly reduces the sound that gets out.

Fig. 6.13 Lower inner shell.

11. Lower Inner Shell

The lower inner shell is a functional extension of the inner shell, serving the same purpose. It wa also printed in the Stratasys stereo lithography printer. It was secured with three screws to the motor chamber, which was secured with three screws to the inner shell.

12. Bottom Rib Holder

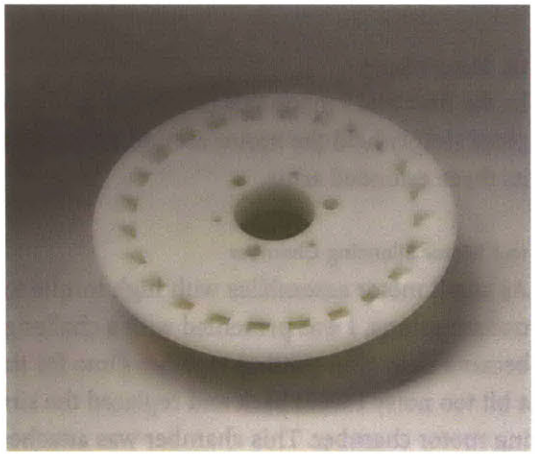


Fig. 6.14 Bottom rib holder.

The bottom rib holder is a Stratasys 3D-printed part with twenty-four inlets that provide a rocking joint for the bottom end of each of the twenty-four ribs. There are also twenty-four small holes for mounting set screws to clamp in these rib ends in case the rocking turned out to be too unstable. However these were not used because the rocking of the ribs inside the layered-in-printing and therefore very slightly ribbed surface provided some nice interesting unexpected jitters and kicks. (See comments p? of chapter 7.) The ribs are plenty secure from falling out without any set screws.

13-36. Ribs

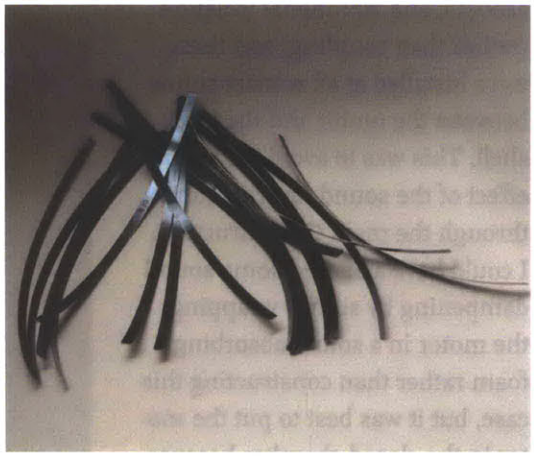


Fig. 6.15 Twenty-four spring steel ribs.

The twenty-four ribs were made of blue-finished and polished 1095 spring steel .020 inches thick and 0.25 inches wide. Before choosing this material, I experimented with different materials including Delrin of varying thicknesses and different thicknesses of spring steel. I made ribs with these and tested them in Omo to determine the ideal material for providing structural support without being over stiff and causing

undue strain on the motor. Some were too weak to withhold the pressure of a person squeezing Omo plus Omo's outer skin. Some were too stiff and were overkill, causing more work for the motor than necessary.

The reason for flat sheet stock rather than flexible rods or other stock is that the flat stock tends to bend only along one plane perpendicular to the surface. This predictable movement is desired for the expansion out and contraction in of Omo even under side sheer forces from people pressing it in funny ways.

Twenty-five feet coils of this steel are available from McMaster-Carr. I cut the long length to make each rib and then smoothed the edges on a belt sander. I rolled each rib a few times though a hand brake to give them a desired curvature. This curvature is the average of the different shapes that they have during breathing so that the overall torque required of the motor to bend and straighten the ribs is minimized.

The ribs were sized lengthwise so that at their maximum extension they almost touch the inner core while still maintaining an outer curvature. They can never be flipped inside out even if someone squeezes them.

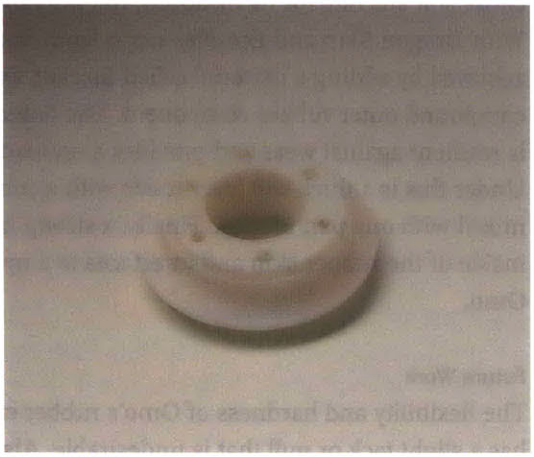


Fig. 6.16 Bottom plug and cable mount.

37, 38. Bottom Plug and Cable Mount
The bottom plug and cable mount guide the air tube from the outer skin into the inner air cavity of Omo. They also secure the nine-pin socket that accepts the various plugs for running, charging, and debugging Omo. The bottom plug was printed on the Stratasys and the cable mount was laser-cut.

CHOOSING MATERIAL FOR SQUEEZABLE SKIN

I considered mechanical, heat transfer, sensor, and other technical requirements, as well as tactile desires, when choosing a material for the outer skin. The squeezable thick outer layers of Omo had to be easily stretchable and had to be something that people would want to hold and cuddle with.

Textile Woven Sensor Fabric Developed as an Option for the Skin

Though I began developing woven and knit sensor fabrics for this project, I decided that I did not want Omo to have a cloth exterior. Cloth as skin could invite interpretations of Omo as either clothed or as a pillow.

Knit or Faux Fur

I considered using a very soft short faux fur or felted knit to construct Omo's outer skin. The faux fur, however, carries too much of a furry animal metaphor. Since an intention of Omo's design was to help a person's perception of Omo move in between whole creature and part of one's self, I chose not to make furry animal-like skin. And the felted knit was a bit too crafty and not quite elastic enough.

Rubber

I decided on the skin-like feel and robust properties of cast rubber. A rubber that is heat reflective with low thermal inertia may be ideal. The surface of Omo could then nicely reflect the warmth of a warm touch of a person holding it. I began experimenting with many rubber materials and found that the chemistry of many compounds were proprietary. In the interest of time, I tried test-casting materials that were closest to what I needed for Omo and that were accessible: polyeurathane and silicone rubbers of different hardnesses. After experimenting with different combinations, I chose soft silicone for its flexibility, integrity over many years, and high tear strength. With Dragon Skin and Eco-Flex-0030 from Smooth-On, varying hardnesses can be achieved by adding a material called Slacker, also made by Smooth-On. Omo has a compound outer rubber component. The outermost layer is Dragon Skin. This layer is resilient against wear and provides a non-tacky skin-like surface to touch and hold. Under this is a thick soft layer made with a combination of two parts EcoFlex-0030 mixed with one part Slacker. Finally, a strong inner layer of Dragon Skin seals the inside of the rubber skin and interfaces to a nylon stocking which covers the ribs of Omo.

Future Work

The flexibility and hardness of Omo's rubber exterior is ideal, however the surface has a slight tack or pull that is undesirable. Also, silicone has low thermal inertia but not as low as some of the proprietary rubber samples that I tested. Although Omo does somewhat reflect heat it could do so much more with a different material. In future versions I will work on accessing or developing a rubber that has a smoother surface feel and a lower thermal inertia.

MAKING THE CAST

Making the rubber outer part of Omo was achieved by making a mold, mixing dry pigments and liquid rubber, and then layering these mixtures to build up a cast. I was sensitive to the differences between direct working of physical forms with my hands versus through a CAD interface. CAD is a much better way to do certain types of mechanical design, and it is a wonderful way to approach form development in many instances. But hand-working affords a direct immediate material relation that I desired for the making of Omo's outer layer. Omo was designed to be relational through touch and holding. Accordingly, the process of making the model for the outer form was figured out through touch. The physical relationship that a holder of Omo would later experience was in part what I was designing through the physical process.

Fig. 6.17 - 6.21 Second wax model of Omo. With this model I finalized the design of the outer form. The bottom three images show stages in the process of making the mold from this model. This mold was then used to cast the outer surface of Omo.

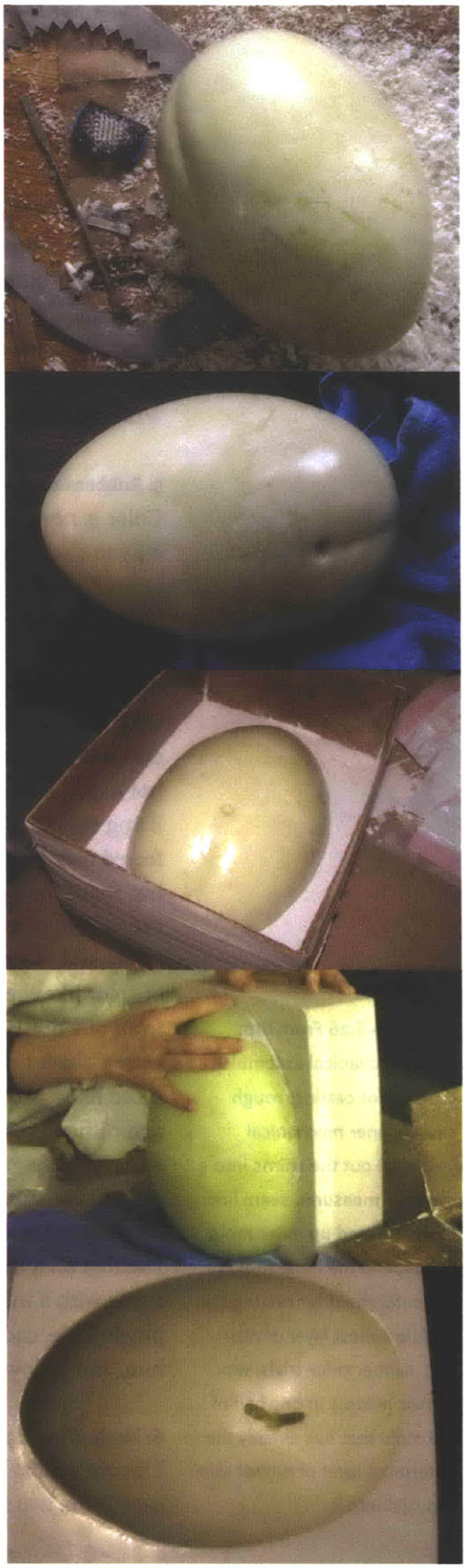
1. Second Wax Model

With the inner mechanical assembly complete, the next step was making a final wax model for the rubber outer element. This model would be used to make the mold for the cast of the rubber element of Omo to well fit the mechanical inner structure. I used a mixture of paraffin and beeswax, kept just below melting temperature in an electric pot, to build up the form for Omo. I used a wide long bristle paintbrush from the hardware store to paint on and build up layers of wax and a rasp and razor blade to shave down areas and smooth the form.

2. Making Plaster Cast as Mold for Outer Surface

Using plasticene, a firm, non-hardening modeling clay that makes a great reusable caulk for mold boxes, I built up a smooth horizontal ground around the wax Omo inside a sturdy box. It was important to make this surface high enough on the form that it would avoid leaving any undercuts that would lock the cast to the wax object. Using petroleum jelly as a release agent, the first part of a three-part plaster mold for making the final outer Omo was cast. When set, the wax model and the plaster cast were kept together and removed from the box and put back in the box with the plaster side down. The plasticene was removed and the second half of the cast was made it two parts, right and left, again avoiding any undercuts so that the plaster would easily release from the wax model. These second and third parts were then connected together after being released from the wax model. Though they could not be made together as they would have locked to the wax and required melting of the wax to release it, the next step was to cast very flexible rubber into these plaster molds. The rubber is flexible enough to be pulled out of even deep undercuts. Having them together for the liquid rubber casting was ideal because there would be less seams produced and pouring the liquid into the bowl-like structure with a horizontal upper level would require no extra mold parts, only gravity.

When dry, the inside surfaces of the two new sides of the mold for the outer surface of Omo's rubber element were cleaned with dry paper towels and coated with a thin wax barrier. This wax sealed the plaster and covered any residual petroleum jelly that can be reactive when casting silicone rubber. These waxed inner surfaces were then smoothed with a curved razor and with the rough side of a sponge to make the surface that would be the skin print of Omo.



3. Inner Wax Mold
I then covered and cast the mechanical structure itself to make a wax inner mold for casting Omo's rubber element.

4. Shims for Suspending Inner Mold
To suspend the wax inner mold inside the plaster outer mold, shims of thin sheet steel were designed in Adobe Illustrator based around an image of Omo and then produced using a water-jet cutter.

5. Rubber Color Trials
Color is never neutral and it was not easy to decide on a color palette for Omo. I wanted the color to not be specific as a fleshy pink, or a skin tone, or an eggshell color, or any certain color that people might have a strong reference about especially when on Omo. I also wanted Omo to in some way look not unlike something that could be a living object. A warm color was preferred over a cold color. I began thinking about the possibility of painting in the rubber in translucent pigmented layers and thereby building up layers of color like the translucent layers that form our human skin. I experimented with a blush that ended up looking more like a rash due to the fast curing and difficult to evenly spread rubber. After much experimentation and incessant consultation with many other people for a wide range of opinions, I settled on a translucent deep green made with a mixture of zinc white, pthalo blue, cadmium red medium hue, and yellow ochre dry pigments.

6. Made Three Layers
The outermost layer of rubber was slip cast in the two separate sides of the

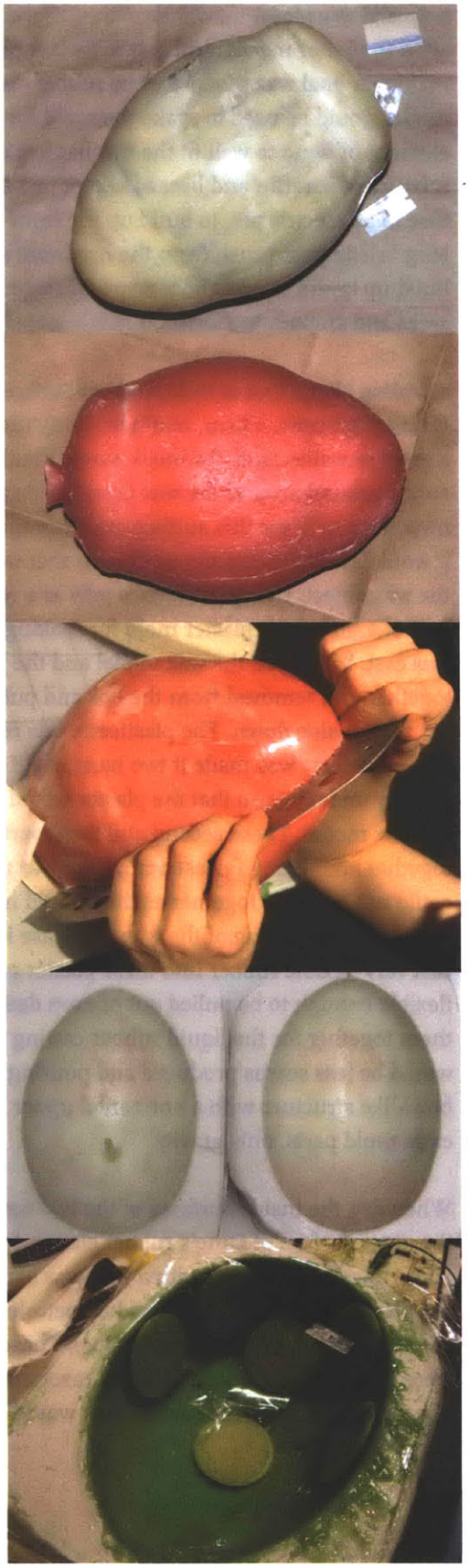


Fig. 6.22 - 6.26 From top: inner mechanical assembley covered for casting; rough cast of inner mechanical volume; i put the shims into a carefully measured seam line in the cleaned up inner mold to suspend the inner mold in the outer mold for casting the middle softest layer of rubber; rubber color trials; wax sensor holders in one half of the mold that has already the outermost layer of rubber skin slip cast into it.

plaster mold. This outermost layer is Dragon Skin mixed with dry pigments for color.

Before casting the middle thick section of rubber, sensor placeholders were secured where the real sensors (described in the next section) would be later placed. These placeholders were made of wax and were be removed after casting was complete. The middle softest rubber is a mixture of EcoFlex and Slacker with dry pigments for color. It has a low viscosity before curing. It was poured into the plaster outer mold, the wax inner mold was lowered in and then carefully aligned.

When the middle thick section was cured in one side of the mold, the wax inner mold was removed and the process was repeated with the other side of the plaster outer mold and the other side of the wax inner mold.

With the main thick layer cured, the inner wax mold was set aside and an innermost layer of Dragon Skin was slip cast to seal the surface of the soft middle rubber. This innermost surface is designed to press against the ribs lightly.

7. Inner Nylon Stocking for Low Friction Surface Facing Moving Ribs

A nylon stocking made by apparel designer Yoilta Nugent slips over Omo's ribs to provide a grip-less interface between the moving ribs and the rubber skin.

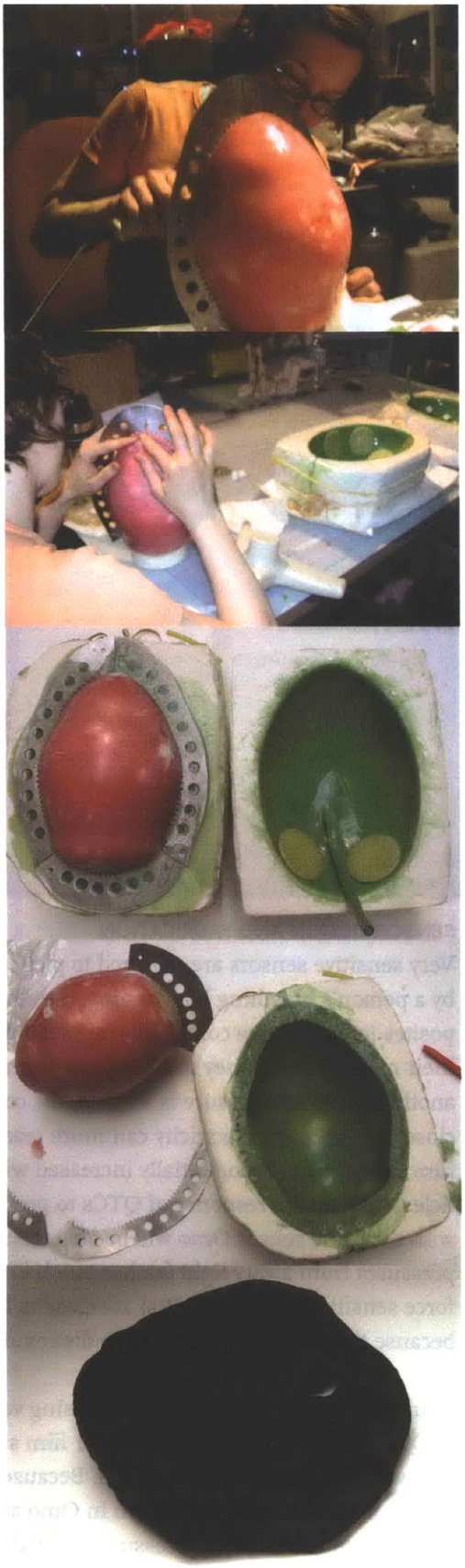


Fig. 6.27 - 6.31 From top: placing shims in inner mold; placing shims in inner mold (outer mold seen in background); outer-most layer of rubber skin in the half of the mold on the right side, inner softest layer of rubber being cast into the half of the mold on the left side; inner layer of soft rubber skin is cast in one half of the mold; nylon stocking that smoothly interfaces the rubber skin over the ribs of Omo.

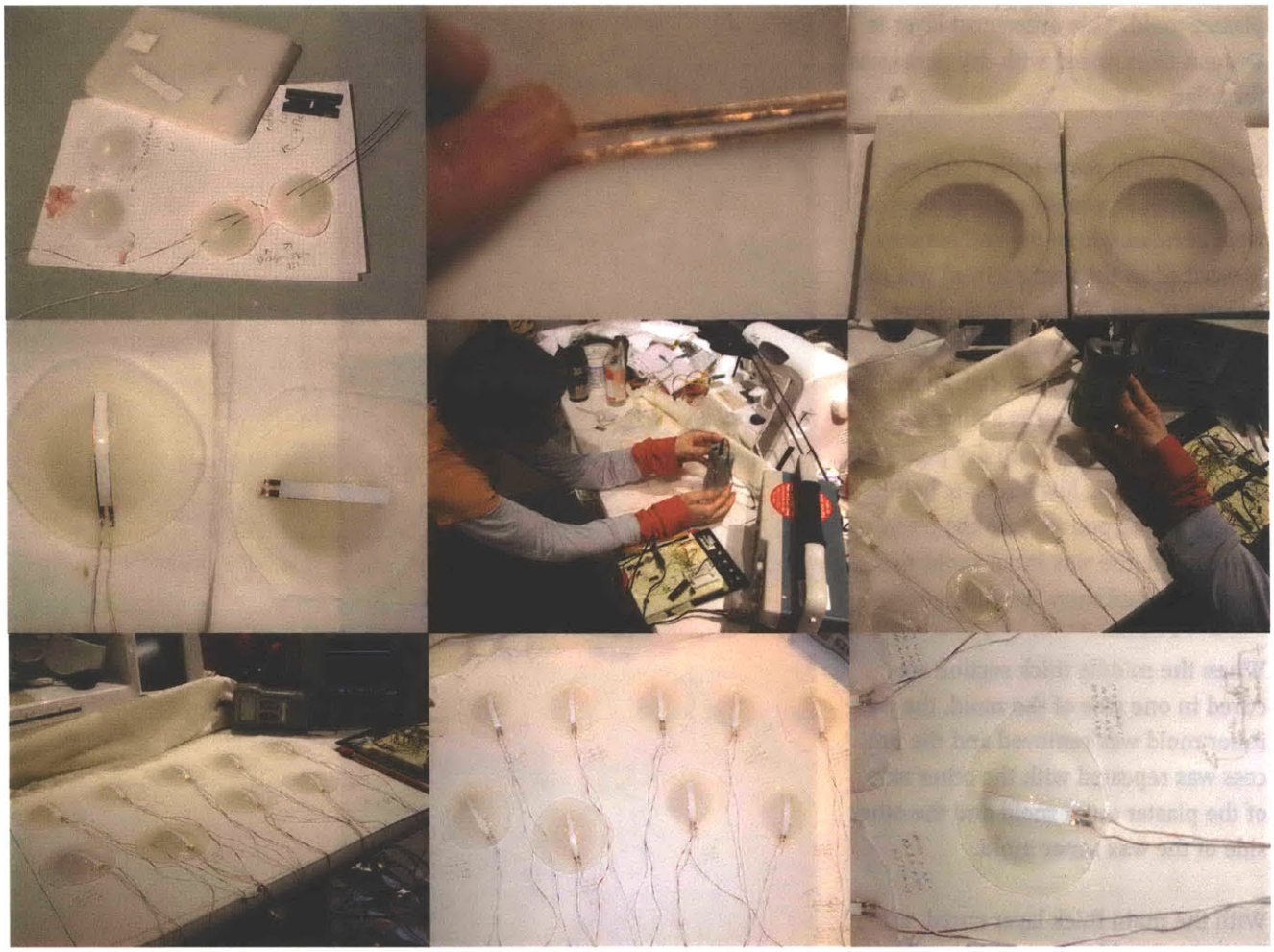


Fig. 6.32 - 6.40 Designing, fabricating and testing the sensors.

SENSOR DESIGN AND FABRICATION

Very sensitive sensors are required to pick up the slight changes in pressure caused by a person's breathing body against the surface of Omo. Quantum Tunneling Composites (or QTCs) are composites of metal particles and an elastomeric binder. As their name implies, they use quantum tunneling to move electrons from one area to another. As more pressure is applied, the conductive particles in the composite move closer together and electricity can more readily tunnel across the insulator. The quantum tunneling is exponentially increased with decreased spacing between the particles, making the response of QTCs to pressure changes ideal for Omo. Specifically, with the same sensor Omo will be able to sense and distinguish a smooth gradient of pressures from a very light feather touch to a inhumanly hard squeeze. In contrast, force sensitive resistors (FSRs) are close to linear in their response. They are not ideal because they would only be able to distinguish a limited range of pressures.

I built and tested prototype sensors using various electrode materials and pieces of QTC printed on a boPET polyester film substrate. The QTC on boPET polyester film was purchased from PeraTech. Because these sensors were to be placed in fitted rubber pockets reserved for them in Omo as described above, their backing had to be rigid enough to gather pressure. But I also wanted them to not feel like pellets

or disks inside the soft squeezable rubber. This would be too much like a disturbing unwanted growth in Omo. So, I designed rubber mounting substrates for these sensors. They are made of EcoFlex. They are of a slightly higher hardness than the very soft EcoFlex and Slacker comprising the main thick soft rubber section of Omo. They are almost as thick as the rubber layer. The breathing of a person interacting with Omo pushes on the Dragon Skin outer layer which in turn pushes against these rubber sensors. Their dome shape helps to focus the pressure. They are close enough in durometer to that of the soft rubber that surrounds them in Omo that their slightly higher hardness does not render them noticeable in interaction for a person.

I tried using conductive epoxy and also using conductive steel thread for the electrodes. The best material I found for the electrodes was copper foil shim material 0.001 inches thick.

The final sensors have two copper electrodes spaced 0.04 inches apart and a strip of QTC on top of each of these, making full contact with them and also full contact with a silicone substrate between them. All of this rests in a dome structure of EcoFlex silicone rubber with a durometer hardness of 20A.

When someone's torso or hand touches Omo, the physical pressure gets focused on the head of the dome shaped harder sensor inside more than anywhere else, making this sensor design well suited to pick up larger area pressures.

The sensors' dynamic range is logarithmic and translates to Omo's circuit as a resistance between 500hms and 300kOhms.

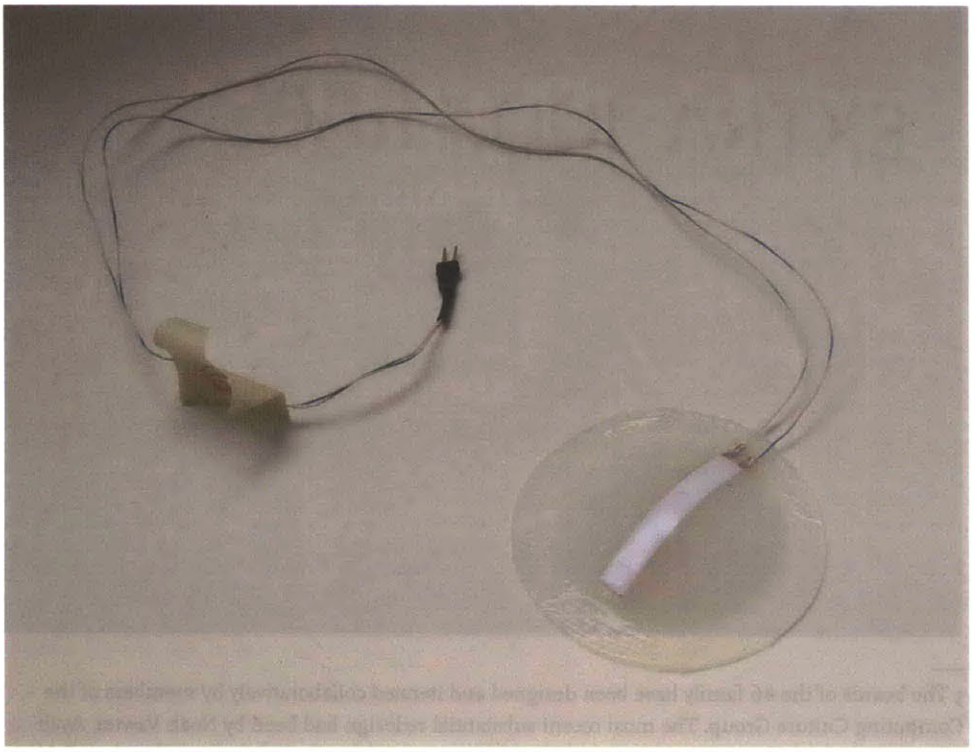


Fig. 6.41 A complete sensor of QTC on boPET, copper, silicone, and wire leads ready for attachment to the Omo circuit.

HARDWARE

1. Main Circuit Board

I designed a small double-sided surface mount board based on Computing Culture's Number Six board,[3] in turn based on the AtMega32 microcontroller. I miniaturized this board and added eight sensor inputs and an AREF buffer and a logarithmic amplifier for signal conditioning. I also implemented two limit switches on an interrupt line to watch for over-turns of the lead screw in the forward and backward directions. These limit switches are mounted inside Omo and are met by the top rib holder if ever the lead screw is over-turned.

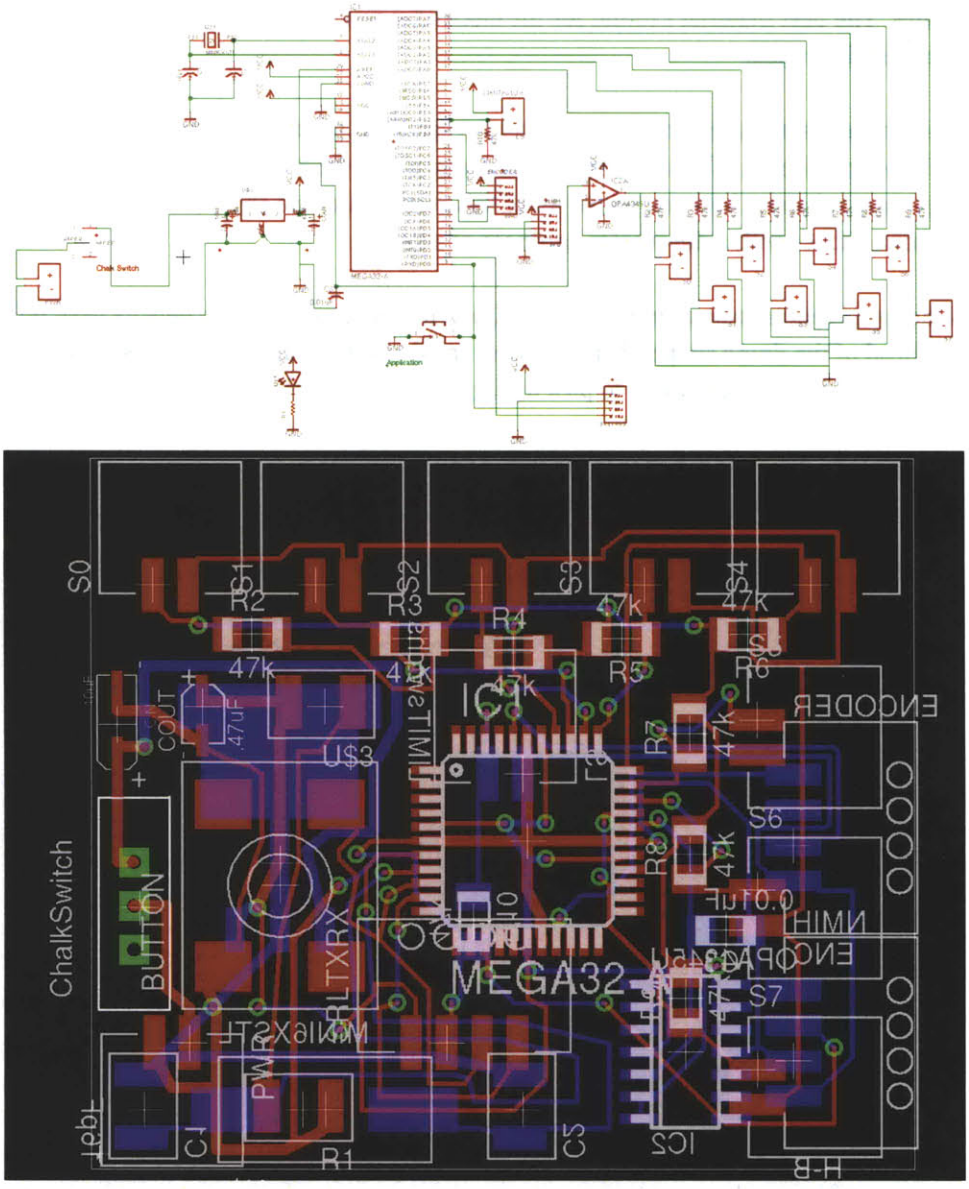
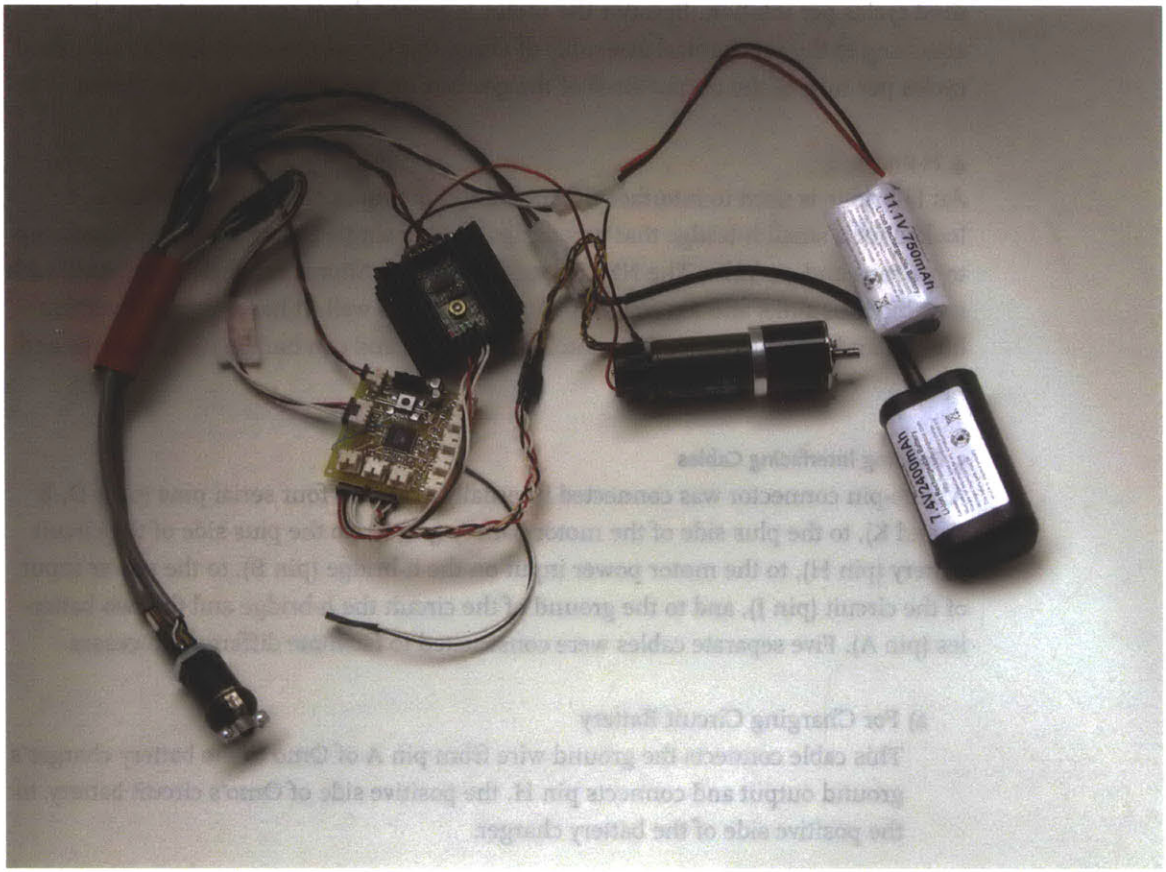


Fig. 6.42 Omo's AtMega32 microcontroller based circuit schematic and board design made in Eagle. The board has sensor channels conditioned and coming in on eight A/D pins.

3 The boards of the #6 family have been designed and iterated collaboratively by members of the Computing Culture Group. The most recent substantial redesign had been by Noah Vawter, Ayah Bdeir and Gemma Shustermann in 2003. We (Computing Culture Group) have made #6 available, along with code examples and tutorials, online and open source.



2. Batteries

Keeping power supplies separate for motor and circuit applications is a common practice. Motors can draw a lot of current and their electrical noise can sometimes "brown out" the circuit.

The circuit for Omo is powered by a rechargeable 7.4 Volt 2000mAh lithium-ion battery pack. The motor is powered separately by a rechargeable 11.1 Volt 750mAh lithium-ion battery pack.

The circuit battery has 2000 milliAmp hours while the motor battery provides only 750 milliAmp hours. In use, Omo's motor battery may deplete faster than the circuit battery depending on how actively Omo is breathing. These batteries do not last as long as would be ideal, but size was a constraint. As new batteries are developed Omo will get a power upgrade. These batteries can be charged by an external battery charger connected at times of charging with a cables built for Omo and described below. I would like to implement a capacitive charging element in the next prototype of Omo to replace this external cable requirement.

Figure 6.43 Omo's hardware from left to right: interfacing cable, main circuit board, h-bridge, motor with encoder and gear transmission, 11.1V motor battery, 7.4V circuit battery.

3. Motor Encoder

Omo uses a miniature shaft-mount optical encoder attached to the small motor shaft at the end of the motor without the gear box. This quadrature encoder has one hun-

dred cycles per rotation. Because the motor is geared down 100:1 revolutions before attaching to the mechanical assembly of Omo, this encoder is counting ten thousand cycles per turn of the output shaft of the gearbox on the other side of the motor.

4. H-Bridge

An H-bridge is used to interface the motor and the main circuit board of Omo. I looked for a small h-bridge that was designed for a single motor and could handle up to 3 Amps and 20 Volts. The NMIH-0050 from New Micros is a dual-layer board with nice big heat sinks and fits well into Omo and works well. It has overload detection built in and is designed for DC motor applications and can handle up to 5 Amps and up to 40 Volts.

5. Building Interfacing Cables

A nine-pin connector was connected internally to Omo's four serial pins (pins D, E, F, and K), to the plus side of the motor battery (pin C), to the plus side of the circuit battery (pin H), to the motor power input on the h-bridge (pin B), to the power input of the circuit (pin J), and to the ground of the circuit the h-bridge and the two batteries (pin A). Five separate cables were constructed to facilitate different processes.

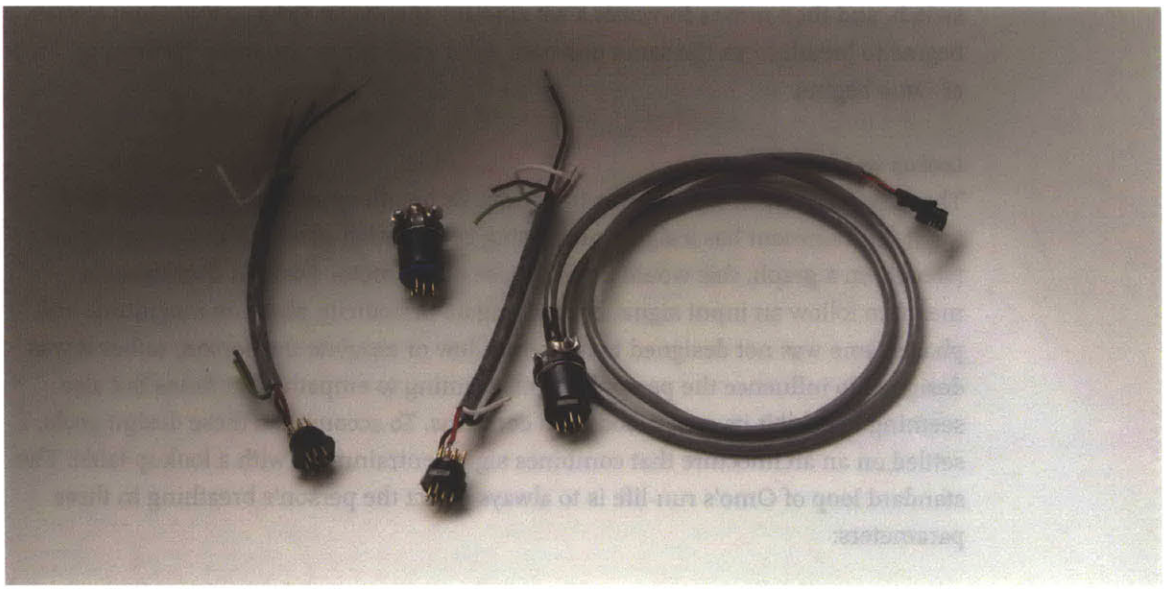
a) For Charging Circuit Battery
This cable connects the ground wire from pin A of Omo to the battery charger's ground output and connects pin H, the positive side of Omo's circuit battery, to the positive side of the battery charger.

b) For Charging Motor Battery
Separate charging is required for the two separate batteries. This cable connects the ground wire from pin A of Omo to the battery charger's ground output and connects pin C, the positive side of Omo's motor battery, to the positive side of the battery charger.

c) For Connecting Power and Running Program
To connect each of the batteries to their respective hosts, this plug jumpers pin J (positive input of circuit) to pin H (positive circuit battery lead), and separately jumpers pin B (positive input of motor via the h-bridge) to pin C (positive motor battery lead). The grounds are connected internally to Omo.

d) For Updating Code and Gathering Serial Output
This cable connects each of the batteries to their respective hosts as described in the above cable c. It also connects the four serial pins of Omo along a three-foot cable to a four pin header. This header can be interfaced through a serial converter to a computer and terminal for debugging and reprogramming Omo.

e) For Off State Open Circuit
This plug (not shown in image) is a safety cap insulating each plug pin. It



ensures against accidental shorting of neighbor pins while Omo is meant to be turned off.

SOFTWARE

Omo breathes in an expressive way with different patterns: it hyperventilates, sighs, laughs, and breaths slowly and deeply. Through its eight sensors, it can detect the nuanced breathing of the person holding it and entrain its patterns to theirs. To accomplish this, I developed custom software on the microcontroller that powers Omo to negotiate the complex sensor inputs and convert them into breathing patterns for the motor inside.

The software is written in C for the Atmel AtMega32 microcontroller. On power up, it initializes the core components of Omo: the eight sensors, the pulse width modulator (PWM) circuit that controls the breathing rib motor, the contact switches at the extreme of each cycle in case of emergency to prevent breaking Omo, the rotary encoder to get breath feedback, and a serial console for debugging.

The eight sensors are input to the system as analog to digital conversions. The microcontroller discretizes them to eight bits each for a range of values between 0 and 255 (255 is no touch, 0 is hardest touch). The motor is controlled through a PWM scheme that can set direction and speed at the same time, and the motor returns encoder "ticks" (how far it actually traveled) through a quadtrature encoder back to the chip. Two limit switches on interrupts can pause the code and restart in case of an accident.

Figure 6.44 Omo's interface and charging cables (left to right: b, c, a, d).

After initialization, the code begins a calibration process of the rib motor. It moves backwards until Omo is fully breathed out and the top rib joint hits the top contact

switch, and then moves forwards a set amount of encoder ticks so that Omo always begins to breath from the same position. After calibration, the main "breathing" loop of Omo begins.

Lookup versus Learning

The first design goal of Omo was to entrain its breath cycle from the person holding it. Entrainment has a signal processing connotation in which an output signal (viewed on a graph, this would be the phase of the motor position over time) is meant to follow an input signal by studying its periodicity, absolute magnitude and phase. Omo was not designed to directly follow or emulate the person; rather it was designed to influence the person by both seeming to empathize at times but also seeming to exhibit its own moods and concerns. To accomplish these design goals, I settled on an architecture that combines signal entrainment with a lookup table. The standard loop of Omo's run-life is to always detect the person's breathing in three parameters:

*frequency: the periodicity of the breath cycle. How many "cycles" (Omo defines a cycle as the window detection length of a sensor) between a breath intake and the next.
*breath intake phase: the delta between Omo's start intake breath and the person's. In a zero phase system, both Omo and the person begin intake breaths at the same time.
*magnitude: the pressure on the sensor from the person's torso gives an indication of breath magnitude (how deep their breathing is).

From these three parameters Omo can easily follow and entrain a person's breathing. The main loop continually detects these three parameters and slightly adjusts (at 10% increments) its own parameters of frequency, phase and magnitude (all controlled by adjusting the motor controller's direction and speed) to move towards the person. However, in practice people found an aping Omo to be non-effective. The time of entrainment was too long to be effective, and often large movement by the person or sensor misreads would cause Omo to become wildly confused and would take ages to settle down. In the first evaluations, people found Omo to be almost too neurotic and confusing.

Therefore the result architecture keeps the parameter following routines but augments them with a large set of look-up tables that can be modified depending on the situation. Omo begins breathing with a list of instructions that define speed, pauses, and direction. Its overall periodicity follows the person but it does not directly mimic every cycle; rather, there is a window size of over a few secondsduring which the routine patiently measures the person's breathing and then makes a carefully informed decision on the next chosen breath cycle.

There is a series of breath cycle look-up tables that include normal breathing, deep breathing, hyperventilating, sighing, and laughing. Omo will often stay in the "normal breathing" state, unless it detects fast breathing, in which case it will entrain and then slow down. Other times it may unpredictably choose its own hyperventilating

cycle. This was achieved in this first prototype of Omo software by leaving room for it to misinterpret sensor activity as breathing. This is not the final design. Something unpredictable but related to what is happening and has happened to Omo, more like the neurotic behavior of an individual, needs to be developed further in future work.

Future Work

Ideally, Omo would learn over time about the touch and the breathing of the people that it interacted with and would learn about them personally and be able to interact with them personally. Omo should have a memory. It could then store experiences it has had that could feed into its own behaviors and the reactions that it has learned from people. Omo might learn new behaviors and breathing patterns from the way it has been breathed with. If Omo seemed to a person to be in a frazzled nightmare state, and someone tried to call it down, it could then use that human reaction in its own reactions in the future.

PUTTING OMO TOGETHER

Omo had to be put together in a certain order as a 3D puzzle in order to fit all of the parts and properly attach them.

1. Upper Shell, Lead Screw Bearings, and the Three Structural Rods

First, two bearings were press-fitted into a small inset in the inner uppermost point of the upper shell 3-D printed part. These bearings hold the top end of the lead screw when Omo is fully assembled so that it can turn freely without wear on the plastic of the upper shell.

The next step was to attach the three structural stainless steel rods to the upper shell by pressing them into their three insets in the shell and then securing them with three 4-40 inch screws.

2. Lead Screw, Precision Nut, and Upper Rib Joint

The precision nut was press-fitted into its hole in the upper rib joint. Small screws reinforced this attachment. The lead screw was put through the nut and was slid over the three rods until the top of it fit into its bearings in the upper shell.

3. Motor to Inner Shell, and Inner Shell to Three Structural Rods

The motor was attached with rubber washers interfacing to the upper inside of the inner shell. The motor sound chamber was then mounted around the motor and to the top inside of the inner shell using a fitted rubber gasket and rubber washers for sound and vibration dampening. The motor wires were routed out a small hole in the bottom of the sound chamber. The hole was then plugged with warm soft thermoplastic plastic that hardened to form a seal. One hub of the flexible shaft coupler was attached to the protruding shaft of the motor gear assembly at the top outside of the inner shell. The inner shell has three holes to fit the three structural rods. It was slid onto the three structural rods until the other hub of the flexible shaft couple met the

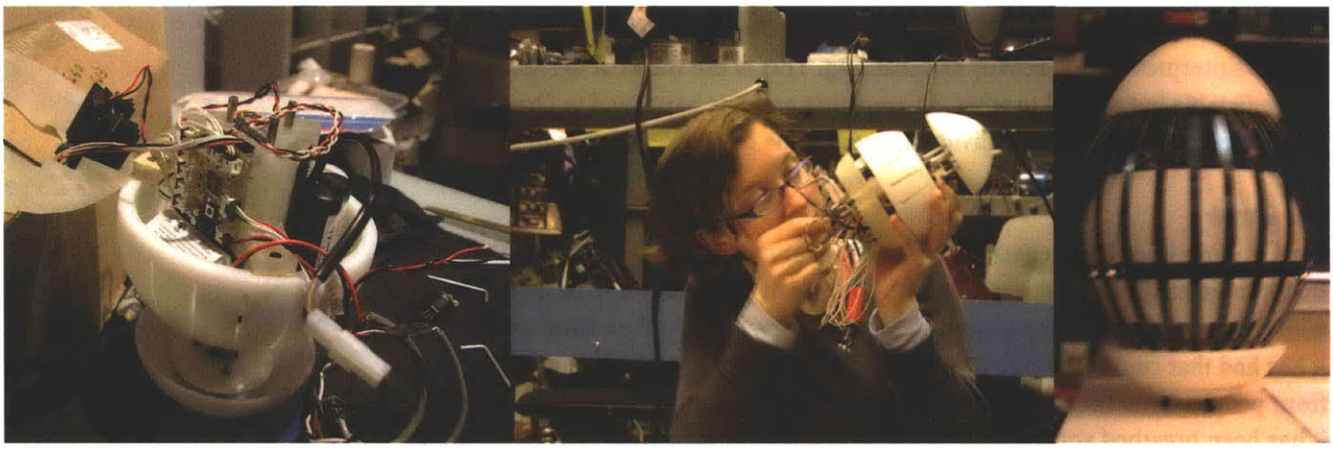


Figure 6.45 Putting Omo together.

lead screw. This hub was attached to the lead screw and the three positioning rods were secured in place by three collar clamps screwed to the inner shell.

4. Mounting of Circuit and Batteries to Motor Sound Chamber

The circuit was mounted to one of the three sides of the motor sound chamber. Three holes for three 2-56 screws were drilled into this side of the sound chamber lining up with the holes in the circuit board for mounting. The circuit was stably secured in place using rubber standoff washers and three sets of screws and nuts. The sensor connection cables were attached after mounting and guided out the bottom of the inner shell.

Each of the two batteries was mounted with industrial Velcro to the remaining two sides of the motor sound chamber. Screw terminals we re then used to attach the battery lead wires to the main Omo cable leading to the plug where attachment cables for running Omo, charging Omo, and debugging/reprogramming the serial output of Omo can be attached.

5. Lower Inside Shell

The lower inside shell was attached through holes in the extensions of the motor sound chamber and to the inner shell with 6-32 1-inch screws.

6. Bottom Rib Holder and Plug Mount

The bottom rib holder has three recesses fot the three rods. It was press-fitted onto the three structural rods and secured with three 4-40 inch screws. The plug mount and bottom rib holder have holes to accept three 4-40 screws to attach them together. The cable with a nine-pin terminal is mounted in the plug mount so that it can be made accessible under a small plug of rubber made removable from Omo's outer skin.

7. Ribs

The ribs were put in one at a time by pressing them into their respective slots in the upper rib joint and bottom rib holder.

8. Sensors and Skin

The two sides of the outer skin were sealed to each other using the same three mixtures used to make the skin. A sealing edge of about seven inches was left so that the skin could be pulled over the inner mechanicals of Omo and then sealed. The sensors were carefully mounted in their respective pockets in the skin and their wires were routed to the sealing edge of the skin. The nylon stocking was placed inside the skin. The nylon stocking and skin were then pulled over the mechanical assembly of Omo. The sealing edge was mostly sealed.

A DAY IN THE LIFE OF OMO

Omo starts up with the insertion of the run plug. Once the initialization is complete, Omo begins checking its sensors. If there is no sensor activity indicating the interaction of someone or something with Omo, Omo breathes at its own very slow rate of approximately two small breaths a minute.

When someone holds Omo and Omo senses a breathing pattern (accomplished by a linear regression using a sliding window over the sensor values) Omo will often begin to change its own breathing pattern to line up in phase, period and envelope with the person's breathing, deduced through continual processing of the real-time sensor input. This doesn't all happen at once – Omo takes some breaths and time to adjust its breathing to the person holding it. In this time, the person may consciously or very often subconsciously adjust their breath to entrain to Omo as well.

Once the breaths of Omo and the person are synchronized, Omo might begin to change its own pattern to influence the breathing of the person. Omo can adjust its breath envelope and breath rate slowly enough to continuously establish synchronicity with the person – the final effect being to influence the person's breath rate and pattern.

Chapter 7

EVALUATION, SUMMARY AND FUTURE WORK

This chapter offers critical response to the objectives and projects of this thesis, which in turn inform the goals and future concentrations of this ongoing work. In the Critiques and Responses section of this chapter I present insights and observations from formal art critiques and participants' responses to Omo. Next, in the Summary section, I review what we have seen in the work of Machine Therapy so far, including its contributions to art, critical theory, and machine design. In the Future Work section I introduce the beginnings of studies and recontextualizations of some of the projects presented in this dissertation.

CRITIQUES AND RESPONSES

I chose to focus on a formal art critique with Omo because this type of analysis can reveal what a creation is actually doing with people, and how it is experienced. What is revealed through this process may differ greatly from what I intended for Omo to be doing and meaning for people. Or, on the other hand, it may reaffirm what I intended and hoped the Omo system's meaning would be. Usually, critiques bring up some of both of these elements – affirmations and surprises. Formal art critiques are an established technique for artists. By engaging in serious critiques, artists and designers may learn what are the vital experiential factors; including parapractic elements.

Twenty-one experts in the fields of art, art history, critical theory, psychoanalysis and machine design participated in two days of formal critique sessions with Omo. It was a group of people uniquely suited to understand many of my concerns and intentions, all able to look at the work with fresh eyes. I will present what was discussed in those sessions as well as some follow-up responses.

The critique sessions were held on two consecutive days and lasted about two hours each. Let me begin by briefly introducing the people who participated.

Panel of Experts

Day 1

Bill Arning
Christopher Csikszentmihályi
Jane Farver
Zhang Ga
Wendy Jacob
Caroline Jones
Lauren Kroiz
Ewa Lajer-Burcharth
Dana Moser

Day 2

Edith Ackermann
Barbara Barry
Ute Meta Bauer
Wendy Hui Kyong Chun
Susan Cohen
Patricia Fuller
Marjory Jacobson
Muntadas
Rosalind Picard
Meg Rotzel
Michael Rush
Krzysztof Wodiczko

I began the first day of critiques by briefly presenting my previous work and designs for Umo and Amo, as well as Omo. The working mechanical apparatus of Omo was not yet in the sensate skin. This made it challenging for participants to fully experience what the project would be like when finished. On the second day Omo was complete with its sensate skin and we began by passing it around and interacting with it and each other.

Interesting and centrally important observations came out of each session, including a few serious surprises.

Comments, Discussions, and Observations

Some of the issues raised during the critiques confirmed and further informed my design intentions, such as Omo being perceived as both separate and part of a person in affective and visceral ways. Others raised concerns I had not considered but that are important to address as the project continues. I am going to highlight some of the findings that crucially inform the work as it goes forward.

Useful Disruptions of Psychoanalysis

> *"Are the machines therapists or are the people therapists for the machines? I think there is this really wonderful ambiguity."*

Caroline Jones brought up this intended ambiguity in the work, and asked me to think about it further and to clarify my own ideas about it. She suggested that, because I am dealing with ideas about the self and the mechanical – are the machines absorbed by the body or is the body affected by the external machine? – I may want to sharpen my ideas as they relate to therapy.

Caroline Jones added the point also that Freudian talk therapy structures itself obsessively around relationships of self to other, of analyst to analysand, and that I therefore may want to incorporate this critically into my own thinking about these machines. It may be useful to sharpen my ideas about the self and the mechanical: are they being absorbed by the body? Or, is the body being affected and possibly absorbed by them? I may decide to keep things ambiguous. This point brought out what has been a constant negotiation for me due to my own ambiguous approach to these machines. On the one hand, I have intended for them to offer passages into reflective and subconscious emotional relating that can be comforting and healing. At the same time, in contrast and if I am not successful then also in negation of the soothing capacity intention, I have wanted them to be unpredictable at times, to present energetic states and jittery states, to be somewhat neurotic themselves. I have intended for Omo and Umo and Amo to be critical alternatives to companion robots designed to always soothe and support homeostasis. These as critical alternatives to the current standard approaches to companion robots was for me among the most important elements in the conceptions of these machines. But in the critique this was not yet clearly present through the material experience. Caroline Jones explains it well by saying,

> *"It's very interesting to hear you say that you want these to be occasionally capricious and mischievous ... but most of what they're doing seems actually aimed at the person holding them, to train them, [to soothe the person holding them.]"*

I had explained in my presentation of the projects that I intended for them to be capricious, but, as Caroline and others justly observed, Omo was more calming than mischievous in our session. I am reassured to hear that the disruptive misbehaving aspects are desired by others. The fact that these behaviors were not clearly behaviorally developed yet in Omo at the time of the critique, especially not on the first day of the critique, is one I was aware of. I am currently working on further developing this centrally important aspect of Omo..

Wendy Hui Kyong Chun experienced Omo on the second day. She held it and was a bit disturbed by it as well as soothed by it, and said something very similar to what, unbeknownst to her, Caroline Jones had offered on the first day. Because on the second day Omo was fully embodied, it was a bit more able to present its occasional simple neurotic propensities. Wendy said,

> *"What I find fascinating is the way in which you were not just using psychoanalysis, you were disrupting psychoanalysis in really interesting ways. One of the things that*

struck me looking at the objects is that you were not just disrupting the notion of separation between subject and object, but also between analyst and analysand. So sometimes the human is the one being analyzed and it is a therapeutic relation to a machine, and at other times the machine is giving off these parapractic signals that you need to interpret. It is really interesting that you are always oscillating between that relationship and disrupting that in really productive ways."

A second comment from Wendy Hui Kyong Chun brought up something which I perhaps once knew but had forgotten about:

"And then thinking about the tactility as well: earlier Freud worked with hysteria through massage and then he moved away from that. It struck me that you are actually going deeper into some of the forgotten histories of psychoanalysis as well and doing something really productive in relationship."

In terms of sharpening my own ideas presented through these projects in relation to traditional psychoanalysis, this historical tie is wonderful and extremely significant.

Material Formal Properties

Concerning the material properties of the wax models for Umo, Amo and Omo, and of the finished rubber Omo, participants in the critiques made revelatory associations. On separate days, Muntadas and Wendy Jacob commented on the forms being very Brancusi. Ute Meta Bauer said [and here I paraphrase] that they looked very clean, like safe sex, yet nevertheless one wonders what is going on inside – that there is a subversiveness; that people feel seduced by the objects through their external form but that this form is a bit of a disguise; that in these projects there is also a carnal dark side of desire which is nice.

In fact, without thinking of myself as a trickster, I was designing the objects from the start to be seductive, to invite holding and cozy embraces. I needed these interactions to be occasioned in order for the machines to be able to read signals from the people and interact with them in immediately informed ways as they were designed to. The forms were developed in the physical process of making them by holding them myself and by feeling what feels good to hold, thinking about how I wanted to hold what parts of each object, and judging if the size and surfaces were just right for my body to be easily at home with them. That the forms were very Brancusi was never conscious, though in looking at them afterwards and in light of these comments I agreed that they were. That Brancusi made sculptures for the blind is a relevant, telling connection.

That the forms were perhaps more "cozy" for the participant on their surface than what is happening inside the machines at times was never a completely conscious plan of seduction, or a construction of an excuse for people to embrace the machines. Only through the discussions did it become clear to me how vital these forms were and how specifically they were acting with people in inviting and seductive kinds of ways.

Wendy Jacob offered an important point about the rubber versus the hard wax of the models.

> *"I'm thinking of autistic children who really respond to a washing machine as it is going through all of its different cycles, lying on top of it, especially as it goes through its cycles. And there's nothing about that washing machine that feels like skin, or is tactile beyond just a cold surface. But it is still very useful and comforting. So I'm wondering if the movement in these [Omo, Amo, Umo] towards body references is maybe not the point – but that it is something else that is happening inside of it that makes you respond to it."*

Wendy herself preferred the feel of the hard wax model to the soft squishy rubber skin. Zhang Ga agreed saying that maybe I was taking the metaphor of the body relation too far, that it does not need to be literally body-like in touch.

Zhang Ga also made an interesting observation about a few of my previous projects in comparison to the material presentation of Omo. He commented on the forms and the functions being disharmonious, somewhat like what Ute Meta Bauer said on the other day of critique. Zhang Ga said:

> *"To bring about this freaky part of it – as in the [violent, guttural] shouting into something [smooth, tame] organic, a disguised form – these[referring to Blendie and ScreamBody] bring a level of criticality to the human-machine interaction. To me that is actually more important than trying to create this harmonious human-machine relationship."*

Many on the critique panel commented in different ways about the visual and visceral metaphors in Omo, Amo, and Umo – looking like Brancusi sculptures, perhaps being too body-like, being ambiguous about how a person is to approach them. These observations point dramatically to the fact that I need to be very careful about how I contextualize these objects both through their embodiments and through the situations they are presented in. As Zhang Ga and Chris Csikszentmihályi pointed out in the critique, with Blendie a viewer already has a great deal of context because they recognize the object as a blender – and not just any blender but a blender from the 1940s, with familiar functions. Also, in the video with Blendie I perform the new approach to the machine, thus offering a lot of clues for a person approaching the project. With Omo, Amo, and Umo the viewer has never seen these objects before. Therefore all of the visual, tactile, and situational information becomes hugely important. It is up to me as the designer/artist to successfully provide that information in a way that helps people access these objects and their possibilities. Because I had been in the middle of making the machines for so long I was intimately linked to them, so much so that before the critiques I had not stepped back enough to realize that everyone else would not know just what to do with them, that people would need and would use whatever hints and clues were present. Through the critique process, it became very clear that it was my responsibility to very carefully construct each hint and clue. Of course I knew this on some levels beforehand – I designed the forms in ways to invite certain methods of holding and placement and I carefully came up

with a color that was comfortable without looking fleshy or cold and I tried to avoid specific form references – but my ideas of hints and clues did not cover everything.

The situation I found myself in as the maker of Omo, Amo, and Umo relates very much to that of other machine designers – when one is intensely involved in the engineering and physical construction of making something function as desired, one has a very different understanding and rapport with the object than can be expected of a newcomer to the thing. The designer may know exactly how to use a device that a newcomer to the device would need guiding elements and contextualization of the device to know what it is and how to perhaps use it. How these guiding components are produced and presented is part of the object, whether a product with placement and advertising or an artwork with installation and contextualization, and whether consciously considered and carefully planned or haphazardly constructed.

Where And How To Present This Work

The contextualization of the Omo, Amo, and Umo will be centrally important to peoples' interpretation and approach to them. Ewa Lajer-Burcharth pointed out :

> *"We are more or less adults, right? Why would we want a transitional object? It is not that we wouldn't – I love these machines – they are fantastic and I think that on the level of machines you have done the most interesting and fascinating work. What needs to be thought of more is the relation of these machines, as ambiguous, to us. ... One way of doing this would be to think more about that while a bio-medical device makes us assume, really, some kind of biomedical state – but on what grounds?"*
> *... "Perhaps it would be helpful/useful for you to think of specific situations in which one would want to get in touch with this object. Not general psychologically defined situations of happiness, meditation versus anxiety. Because most of us, since precisely we have developed past the transitional object would not think of a transitional object as something that would solve our situation – more likely a drink, or a shrink, but not the [transitional] object. So it would be nice to actually reintroduce this idea to us – that it might be useful to think of an object like that. And that could be done through the invasion of some social complex such as the classroom, teaching, biennials, visit to Documenta... some kind of experimental situations which would be connected to either people's desire for and need for some sort of radical departure from the context that produces anxiety, as in the classroom, or people's willingness to engage with strange things as one does in biennials, Documenta, and other such things where you can introduce a very different kind of para-performance activity such as that."*

Besides the machines themselves, this other component that is also central, which is our relation to these objects, indeed needs to be addressed in the design of specific scenarios and situations. I had been focused on building the machines and thinking about the theories informing the machines. I had not yet very much begun to deal with how these objects would be presented in the world or how they would be introduced to people. I will not leave the fate of these machines up to whatever happens. Rather, it is up to me to guide, map, choreograph (as situations choreograph a person's actions within the situation). As Ewa Lajer-Bucharth suggests, for these to

be successful art projects I need to plan how to set up these objects in a scenario in which people will be willing to step out of their day-to-day behaviors and expectancies, as in an artistic happening or extended event. I have done this in the past with Blendie and ScreamBody. And Krzysztof Wodiczko and I presented Aegis together at Art Forum Berlin one year in an event in which people expected to be surprised and taken out of their regular assumptions through performance and/or installation or other ways of experiencing the work. Omo, Amo and Umo can be presented in a useful and appropriate way for the intentions and ambition of the work. Some possibilities of how these projects may be put out into the world will be described the Future Work section of this chapter.

People Negotiate the Intimacy and the Separateness Continuously

In the critiques, especially during the second day when Omo was working and put together in its skin, I assumed everyone would want to hold it and experience it primarily as something that one holds. Something was missing in this assumption though. Though people did all hold it close, they did so for varying amounts of time and also people held it at a distance. People also closely attended to what was happening with Omo and other people as other people held it.

Edith Ackermann tried different approaches to Omo. She experimented by putting Omo in different places in the space – on a felt cushion, on the floor, near other things.

Edith Ackermann:

"As I am playing with Omo (gesturing towards Omo as it is on the table where Edith has put it, breathing) I am solving a dilemma I had with it – because we think of it in terms of touch, this thing we cuddle, and mother and child and so on – but this is so funny, just seeing it do its things. Every now and then it does a strange dance and it starts moving. It is breathing – you can see it very well. And there are all different ways in which it can be staged."

A person can be in an intimate close-contact relationship with Omo wherein it may be passing between being experienced as separate and then part of the self. A person may alternately put it physically away from one's self and leave it and let it be alone in the world. From this second perspective a person can experience Omo relating to what is around it. This is different and also interesting. Through Edith's experiments and explanation in the critique she brought out Omo as being as, she put it, "a funny extension of a relational object: an object that is maintaining its own rapport with whatever is around it. Because whatever they sit on top of they relate to. So that's a funny side effect."

As I think about setting up situations in which people will have experiences with these objects, I need to consider the full range of ways people may try to experience the objects. Both up close and kept at a distance, the ways in which people will learn from the objects is dependent on the situations that are being called forth. People can also learn or take on ideas of what to do with them by seeing other people in

various spaces and situations doing things with these machines. The machines can be observed conducting their own rapport with whatever they are sitting on and also with whomever else is interacting with them. The social situation manifested by an installation or happening will be an intimate and central part of the work.

Relationship In Which There Is No "Other"

Krzysztof Wodiczko:

> *"I always wanted to be pregnant. It's a kind of nice moment in my life – being closer to this."*

An interesting surprise for me was that many people, especially women, associated holding Omo with being pregnant. The little [unintended] kicks that Omo's ribs make as they move in their sockets added to this impression. Even women who have experienced pregnancy made this comparison. The shape of Omo is like a pregnant belly, and one holds it in front of the abdomen. But it was all of the more subtle actions – the kicking, the breathing, the unknown surprises that Omo enacts – that people commented on as making the experience of holding Omo uncannily like being pregnant. It could be interesting to look at the gender differences in interpreting Omo. The pregnancy metaphor may be a good sign that Omo is successfully moving into being perceived as part of one's body. At the same time, this pregnancy metaphor may limit other more subtle interpretations.

One of these other more subtle interpretations was clearly articulated by Krzysztof Wodiczko as he reflected a possible ethical dimension of the work.

> *"The idea is the issue of having a relationship that is not based on difference, and not just being the other. So, if we can learn, this might have some good effects in terms of our relations to self and others."*[1]

If we can learn to experience ourselves and others without clear boundaries between – with Omo as an example helping to remake our conceptions of relations – we may be able to re-perceive what we once termed "others" as neither separable nor part of one's self, but rather in intimate contingent connection. This might have some good effects on personal, social, and political scales.

Unknown Boundaries

In the beginning of the second day of critiques when Omo first began breathing with people it was experiencing a bit of the hiccups. It was not really breathing. A group gathered around it, watching and listening for it and closely following the facial expressions of whoever was holding it, looking for clues. People were very attentive, nervous, and unsure of what Omo may do. When it started breathing there was a group sigh of relief in the room.

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1 Krzysztof Wodiczko related this to the work of artist, psychoanalyst, and theorist Bracha Lichtenberg-Ettinger.

People would rather keep all of the possibilities open when dealing with an alien object. It never occurred to me that, for example, people would be afraid that it may expand out suddenly and pop itself.

Edith Ackermann asks,

> *"Do you feel it?"*

Wendy Hui Kyong Chun looks to her nodding,

> *"It feels like it's going to explode."*

Edith Ackermann immediately recognized the interesting relevance of this comment.

> *"That is a very interesting. (Edith turning to me) Did you hear that? When it expands, a person who is not familiar with the intricacies of its design does not know what its boundaries are going to be."*

I did not anticipate these reactions when designing Omo. I knew where its breath cycle boundaries were and therefore I thought it was just going to breathe. The critique participants gave it more room when imagining how it may behave. This is an interesting side-element I had not considered. Depending on the context, I can imagine playing with this ambiguity a little more or, in contrast, giving the person reassurances that Omo is not going to explode. There are many ways this could be done. One possible reassurance is revealing the inner mechanism by using clear rubber on the outside. Another is providing video or printed instructions of some kind that explain how Omo works. It will be important to consider what the side effects of different reassurances may be and to design them in a way such that the ways in which they guide experiences with Omo are appropriate for how I would like to have the work positioned. For example, a brochure that very much productizes and makes Omo a thing with parts may not be ideal as it would over emphasize the object aspect of Omo. I may want instead to make sure the contextualizations help emphasize the transobject aspects and the connections and usefulness of the dissolution of subject–object borders.

It is clear that through the process of formal art critiques with participants familiar with psychoanalytic discourse, art history, critical art practice, machine design and science and technology studies that aspects of the work were consciously interrogated and attended to in ways that crucially revealed aspects that were successful and aspects that needed to be considered further. Because the panelists were deeply informed in the areas in which I am trying to engage, they could offer reflections and evaluations that were specific and contextual to the various discourses Omo and the other projects approach. What I learned through these critiques in invaluable as the work continues.

I was also interested in casual ethnographic observations about Omo in everyday life. A long-term study in planning is described in the Future Work section of this chapter. For now I will just give a few glimpses from a day with Omo.

Some Early Encounters

I would like to share some observations from the first day of Omo breathing and having casual interactions.

Omo and a Young Couple, Keith and Robyn

I introduced Omo to Keith who held it quietly for several minutes, attentively listening to its sounds and feeling as it changed its breathing pattern. When Robyn came into the room Keith asked,

"Do you want to hold Baby?"

Robyn tried holding Omo in different positions, including against her ear. Omo behaved differently as it was moved about. Robyn commented,

"I like it when it takes a really big breath."

Omo and a Cat, Wilbur

Wilbur the cat came across Omo on a bench in Wilbur's backyard. At first Omo was not breathing noticeably and Wilbur was fairly uninterested. When Omo took a noticeable breath, Wilbur began investigations, smelling and poking Omo with his nose and pawing it. Future work will include learning about how domestic animals may interact with these companion machines.

Omo and a Washing Machine

I found that if I put Omo on a washing machine as it is going through its different agitation and spin cycles Omo entrains with it. While there is not yet a market for machines that counsel other machines, who knows...

SUMMARY

There is an incredible, versatile, wide-open and adaptive space among ourselves, each other, and our environments. Doctors, scientists, poets, philosophers, psychoanalysts and artists have tried to comprehend this space and the phenomena of how we constantly make our selves, our relationships and our worlds. The making of machines affords dramatic new perspectives.

With Omo I have made a machine that may help facilitate an ethical dissolution of self versus other boundaries. The greatest contribution of this work may unfold as it continues and is presented and made useable. For now I will describe the concrete contributions of this dissertation.

Main Contributions

1. This dissertation describes the development of a new domain termed Machine Therapy. Machine Therapy describes a practice of connecting with "found" machines, especially through their unintentional yet active side-aspects, in ways that are revelatory and therapeutic for people.

2. Through the development of built projects, performances and discussions concerning machine and human interaction, I have shown the vital relevance of the parapraxis of machine design. Specifically, the work of Machine therapy to date has made apparent and workable the visceral side-elements of human-machine interaction. It has revealed that, though often subconscious, these aspects of machines carry vital significance. I have convincingly illustrated that paying close attention to the autonomic and visceral aspects of our human communications with machines is relevant and important.

3. I have designed and built a breathing viscerally interactive machine: Omo. The process of making Omo and the observations and evaluations of its interactions with people to date have been presented.

4. We have built and begun iterating on a signal processing model of machine voices.

5. For Omo, and for future applications, I have developed a flexible soft rubber QTC sensor skin.

Conclusions

We saw in the background chapter how machines have been used as "thought models" of how people work. Freud, perhaps consciously, based his models in psychology of drives, homeostasis, and energy on the new thermodynamic engine. Lacan's theory of Symbolic Law and his notion that people are nodes who speak their parts in a system are influenced by his contemporaries' development of logical circuits and cybernetics. Aspects of our built environment are always present and active in conceptualizations and makings of ourselves. In this dissertation, for example, we have illustrated the relevance of visceral side-aspects of machines in their effects with people. The machine models that machine designers are currently providing will influence how people make sense of themselves and each other. It is therefore important to pay very close, critical, widely considered and informed attention to what it is that is being made.

Machine design is directly involved in our making of our worlds and our conceptions of each other and our selves. As machine designers making things that used and had deep meaning reflected, we have unavoidable power and responsibility. Even if we cannot expect each individual to be the expert in every aspect of machine making – engineering, science studies, critical art practice, design, social theory, psychology – we can each recognize the vital relevance and necessity of each of these perspectives in machine design. We can seek and respect collaboration across disciplines and across cultures.

FUTURE WORK

In this section I preview some upcoming work with Omo, Amo, and Umo.

At the moment we have only experienced the first prototype of Omo. Amo and Umo will come into play soon as well.

Autonomic Interaction Studies

A study investigating the affective relationships between Omo and a wide range of people has been designed, piloted, and will be underway with a full set of participants later this year.[2] The early feedback from the pilot study supports the notion that Omo does entrain well and then does influence the breathing rate and shape of someone holding it. The statistical data of blood volume pulse, galvanic skin response, respiration, and EKG gathered in the pilot begin to describe physiological affects that may be in play. The exit interviews give insights into the meanings that people associate with Omo as well.

Long-term Ethnographic Studies Via Adoptions of Omo, Amo, and Umo

Recontextualizing Omo, Amo, and Umo and observing responses to them is planned through a long-term ethnographic study.[3] Three of each of Omo, Amo, and Umo will be adopted by people across a wide range of social and cultural lifestyles. By allowing the machines to become interpreted within long-term daily life situations as they may, and following up to learn how and what they come to be used for, could be very informative and fascinating. It may reveal aspects of machine-human interaction that have been hard to articulate in other ways. By putting the machines into social contexts and then seeing what they do, what happens, we will learn things unapproachable by short-term situation-specific studies.

New Material Forms of Umo, Amo, and Omo

Different sizes and installations of Umo, Amo, and Omo for different contexts, such as a large machine for a public group experience, will be constructed.

Work With Members of Autism Communities

Roz Picard and I plan to work with colleagues who are autistic to help develop some of the machines described in this dissertation into useful devices for people with autism. ScreamBody and Omo are the first to be revisited this fall.

Multiple Omos, Amos, and Umos

With multiple Omos, Amos, and Umos people can experiment with putting more than one together and seeing how they interact. People in social situations may stick their companion machines together to mediate interpersonal communication. I will

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2 See Appendix A for a copy of the accepted MIT COUHES proposal.

3 See the work on "cultural probes"of Bill Gaver, and the Placebo Project of Anthony Dunne and Fiona Raby. See Gaver, Dunne and Placenti (1999) and Dunne and Raby(2001).

try networking some together and people in different locations can communicate with each other through the companion projects.

The Next Round Of Parapraxis

There will always be parapraxis in machine design. As the visceral side-elements that this dissertation focuses on become mainstream considerations, we turn the lens of Machine Therapy to uncover new sets of critically active subconscious aspects that we have been incorporating through our machine designs and uses.

Machine Therapy Continues

I provide, with this new domain, foundation for a continuing process of discovery, unmaking, and investigating our reconstitution of perceptions and experiences related to machines.

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