THE EPISTEMOLOGY & EVALUATION OF EXPERIENCE-FOCUSED HCI

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THE EPISTEMOLOGY & EVALUATION OF EXPERIENCE-FOCUSED HCI

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The topic of study of Human-Computer Interaction (HCI) is constantly changing as people develop new uses for new technologies. In this thesis I present three contributions to the field of HCI that address these ongoing changes. These contributions are around the themes of epistemology, experience, and evaluation.

I begin by importing from the field of Science & Technology Studies (STS) the notions of epistemology – the study of how we know what we know – and comparative epistemology – the comparison of different ways of knowing. STS researchers work from an intellectual position outside their field of study; I propose 'epistemological reflection' as a way for HCI researchers to engage with questions of knowledge and validation while remaining within the field. I argue that epistemological orientations have impact throughout the research process, and that HCI currently lacks the vocabulary to discuss intellectual clashes on an epistemological level.

My second contribution is a study of the term 'experience' in HCI, a discussion of its meanings in the field, and the identification of an emerging sub-field I call experience-focused HCI. Experience-focused HCI aims to design for the multiple, complex and situated experiences people have with technologies. This is not simply a shift from researching 'tasks' to researching 'experiences'. Rather, it treats experiences as situated interactions formed in the course of a specific interaction, and recognizes any representation of an experience is inherently incomplete. Experience-focused HCI also implies engagement with themes of affect, aesthetics, the body,

human practices, and the role of the artifact in knowledge production throughout an open-ended research process.

My third contribution is a set of methods for the evaluation of experience-focused HCI, based on a discussion of the epistemological foundations of evaluation: a successful evaluation not only validates the technology in question but also the topic of study and methods used to study it. Due to the open-ended nature of experiences, evaluation must shift from defining a priori metrics which can then be tested in laboratory situations to developing situated metrics through user experiences 'on the ground.'

BIOGRAPHICAL SKETCH

Joseph 'Jofish' Kaye was born in England in 1977. He attended Mrs. Packham's playschool in Richmond, London and then a succession of schools: Darrell Primary School in Richmond, the Lycée International in St Germain-en-Laye, Tanglin Junior School in Singapore and St. Mary's International School in Tokyo, Japan. He then completed an International Baccalaureate at Southbank International School in London, England. After a gap year during which he went 22,000 kilometers by train, worked at various financial institutions in the City of London, the Metropolitan Opera Company and a small computer company in Brisbane, Australia, he began his undergraduate studies at the Massachusetts Institute of Technology. He graduated with a B.S. in Brain & Cognitive Science after three and a half years, much of it spent doing research at the Media Lab. After nine months working for GEA, an Italian consulting company, he returned to the Media Lab to complete a Master's degree in Media Arts & Sciences, concentrating mainly on technologies for homes of the future and computerized smell output. This included a semester at Media Lab Europe in Dublin. After finishing his degree, he worked with startups in Cambridge, MA before coming to Cornell in 2003 to join the Science & Technology Studies program and then joining the Information Science program at its founding in 2004. In the course of his Ph.D he spent a summer interning in the Domestic Design & Technology Studies group at Intel in Portland, Oregon and six months as a Visiting Researcher at Microsoft Research Cambridge, England. After completing his Ph.D, he intends to join Nokia Research in Palo Alto, California. He lives with three friends in Mountain View, CA, and an elegant and charming Maine Coon cat called Annie.

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As my advisor has been known to point out, it takes a village to make a thesis. I have written this thesis as very much part of that village, working through the ideas here in discussion with many people over five years. Errors are of course my responsibility alone; the same cannot be said for the contributions. It is hard or impossible to list everyone who has been a part of that village over time, and I trust my friends and colleagues will forgive me if I accidentally lose them from what must by necessity be a very long list indeed.

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It is perhaps indicative of the amount of support I have had from my friends that every single one of my committee members ended up receiving their defense drafts through the aid of my friends rather than directly from me. From delivering to the appropriate department at Cornell because the doors were locked when I tried (Megan Halpern, Katie Proctor), to printing, binding and delivering it in Stockholm (Tove Jaensson, Jarmo Laaksolahti & Petra Sundström) or trekking across Seattle to pick up the draft from Kinkos and drop it off at the hotel (Erin Panttaja), I could rely on my friends and for that I am deeply grateful.

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1.1 Introduction

When I started my Ph.D at Cornell University in August 2003, I was in a long distance relationship. My partner was doing a postdoc in Los Angeles over 2500 miles away, and I missed her. I wanted a piece of technology that would enable me to feel more connected to her. I started a research project called Intimate Objects to study couples in long distance relationships, which resulted in the Virtual Intimate Object: a piece of software designed for couples in long distance relationships to communicate intimacy.

The VIO is based on a number of interviews and discussions with couples in long distance relationships. It works very simply: each member of a couple has a circle in their taskbar. When they click their circle, their partner's circle turns bright red and then fades over time. When users move the mouse over their own circle, it displays the current color of their partner's circle. That is it. There's no content in the message, no style, no way to change what is transmitted other than the single click.

My partner and I liked using the VIO. However, to publish a paper about a new technological system such at an HCI (human computer interaction) conference or in an HCI-related journal, it is usually necessary to demonstrate that the technology works for people other than the designers. To do this, I planned to give the VIO out to a number of couples in long distance relationships to evaluate it, and realized that I had a problem. How could I know whether they liked it? How could I find out what was wrong with the experience of using the VIO, and what needed redesigning? Was the VIO better than telephones or text messaging or instant messaging or sending postcards and letters – or just different? How was it different? Was it possible to measure how much closer couples felt when they were using the VIO? Did it change

their relationship? Did it make them feel happier? Did it make them miss their partners less? Or more? Which would constitute success?

I realized that to understand how well I had succeeded in designing the VIO, I needed to find ways to understand what it was like for couples to use the VIO, to find ways to characterize the experience of VIO use. What would a characterization of such an experience look like? How would I know if the characterization was correct, good, valid – and which of these were relevant criteria to apply? What did knowledge about an experience look like?

As my work progressed on the VIO and on other projects, I realized that these were serious questions. It was relevant not just to the VIO, but also to many other projects in HCI. HCI, as a discipline, has developed excellent techniques for understanding and measuring and evaluating new ways of doing *tasks* – having operators look up telephone numbers, taking money out of cash machines and so on – but there are no clear evaluation techniques for deciding if a new technology has increased feelings of intimacy in your long-distance relationship, or suitably allowed you to express feelings of love and desire.

However, there were clearly a growing number of researchers and designers who were building systems that were not intended to be used for completing easily-defined tasks, but were designed for communicating with loved ones, for expressing identity, or for encouraging the user to reflect on the role of technology in society. In talking to these researchers and designers, many of whom had more experience than me, I realized that we were all running up against the same problem: it was not clear how to *evaluate* the systems we were building.

Evaluation is the process by which researchers show that their system does in fact do what they say it does. For example, a new system for directory enquiries operators to look up telephone numbers might be evaluated by calculating the average

length of time it takes an operator to find a phone number, and seeing if that average length of time is less than with the previous system. However, evaluating technologies that are not clearly focused on solving a particular definable task proves to be a difficult problem.

1.2 Introduction to task, experience and evaluation

In this chapter, I start to explore some definitions of terms which I'll then use throughout the thesis. It is common in HCI (and many other fields) to begin by defining one's terms. In this work, however, I will take a different approach. Instead of beginning by defining my terms, I will begin by identifying the terms that I think we need to define, and I will then spend a substantial amount of work looking at the various ways that the field understands these terms. This allows me to tease apart the differences in meaning that can otherwise be obscured by stating definitions outright. I treat these definitions as *emergent categories*: not independent entities existing in some kind of abstract isolation, but definitions that are deeply embedded in a particular intellectual culture and set of practices (Glaser & Strauss 1967, p. 37). Understanding those definitions can help produce a deeper understanding of not just the entity as defined, but also the situation that created that definition. This enables us to both understand the tensions between different understandings of those definitions in the field and also to contribute towards changing and, hopefully, improving the field's own understandings of the terms.

In this chapter, I'll discuss the term 'task' and 'task-focused HCI' and its formal definitions in theory and its definitions in the course of practice. I'll then discuss the term 'experience' and the related notion of 'experience-focused HCI', which is emerging as a category of practices and approaches in the field that can be read in contrast to task-focused approaches. Finally, I introduce the notion of

'evaluation' in HCI, which is the primary lens through which I'm looking at the field. In particular, I'll discuss how notions of evaluation that were appropriate for a task-focused approach to HCI may no longer be appropriate for an experience-focused approach.

1.3 Tasks & Task-focused HCI

Documenting and understanding the different and changing definitions of task in HCI could be a dissertation unto itself. However, with this section I hope to leave the reader – and particular the reader with a background outside of HCI – with a general comprehension of the everyday meaning of 'task' in HCI.

1.3.1 Understanding the meaning of 'task'

In practice, 'task' has come to mean something like "a discrete unit of work"; perhaps something that might be written on a to-do list. For example, in Czerwinski et al.'s diary study of task switching, one subject's retrospective diary of "task entries" for an afternoon read:

1. Daily Schedule Preparation
2. Synch PocketPC
3. Check Internet Email
4. Check and respond to email
5. Matlab coding
6. Create Charts for Meeting
7. Edit Word documents for meeting
8. Meeting
9. Matlab coding

(Czerwinski, Horvitz, & Wilhite, 2004, p. 177)

They further observe that "For all of our participants, 'email' was clearly considered a task that had to be dealt with repeatedly throughout the day." The authors also report on the range of activities considered by their users to be "tasks":

> Reported task lengths averaged 53 minutes, with a large standard deviation of 90.9 minutes. The distribution of task lengths was highly negatively skewed, with the majority of the tasks reported being shorter than the average length. However, several tasks were reported that lasted throughout the course of the work week. (Czerwinski et al., 2004, p. 178)

HCI researchers often think of the task in a more constrained manner, although there is no canonical theoretical definition of task accepted in the field. In their textbook *Human Computer Interaction*, Preece et al. begin their chapter *Task Analysis* by stating "The concept of a task is central to user-centered system design". They then observe "Recently, it has been realized that the notion of 'task' is increasingly difficult to define." To address this, they introduce a three level hierarchy:

> Goals – for example, produce a letter
> Tasks – activities necessary to achieve goals using a device
> Actions – simple tasks, those having no control structure
> (Preece et al., 1994, p. 421)

This three level hierarchy, while not canonical, is typical of similar approaches in the field. To further clarify this, I need to introduce two related concepts: 'task analysis' and 'activity theory'.

1.3.2 Task analysis

Task analysis is one approach to understanding work practices in order to build technologies to support those practices. Bannon and Bødker write:

> Task analysis, as it has traditionally been conducted in HCI… is based on the idea that a description, containing all necessary information to build the computer application, can be made of the sequence of steps that it takes for a human being (in interaction with a computer) to conduct a task. This task analysis contains a detailed description of each step of the individual user's interaction with the computer application – for example, as inputs and outputs. (Bannon & Bødker, 1991, p. 232)

Proponents of task analysis see it as being central to HCI, and it continues to represent a dominant approach to the field. In his introductory chapter to *The Handbook of Task Analysis for Human-Computer Interaction* Diaper writes:

> Task analysis is at the core of most work in human-computer interaction because it is concerned with the performance of work, and this is what, crucially distinguishes it from other approaches [sic]… (Diaper, 2003, p. 5)

A designer engaged in task analysis first picks a goal that the technology is designed to support. The goal is decomposed into its component tasks, which are then further decomposed into subtasks which are further decomposed into actions. For example, Preece et al. use "Produce a letter" as a sample goal. This is then decomposed into the tasks of "Edit letter" (comprised of subtasks such as "Enter text", "Amend", "Move cursor"), "Print letter", and so on. This entire process is known as "Task analysis". Preece et al. write:

> Task analysis has arisen out of work in ergonomics, psychology and software engineering and is concerned with what people do to get things done. Although similar to the concept of a process or function, there is an important distinction between task and function. Functions are activities, processes or actions that are performed by some person or machine. Tasks are generally considered to be meaningful for the user in that users believe it to be necessary and/or desirable to undertake tasks. The term 'task'…embodies an intentional or purposeful level of description that is absent in the concept of function. (Preece et al., 1994, p. 410)

Task analysis is not without criticism:

> What we often hear, when a computer application fails to function according to the needs and wishes of the users, is that the initial task or flow analysis was "not good enough". In our experience, there is always something more that ought to have been included. Therefore, we might ask ourselves whether it is the very idea of making these kinds of specifications that is the problem … (Bannon & Bødker, 1991, p. 232)

Despite these limitations, the role of tasks and the associated process of task analysis is widespread in HCI. As an example of how widespread the use of 'task' is in HCI, I searched the first hundred documents in the *Proceedings of CHI 2008*, a conference that is the primary publication in the field. To give an idea of scale, these 100 documents are a mixture of "Papers" and "Notes", both of which are considered peer-reviewed publications, and they average 8.2 pages long. The word 'task' appears

in 78 of the documents, appearing 1447 times in all. Clearly the difficulties in accurately defining task have not impeded its use. Draper observes:

> If the notion of task is so unstable and indeterminate in small scale word processing — surely the simplest and most overstudied case in HCI — then what hope is there of using it as a theoretical concept as a component of standards definitions or as the basis of design methods using "task analysis?...
>
> On the other hand common sense and experience tell us that a notion of task is of constant practical help in HCI design. Everyone needs to save their files to disk or to delete a word, and you can look at the problems some designs observably cause users, and how changing the design removes or changes the problems. These simple considerations suggest that perhaps "task" is a simple concept at the level of a command and problems occur mainly at higher levels. (Draper, 1993, p. 207)

This understanding of task – however much it may be defined in practice rather than formally – is ubiquitous in HCI. We can see one example in the way that some researchers in HCI have adopted activity theory.

1.3.3 Activity Theory

One place we find a similar hierarchy of goals, tasks and actions is in certain adoptions of activity theory in HCI (Nardi, 1996; Engestrom, 2000; Matthews, Rattenbury, & Carter, 2007; Kaptelinin & Nardi; Engeström, Miettinen, & Punamäki, 1999). Activity theory is an approach to understanding human behavior (Gay & Hembrooke, 2004) that draws from the work of Soviet psychologist Vygotsky. In its original form it emphasizes cultural and social influences on cognitive processes and how tools develop as a result of interactions between individuals and their environment (Vygotsky, 1978, 1986). One of the hallmarks of activity theory as presented by Bonnie Nardi, one of the foremost advocates for activity theory in HCI, is a very similar kind of hierarchical division of goals, tasks and activities as described above (other interpretations of activity theory in HCI are distinctly less hierarchical and task-focused (e.g. Bannon & Bødker, 1991)). For example, in "Activity Theory:

Basic Concepts and Applications", a tutorial at CHI'97, Nardi and her coauthor Kaptelinin describe the first of five "basic principles" of activity theory as the "Hierarchial structure of activity" and write:

> In Activity Theory the unit of analysis is an activity directed at an object which motivates activity, giving it a specific direction. Activities are composed of goal-directed actions that must be undertaken to fulfill the object. Actions are conscious, and different actions may be undertaken to meet the same goal. Actions are implemented through automatic operations. Operations do not have their own goals; rather they provide an adjustment of actions to current situations. (Kaptelinin & Nardi, 1997)

While the terms – activities, actions, operations – differ from those presented by Preece et al. above, there is still a general idea of a hierarchical structure of action which can be used to break practices down into their component parts.

1.3.4 Understanding the relevance of tasks and analysis

Understanding the commonalities between task analysis and activity theory is important because it provides a point of comparison for the notion of experience-focused HCI that I will introduce in the next section. Task-focused approaches take as a basic assumption that user practices can be understood by breaking them down into their component parts and understanding those component parts. By corollary, this makes the assumption that the practice in question is at very least reasonably approximated by the sum of those component parts. This is a process that is inherently analytic and rationalist, and this makes the corresponding assumption not just that human practices are themselves rational, but able to be recognized and expressed as such by the outside observer.

By contrast, the experiential approaches I'll be discussing in most of the rest of this thesis see human practices as being complex and irreducible to component parts – or rather, these approaches recognize that there is significant loss of aspects intrinsic to the interaction. Rather than the analytic and reductionist approach hallmarked by

an emphasis on task, I will show how the experience-focused work posits a holistic, hermeneutic approach to understanding experience which allows the researchers to more fully understand the interactions between technology and user.

1.4 Experience and Experience-focused HCI

By this stage in the chapter, we have a reasonable understanding of the task, its utility, and of its ubiquity in HCI. It is from this latter point that I now depart. Designing for the task is often the default approach to doing HCI. However, it is not clear that a task-centered model of human-computer interaction gives us a way to represent or understand the interactions a couple have through the VIO. Treating "staying connected with my partner" as a task ignores the serendipitous and ongoing nature of such interactions. A task like "get money from an ATM" has a definable beginning, middle and end which aids in its characterization as a task; while specific instances of "staying connected" such as a phone call may also have beginnings and ends, the endeavor as a whole resists characterization as a task. The same objection applies to other non-task-focused uses of computing: instant messaging, chatrooms, blogging, spending time in virtual worlds like Second Life, gaming, and so on. All of these have task-related components – "entering a message", say – but to address these uses in terms of the task is to miss the very essence of why users are engaged with and performing these actions.

The task is a necessary but not sufficient unit of analysis to explain how people use technology, particularly when that use is discretionary and occurs outside of the workplace. By comparison, we can see the way people experience technology as being part of a larger practice of everyday life: not task- delimited, but understood in context and concerned not just with the effectiveness, efficiency and satisfaction of users carrying out tasks but a more holistic and hermeneutic look at aspects of users'

experiences of interaction with technology. I join a growing chorus of voices that are questioning how to appropriately update our methods and methodologies for new, discretionary, experiential and non-task-focused uses of technology (e.g. Boehner, 2006; Bødker, 1991, 2006; Dourish, 2006; Gaver, 2004; Zimmerman, Forlizzi, & Evenson, 2007; Harrison, Tatar, & Sengers; McCarthy, Wright, Wallace, & Dearden, 2006). I refer to these ways of engaging with HCI as *experience-focused HCI.*

This being said, there's a logical trap that I hope to avoid. It's easy to conceptualize 'the experience' as being just some kind of larger notion of 'the task': a bigger task that just covers more ground. This perpetuates what I consider to be the fundamental error behind a focus on the task: the notion that 'the task' exists in some kind of *a priori* sense, out there, to be grasped and grabbed and identified and pinned down. I am wary of attempts to do the same with experience, to define it *a priori* in a planned and non-situated manner. For a given user interacting with a given technology at a given time there is not a discrete 'the experience' out there in the world to be found and pinned down. Rather, any representation of the experience in question, including a user's own representation of their experience, is just that, a representation crafted through analysis. I will argue throughout the course of this thesis that experience is not just a meta-task which could be parameterized and optimized if only we had sufficient data. While I can and will discuss to what degree experience can be understood, I am working with the assumption that experiences cannot be simplified to a set of tasks, and it is my aim to show through a review of the literature and several case studies that there is value in starting with such an assumption.

At this stage, the notion of experience in question is somewhat nebulous. We know that it is not a task, but we do not have a strong notion of what it is. We know that 'staying in touch with one's partner' is one kind of experience, but it is still

defined in opposition to the task. One way to approach this problem would be to define experience and experience-focused HCI explicitly at this stage. However, I see experience-focused HCI as an emergent category, a way to understand a set of existing work in HCI which, by examining closely we can start to characterize and understand the idea of experience in question. Therefore, rather than defining experience here, I will define it over the course of the next several chapters: by explicating practices of experience-focused HCI in Chapter 4, by explicating different ways of knowing about experience in Chapter 5, and by example in the case studies I present in Chapters 6 and 7.

1.5 Evaluation

We have started to see in this chapter that task and experience are two ways that we can approach thinking about people's interactions with computers. This is relevant not just for building novel technologies, but also studying the use of said technologies. If we see uses of a technology in terms of tasks, then our observation of people using that technology will reflect that approach: this is the nature of task analysis. Similarly, if we see uses of a technology in terms of experiences, then our observation of that technology will correspondingly reflect that approach, as we'll see in later chapters. In HCI, observation and analysis of use of a novel technology is a core part of the process of evaluation, and it is in the process of evaluation that the field creates knowledge and verifies the knowledge that it creates.

That last sentence is significant, and demonstrates an underlying assumption of my work: that evaluation is important, and is a key part of knowledge creation in HCI. More specifically, my aim in writing this dissertation is not an abstract notion of extending the variety of ways in which HCI generates knowledge, but rather founded in a conviction that many of the current methods of understanding peoples' technology

use fail to capture how technology is experienced. Task-focused HCI is appropriate where the primary use of technology is to accomplish tasks – such as in the cases of computing's roots in the office and industrial workplace – but is no longer sufficient for contemporary discretionary use of technology as part of everyday life. I do not address the evaluation of task-focused HCI in this thesis; furthermore, my goal is not to present an abstracted, generalizable study of evaluation applicable to multiple disciplines. The notion of evaluation I am studying is a distinct practice of human-computer interaction, and the considerations I am engaging with are situated within that field.

Once again, I want to be careful about how I define the term evaluation, and demonstrate how we can learn from treating it as an emergent category. As I will detail in Chapter Three, evaluation is a term whose meaning has changed over time. Even contemporary uses of the term in the field cover a wide variety of meanings: as I will discuss, the term can mean something like "testing": verifying that a novel technology works in the way that it is intended or that a given design performs as expected. Other uses of 'evaluation' are based on understanding the ways that users interpret a proposed novel technology: do they use it as expected? do they generate novel practices around the technology? I will explore these differences in understanding throughout this thesis. In the meantime, I will start with a simple presentation of the concept of evaluation and its basic problems, refining this understanding throughout the thesis.

An analogy to explain evaluation in HCI for those unfamiliar with the field might be made to the way that drug companies test new experimental drugs. They have a new drug that they believe cures a disease, so they find a number of people with that disease, give half of them the drug, and show that those that received the drug are more likely to be cured, to live longer, or demonstrate some other appropriate

benefit. Similarly in HCI, we build a new system that we believe will let telephone operators give out phone numbers faster, or help couples in a long distance relationship communicate intimacy. We then test that system to ensure that it does, in fact, do what we say.

However, when examined more closely, even the apparently well-defined and rigorous scientific endeavor of drug testing is complex, layered, situated and contentious. For example, despite extensive prescriptions and drug testing, meta-analyses of trial data of antidepressant medications suggest that their benefit "falls below accepted criteria for clinical significance" (Kirsch et al., 2008). A look at drug testing that emphasizes the socially constructed nature of the process can be found in the book *Impure Science* (Epstein, 1996). Epstein has studied in depth the politics around clinical drug trials for AIDS, and shown how patient activists have changed the way these drug trials were conducted. For example, in a paper that preceded his book, Epstein documented how "treatment activists" changed the practices of drug trials by insisting on a wider subject pool than might otherwise occur:

> In AIDS trials, as elsewhere, the subject populations early on tended to consist largely of middle-class white men. AIDS activists argued that people from all affected populations-injection drug users and people with hemophilia, women and men, whites and minorities, heterosexuals and homosexuals-must be given access to trials. (Epstein, 1995, p. 420)

Similarly, the activists were influential in changing treatment protocols. Epstein discusses the desire of the researchers for "clean data", and the activists' perception of the inaccuracy of such an approach:

> The perception of activists was that, in the name of clean data, people with lab test values or demographic characteristics outside of a specified range, or those who were currently taking other medications or had taken them in the past, were finding themselves excluded from study protocols. Similarly, those enrolled in studies who took other medications without explicit permission were sometimes threatened with expulsion. The practical effect, activists argued, was that in some cases trials were unable to recruit subjects because the treatment options that were offered were too unattractive. In other cases, people were lying in order to get into trials of potentially helpful therapies or were cheating on the protocols while trials were under way. That is, in the context of a life-threatening illness among a savvy group of patients, the very emphasis on clean data was itself helping to produce some decidedly messy clinical trials. (421-422)

My aim with this example is not to concentrate on the details of the impact of AIDS activists on the performance of scientific trials. However, this example does show that even in the case of these apparently scientific clinical trials, the question of how to evaluate efficacy is a topic of ongoing debate. There are two points to draw from this example for our purposes. The first is recognizing that there is contentiousness and debate even in the context of the long-studied question of how to conduct medical trials. This helps understand the opportunity for discussion around this question in the comparatively new field of human computer action; it is far from clearly decided and codified. The second point is slightly more subtle: there is an analogy in HCI evaluation to be drawn to the tension between the 'scientific validity' desired by the researchers in their subject choices, and the 'ecological validity' desired by the activists. As we'll see in this and the next chapter, this axis is a familiar one for debate in HCI: should evaluations be conducted in laboratory conditions with artificial tasks and situations that can be carefully controlled, or should they occur in more 'natural' settings with less control over the actions of the subject but with greater ecological validity? This is a question of ongoing debate, and one that we will return to multiple times in discussions of evaluation techniques.

1.5.1 A brief review of evaluation in HCI

There are a wide variety of ways to evaluate systems in HCI. This is related to the fact that nearly all papers currently published in the field about a new system or changes to an existing system include an evaluation of the system. The ubiquity of evaluation in HCI research has been shown empirically (Barkhuus & Rode, 2006). Barkhuus and Rode sampled the last twenty years of the proceedings for CHI, arguably the most significant publishing venue in the field, and show that while only 60% of systems presented in 1983 included evaluations, a full 98% of systems presented in papers at CHI 2006 were accompanied by an evaluation of some manner.

There are a variety of relatively standardized approaches to evaluating technologies in HCI. While it is possible to make a case for some new method of evaluation that is particularly suited to a new system, there are a number of standard methods that are recognized as having the potential to produce valid results. For example, the *HCI Handbook* (Jacko & Sears, 2003), a standard textbook and reference work, divides evaluation methods for HCI systems into four categories. Three of these categories are identified as mainstream approaches: user-based, inspection-based, and model-based evaluation, and one additionally category, "Affective Evaluation", is presented as more speculative.

The first of these categories, user-based approaches to evaluation, is identified with three methods: administering questionnaires to users, observing them as they use the system, and running formal laboratory-based usability tests (Joseph S. Dumas, 2002). Each of these involves the active engagement of a set of subjects who are representative of the intended users.

By comparison, inspection-based approaches do not directly involve users of the system. Instead, experts look at the system and evaluate it on the basis of their experience, expertise, and various lists of appropriate characteristics (Cockton,

Lavery, & Woolrych, 2002). This has the advantage that it's not necessary to hire expensive subjects to perform time-consuming tests, but has the disadvantage that it requires having multiple experts, at addition cost of time and money, available to evaluate the system.

The third standard set of approaches listed in the *Handbook* are model-based approaches. These use a model of how a real human would act to evaluate a system, rather than ever actually having a live user interact with a system. (Kieras, 2002) Proponents argue that the model-based approaches eliminate the need for experts to be involved in the evaluation of the system, although some argue that the level of expertise needed to build an effective model outweighs such advantages.

The *Handbook* also includes a fourth chapter, labeled "Beyond Task Completion: Evaluation of Affective Components of Use", which discusses evaluating for an emphasis on content quality, access and interaction, or context of experience (J. Kraut, 2002). Kraut uses the term 'affective' in this context to suggest emotional aspects of technology use, with a meaning analogous to the notion of experience I have begun to introduce. For example, in the introduction, Kraut writes that "The focus of nearly all evaluation in HCI has been on how well someone can complete a specified task using the technology being evaluated." and proposes the chapter in contrast or addition to this approach. He suggests that HCI professionals need to be able to assist in the design of "artifacts that provide emotionally satisfying user experiences", and suggest we should consider questions like

- How can we design a user experience that is engaging?
- When will people buy something because of its image?
- How can we measure the social value of a technology?

This approach does seem commiserate with the experience-focused approach to HCI that this thesis is just beginning to explore. The chapter is a solid introduction

to some of the questions that are apparent in issues of experience-focused HCI. However, the chapter is short on both references and details that would enable researchers to actually engage with such questions. Kraut's chapter underscores the necessity for a detailed and careful look at the problems of evaluation when applied outside of the delimitation of the task.

I want to use this summary of the *HCI Handbook*'s evaluation chapters to demonstrate two points about the field to put this work in context. First, there is a general emphasis on analytical, formalized, task-focused methods for evaluating technologies. This is not to say that there are no researchers and practitioners who do not use more hermeneutic, open-ended and experience-focused approaches: indeed, that work is the focus of Chapter 4. However, the task-focused, analytical approach is widespread in the field. Second, there is a comparative scarcity of accepted methods for engaging with experience-focused uses of HCI. Once again, I will discuss some of the approaches that do exist in Chapter 4, and, indeed, much of the rest of the thesis, but I want to emphasize at this point how both my own and others' work on experience-focused HCI needs to be read in contrast to much of the task-focused work in the field.

1.5.2 The contentiousness of evaluation in HCI research

The challenge of determining an appropriate evaluation technique is deepened by the fact that criteria for appropriate evaluation methodology and methods are by no means a settled question in HCI today. The CHI 2007 website, for example, lists 'validity' as one of the explicit review criteria for CHI papers, then goes on to note that

> Methods for establishing validity vary depending on the nature of the contribution. They may involve empirical work in the laboratory or the field, the description of rationales for design decisions and approaches, applications of analytical techniques, or 'proof of concept' system implementations. (http://www.chi2007.org/submit/papers.php)

The heterogeneity of these potentially valid evaluation criteria is striking (although arguably appropriate for a field as interdisciplinary as HCI). At the same time, it makes sorting through knowledge claims in the field problematic, since an evaluation that may seem unproblematic to one reviewer may seem highly dubious to another trained in a different approach.

The very diversity of the list suggests that evaluation can be contentious in HCI. For example, Lieberman railed against the 'tyranny' of inappropriate evaluation in his 2003 CHI Fringe paper (Lieberman, 2003). He points out that effective scientific validation relies on being able to control all relevant variables and manipulate the one under question, something nearly impossible given the complexity of user interface systems and variety of users, uses and situations. He writes:

> The experimentalists look for the effects that are measurable and ignore the rest. They insist that all interfaces be judged solely by the criteria that their experimental methodology can quantify.

He further points out that, unlike the (supposedly) rigorous double-blind approaches that are common in medical experimentation, the evaluators are frequently the same people as the designers:

> In medicine, they would be horrified at the idea of someone who developed a technique being the one to evaluate it. Medicine developed double-blind studies for a reason -- studies by people originally involved with whatever is under study were shown to be biased.

Lieberman concludes that HCI needs to abandon its reliance on evaluation as a measure of research quality, as the evaluation techniques used are so deeply flawed to begin with. Zhai replied to this provocation in his CHI Fringe paper from the same

year, in which he suggests that while HCI evaluations could be inappropriate, they still were the most effective way of ensuring the validity of knowledge (Zhai, 2003). Zhai defends the necessity for evaluation:

> Yes, all evaluation methods have limitations and deficiencies, just as democracy as a form of government is full of deficiencies. The fact is that we do not have a better alternative.

As Barkhuus & Rode demonstrated in their (2006) study, Zhai's approach seems to be representative of many in the community: evaluation is ubiquitous in current published HCI research. My goal with this thesis is neither to undermine nor to unnecessarily prop up evaluation as part of the intellectual structure of the field. Rather, I hope to come to a deeper understanding of the role that evaluation plays, and provide both ways to think about evaluation and techniques for evaluation that are appropriate for the (experience-focused) problems under study.

1.5.3 Evaluation by researchers & reviewers

There are two distinct points where evaluation occurs in the process of academic and related research in HCI. The first comes at the end of the design process, when researchers evaluate their system to determine whether the proposed technological solution works. This is the primary form of evaluation with which this thesis is concerned. However, there is a second process of evaluation that is arguably just as important, which is part of the process of peer review. In this process, researchers who are also in the field (or 'peers') evaluate the overall research represented in a publication. These reviewers determine whether the research seems appropriate for the publication forum, whether the starting assumptions are reasonable, and whether the evaluation or testing methods employed are appropriate and measure what they claim to measure. These two points of evaluation are obviously related: both involve claims of validity, ways of knowing, and understandings and negotiations

of what constitutes valid knowledge. In considering the role of evaluation in HCI, I have found it necessary to consider the second process of review as part of evaluation; while it may seem external to the process of doing research, it is fundamental to the way research is codified, validated and accepted. It also emphasizes again how evaluation is not just a formality at the end of the design process, but rather a key point of knowledge production and validation.

1.5.4 The rhetorical role of evaluation in HCI

Besides validating the particular results in question, evaluation has another role, which is usually not explicitly stated in HCI practice. One of the core points I am trying to make through this thesis is that evaluation is how we confirm that both the *knowledge* and the *kind of knowledge* we have created is valid. Stating that our new system for telephone operators to find numbers is 'better' than the old system is not sufficient; we need to present evidence to support that claim. Through the way that we generate and present that evidence, we make statements about the kinds of evidence we consider valid. For example, one kind of evidence might be that the average time taken for a group of telephone operators to find a sample set of telephone numbers has decreased. This makes two statements: we have *knowledge* about the decreased length of time, and we are stating that measuring average time is an appropriate *form of knowledge* to evaluate our technology. Another approach to answering the same question might involve looking at the satisfaction of the telephone operators with their jobs and demonstrating that fewer operators are quitting their jobs soon after finishing training because of their frustration with the system: a different *form of knowledge.* Both may be reasonable ways to evaluate a commercial technological system, and yet they are different kinds of evidence and make different kinds of statements about the

kind of knowledge that the authors wish to emphasize. Again, this emphasizes the role of evaluation as one of knowledge creation.

1.6 Foundations & moving forward

In this chapter, I have presented the notion of task as a foundational concept for much work in HCI, and I have introduced the notion of experience as an alternative approach to understanding and designing for people's uses of computers. I will show how experience is conceived and understood as an emergent category in the field throughout this thesis. I have also started to define a variety of HCI that embraces this way of characterizing computer use as "experience-focused HCI", and I will be explicating more about what this term means and what work it does in explaining a set of related work in the next several chapters. In each of these cases, my aim is not to narrow down my definition to a single canonical statement; rather, I hope to show the richness of the terms and how their meanings are situated in practices, methods and approaches to HCI. I have also introduced the practice of evaluation in HCI, and briefly introduced the role it plays.

In addition to introducing these terms, I have begun to introduce a larger intellectual agenda that I will explicate in this thesis, which concerns itself with the role of knowledge in HCI. It is for this reason I have chosen to concentrate on evaluation, as a key point of knowledge creation in HCI research. Furthermore, I have made the point that in the process of evaluation a researcher is stating both that the knowledge created is valid, but also that the *kind* of knowledge created is valid and appropriate for the situation.

In negotiating the kind of knowledge to be created, the researcher must balance the tension between, for example, demonstrably correct knowledge derived from studies in a laboratory which may not replicate important aspects of the situation

within which the processes studied usually occur, and ecologically valid knowledge derived from studies in the field which may not be demonstrably accurate or impartial. In this thesis, I will explore the impact on HCI, on evaluation practices, and in particular on knowledge creation practices in HCI of moving from an analytical/ reductionist/ component analysis approach to a hermeneutic/ experiential/ holistic approach to understanding human practices with technology. This is very much a blanket statement at this stage; in the next chapters I will explore this approach in depth.

In the next chapter I will discuss the two academic disciplines I draw from in this thesis: human computer interaction (HCI) and science and technology studies (STS). I will contrast these two disciplines and how they create knowledge, with particular emphasis on the case of "user studies". In particular, I will show how the concepts of epistemology and epistemography drawn from STS can be used to address important problems in HCI that we lack the vocabulary as a discipline to discuss. I finish the chapter by introducing 'epistemological reflection' – being aware of one's own notion of what is considered valid knowledge – and framing this approach as a variety of critical technical practice.

In Chapter Three, I show how this notion of epistemology can be applied to the question of understanding evaluation in HCI by taking a historical look at the meanings of evaluation in HCI over time, and showing how they have changed to reflect certain assumptions about knowledge and the kind of knowledge that is appropriate or relevant to HCI. In particular, I present the 'Damaged Merchandise' controversy as a case study for understanding the role of epistemology in HCI.

In Chapter Four I return to the notions of experience and experience-focused HCI I introduced in this chapter. I present the emergent field of experience-focused HCI by surveying the different practices and themes in the field, showing how

experience-focused HCI can be seen as a coherent approach to the practice of HCI. In Chapter 5 I then look at the multiple epistemologies of experience-focused HCI, and discuss how those epistemologies can be used to address questions about knowledge creation in this field.

Chapters Six and Seven are two case studies: the first of the aforementioned Virtual Intimate Object, and the second of the Ambient Ink Display. In these studies I show how experience-focused HCI works in action by looking at two different cases of evaluating experience-focused HCI.

Finally, in Chapter Eight, I conclude by summarizing this work and discussing prospects for future work in experience-focused HCI. I emphasize the three contributions I make with this thesis. The first is the introduction of epistemology and comparative epistemology to the field, and the proposal of epistemological reflection as a method for use by researchers within the field The second is a study of the term experience, its use in HCI, and a discussion of the emergent field of experience-focused HCI. Finally, I discuss various methods for the evaluation of experience-focused HCI.

Through this thesis, I will move up and down between different levels of analysis: studying the evaluation of a particular system, looking at the ways that multiple people evaluate systems, looking at the ways those evaluations are themselves evaluated and understood, and exploring the different notions of knowledge encapsulated in evaluation. Doing this kind of work on multiple levels requires a certain approach to understanding scholarship which differs from that which is standard in HCI. I will now discuss the way I will approach this work in the next chapter, *Using STS in HCI.*

CHAPTER 2: USING STS IN HCI

2.1 Learning from cross-disciplinary interactions

In Chapter One, I introduced the concepts of task, experience, and evaluation. However, rather than defining them, as might be expected when one introduces new terms at the start of a work, I chose instead to leave their definitions open for further unpacking as emergent categories. This is a somewhat unusual step in HCI, and in this chapter I intend to explain that decision further by explaining how I have drawn from the field of science and technology studies (STS) to understand both the emergent field of experience-focused HCI, as well as questions about practices and approaches to knowledge creation and validation in the field.

My approach to this work is rooted in two disciplines. My home discipline, and the discipline to which I primarily intend to contribute with this thesis, is human-computer interaction (HCI). HCI is the study of how people interact with and through technology, of how we can understand and improve those interactions, and of what it means to improve in that context. This work engages primarily with the literature, problems, and questions inherent in the field of HCI, and the tools I explore for studying these problems are primarily intended for use by HCI researchers.

However, my intellectual approach is also strongly influenced by STS. STS looks at the impact of social, cultural, and political factors on developments in science and technology, and the impact of developments in science and technology on society, culture, and politics. It looks at how science works, how scientists see the world and go about their jobs, and, as such STS provides a set of intellectual tools for talking about how scientists and technologists go about creating and validating knowledge in practice. HCI has excellent tools for building novel technologies, such as studying potential users. However, it does not have tools for talking about the creation and

validation of knowledge. It is for this reason that I have drawn from STS as a source of theoretical tools for understanding the nature of knowledge in the field, and for understanding the changing meanings of task and experience and evaluation by treating them as emergent categories

Furthermore, it is because of this dual audience that the reader may find themselves reading definitions of processes or concepts that would normally be taken for granted: for example, a reader familiar with HCI might wonder why I would bother to explain 'evaluation' in the previous section. My hope is that readers from a particular field will not simply skim over characterizations of their field. The experience of becoming defamiliarized with aspects of one's discipline by seeing them from the point of view of another discipline can be a powerful tool in rethinking one's assumptions about the 'right' or 'normal' way of doing work, and can even be inspiration for improvements.

In this thesis, I write as an HCI researcher taking advantage of certain aspects of STS approaches to understanding technology use. I am not writing as an STS researcher myself, but draw from the field to find inspiration to address problems in HCI. As such, I do not necessarily aim to nor succeed in seeing a field from an outsider's point of view as might be common in STS. However, I hope to show that the approach I have taken allows me to engage with and make attempts to solve pervasive problems in HCI, drawing from both a deep knowledge of the field itself and a working knowledge of the toolkit that STS provides to uncover and explicate questions around science and technology development and use.

To demonstrate this, I will now provide overviews of HCI and STS, and go into some depth on both disciplines' uses of the term "user studies" as a case study to further explicate the differences in practice.

2.2 HCI

HCI is a highly interdisciplinary field; it encompasses work related to psychology, cognitive science, computer science, ethnography, design and more. Trying to define HCI, much as trying to define any other interdisciplinary endeavor with a wide range of stakeholders, is difficult and complex. One way to characterize the field is through its shared commitment to improving computing technologies and peoples' uses of them, but this kind of focus on the end product can miss much of the theoretical, methodological, sociological and psychophysical work done under the auspices of HCI. One could also define the field as studying the ways people use technology – but this would miss the emphasis on building as a way of knowing that is an important part of HCI, and which is often a significant point of difference between HCI and more theoretical disciplines.

It is not my intent to give a history of HCI here: a good overview can be found in Pew's article *Evolution of Human-Computer Interaction* in *The Handbook of Computer-Human Interaction* (Pew, 2002). From the beginning, the field has had an emphasis on building novel technologies, an emphasis I'll discuss further in Chapter 4. However, in addition to this perhaps pragmatic approach, I want to very briefly mention three influential trains of thought in the field, each of which I will return to later.

The first is the influence of cognitive science and experimental psychology on the field. This became prominent in the early eighties, highlighted by the publication of *The Psychology of Human-Computer Interaction*, which developed approaches for optimizing the design of systems by building cognitively-based models of human capabilities (Card, Moran, & Newell, 1983). This was a highly influential approach and its legacy is reflected in the emphasis on laboratory techniques and scientific verification of knowledge that have become the default approaches of many to HCI.

A contrasting approach can be found with the development of computer-supported collaborative work (CSCW), a sister field and approach to HCI which draws from sociology and emphasizes group work and how work practices arise in a social manner, rather than the cognitive emphasis on the individual taken by Card, Moran & Newell (Bannon, 1992). This approach also emphasizes the value of ethnographic observation in natural settings, such as Lucy Suchman's influential work on photocopier use in the office (Suchman, 1987). Such approaches are often referred to as practice-based, in reference to their emphasis on learning from human practices.

Finally, the field is also influenced in a different manner by goals that are not primarily stated in terms of theory. For example, a key influence of the last two decades has been Mark Weiser's vision of ubiquitous computing, which predicted increasingly small and cheap computers, and seamless interactions with said computers embedded throughout the world (Weiser, 1991, 1994; Weiser & J. S. Brown, 1996). Weiser's vision was clearly influenced by the increasing availability of low-cost computing technologies and devices, but itself has influenced the further development of such technologies and devices – which was, indeed, part of the intention. This kind of circular causal relationship between technology, observation and research is very much part of the practice of HCI, and is an example of a key way in which it differs from STS research. There is a deliberate causality: forward-looking statements in HCI papers do not just predict the future, but attempt to make it happen.

I have chosen to talk about HCI this way, rather than presenting a more conventional history of the field, because I want to emphasize how HCI sees itself. There are other aspects of the field I have not mentioned, such as the strong influence of a pragmatic emphasis on improving software and websites, under the label of usability, often occurring in industry, rather than academic or even industrial research labs (Nielsen, 1993) (McCracken, Wolfe, & Spool, 2003). However, the division

between cognitive and practice-based approaches is significant in the field, as we'll see in the rest of this thesis, and Weiser's ubicomp work is both influential and exemplary of the relationship between object and product of research in a way that differs significantly from the approach taken in STS.

2.3 STS

I will now outline the field STS (Science and Technology Studies) for the benefit of scholars in HCI. Once again, this is not a standard history of the field. Rather, I want to give a sense of what the stakes are that matter to scholars in STS, and explain the ways issues and topics are framed in the field. Both STS and HCI are concerned with how people interact with technology, but STS is at the core a critical discipline that observes and discusses such interactions, while HCI is at the core a building discipline that creates novel technologies. Much as with HCI, it is a diverse field and trying to define it is difficult and complex; a summary can only serve to give the briefest of overviews.

STS's earliest roots can be found in Philosophy of Science and related fields. STS differs from Philosophy of Science which traditionally assumes that, ultimately, science works to find out truths about the world; the question then becomes "How does science work?". By contrast, STS does not take a stand on whether the theories and results of scientific work do or do not accurately represent reality. Rather, as a discipline, it is interested in the ways scientists construct hypotheses and demonstrate their verisimilitude, regardless of whether those hypotheses turn out to be considered correct at some point in time.

This orientation was formally stated as the Sociology of Scientific Knowledge (SSK), explicated in Bloor's work *Knowledge and Social Imagery* (Bloor, 1976). Bloor emphasized the influence of social factors on the practice of science, and he

listed four characteristics of this framework that "will embody the same values which are taken for granted in other scientific disciplines." (7). The first of these characteristics is that the study of scientific knowledge needs to be *causal*: concerned with the conditions that bring about knowledge. Reportage of a situation is not sufficient for this variety of the study of scientific knowledge: it's necessary to try and understand the relationship between a situation and the knowledge produced within that situation. The second characteristic emphasizes the importance of *impartiality*: the researcher cannot use an initial assumption of success or failure, or the truth or falsity of a claim to reconstruct an explanation of an outcome. This means, for example, that a researcher cannot use the knowledge that the earth revolves around the sun to explain why Galileo believed that to be the case. This is a warning against hindsight: it's easy to explain in retrospect why a particular theory or technology did or did not turn out be as universally successful as may have been anticipated by its creators, but doing so does not help explain why those involved made the decisions they made. Similarly, the third characteristic, *symmetry*, says that a given type of cause needs to have the same general form of social explanation to explain true and false beliefs. As Jasanoff writes:

> If Justus Liebig's successes in setting up a research programme in Giessen were attributed to his psychology, his resources, his relations with students and his choice of research field, then the same factors should be employed in explaining the failures of his contemporary Thomas Thomson in Glasgow (Jasanoff, 1996, p. 396).

Finally, Bloor emphasizes that this needs to be a *reflexive* approach: the practitioner of this approach needs to be able to understand their own processes and studies in this manner. He writes:

> Like the requirement of symmetry this is a response to the need to seek for general explanations. It is an obvious requirement of principle because otherwise sociology would be a standing refutation of its own theories (Bloor, 1976, p. 5)

This foundation of SSK was built on by several studies of scientists in the lab in which researchers observed first-hand and analyzed how science is done on a day-to-day basis. These studies frequently involve extended periods of observation in the laboratory, typically in the course of employment as a laboratory technician or in a similar position, and then explanations of the myriad convoluted ways in which scientific knowledge is actually constructed by scientists (For example, Latour & Woolgar, 1986; Lynch, 1985; Knorr-Cetina, 1981; Collins, 1982). Bijker & Pinch took this theoretical basis a step further when they proposed that the Sociology of Scientific Knowledge could explicitly be used for understanding technology as well as science, an approach they refer to as the Social Construction of Technology (SCOT) (Pinch & Bijker, 1984).

A particularly relevant portion of the field to our understanding of the differences between STS and HCI comes with discussions of the influence of politics and policy on science and vice versa (Jasanoff, 1997, 1998, 2004; Latour, 2008). It is in this area that debates have been most apparent about tensions between the role STS as a neutral observer, merely reporting on controversies, and the role that such inquiry can play in attempting to change the situation under consideration. The fact that this is a matter for debate is a key marker of the distinct contrast between HCI and STS: in HCI, it is a core assumption of the field that the role of the researcher is to change the situation under study. For example, in their article "Captives of Controversy: The Myth of the Neutral Social Researcher in Contemporary Scientific Controversies", Scott, Richards & Martin discuss their involvement as researchers around discussions of bringing live foot-and-mouth disease virus into Australia for research purposes, around fluoridation of public water supplies, and on the potential for vitamin C to ameliorate cancer. In their abstract, they write:

> According to both traditional positivist approaches and also to the sociology of scientific knowledge, social analysts should not themselves become involved in the controversies they are investigating. But the experiences of the authors in studying contemporary scientific controversies-specifically, over the Australian Animal Health Laboratory, fluoridation, and vitamin C and cancer-show that analysts, whatever their intentions, cannot avoid being drawn into the fray. The field of controversy studies needs to address the implications of this process for both theory and practice. (Scott, Richards, & Martin, 1990)

This paper, published in *Science, Technology, and Human Values*, an important journal in the field, can be read as demonstrating how non-intervention was generally accepted to be the standard way of doing business in STS. Their article has been influential, and it is now not uncommon for research in STS to have a deliberate effect on the object of study, but the paper serves to emphasize just how different from the norm this approach to doing research actually is in HCI.

In the twenty-odd years since the publication of Scott et al.'s article, this topic has continued to be discussed and debated in the field. Richards & Ashmore edited a special issue of *Social Studies of Science* on the topic (Richards & Ashmore, 1996). Some papers in the volume report on researchers' interactions with scholars in other fields, such as a discussion of the appropriateness of the STS researcher intervening to aid the publication of a paper proposing a link between polio vaccination and AIDS (Martin, 1996). Other contributions, in the course of calling for researchers to make normative judgments in the course of their work, emphasize that the default investigative stance of STS is fundamentally neutral (Jasanoff, 1996). Other work has discussed the role of STS scholars as expert witnesses in legal trials (Lynch & S. Cole, 2005; Lynch, 2006a); again, issues that are in question precisely because of SSK's base case assumption of neutrality with respect to the issues at hand.

I draw particular attention to this aspect of the field because it is in this area that STS fundamentally differs from HCI. Once again, both disciplines are concerned with how people interact with technology, but STS is a critical discipline that observes

and discusses such interactions, while HCI is a building discipline that creates novel technologies. To underscore this difference, I now wish to discuss one example of how the two fields differ: their understanding of the term "user studies".

2.4 Contrasting STS & HCI

I will now illustrate the differences between the two fields by briefly looking at a specific case that is both exemplary of the respective fields but also serves to clear up a potential confusion. Both STS and HCI use the term "user studies". In both cases it has a specific meaning that is familiar to the field. However, the term is a *faux amie;* it means significantly different things in each context, and, as I hope to demonstrate in this section, is indicative of some understandings of what is worthy of study that are core to each field. To summarize, in HCI, the intent behind user studies is to leverage observation of users with a specific technology to build a better technology, usually a better version of the technology being used. In STS, the intent behind user studies is to show how users reappropriate, change and modify technologies. These show distinctly different attitudes not just to the specific case of user studies, but to the question of what phenomena are being studied and addressed by the discipline.

2.4.1 User studies in STS

In STS, the term "user studies" implies a critical study of how users adopt and reappropriate technologies. They frequently emphasize how both users and technologies serve to "re-write" each other. In the introduction to their book *How Users Matter*, a collected volume of work on user studies in STS, editors Oudshoorn and Pinch write:

> We are interested in how users consume, modify, domesticate, design, reconfigure and resist technologies. In short, our interest is in whatever users do with technology. There is no one correct use for a technology. (Oudshoorn & Pinch, 2005, p. 1)

Oudshoorn and Pinch identify three strands of user studies in STS, and I summarize their overview of the field here. The first is the Social Construction of Technology (SCOT) approach developed by Bijker and Pinch which, in its original version, emphasized how users were involved in deciding or "closing down" the dominant forms and uses of a technology (Bijker, Hughes, & Pinch, 1989). Later forms emphasized how users reappropriate technologies: for example, Kline & Pinch (1996) discuss how farmers used their Model T Ford cars in a wide variety of ways; Kline (1995) also discusses how farmers adopted, resisted and modified the telephone during its early adoption in the rural United States.

The second is a feminist approach that emphasizes issues of diversity and power in reaction to a historical approach dominated by stories about (mainly male) innovators of technology. For example, Ruth Schwartz Cowan's influential book *More Work for Mother* emphasized the importance of female users in choosing and influencing domestic technologies (Cowan, 1985). Such feminist approaches also emphasized the power of users to reconfigure and reappropriate the technologies they use, moving discussion of the agency to change technology away from the engineers and designers and towards a broader understanding of influence. These approaches also emphasizes how users and technologies inscribe gendered statements about both users and technologies: Oost's chapter in the volume discusses how fifty years of Philips electric shavers make statements about their intended users' masculinity and femininity (Oost, 2005), much as an earlier article by Hoffman discusses how word processing software makes gendered statements about its users (Hofmann, 1999).

A third approach to user studies in STS emphasizes how technologies are scripted to be used in a certain way, and how both designers and users react and respond to those scripts. For example, in Woolgar's paper *Configuring the User* he studies how a medium-size computer manufacturer decides on the identity of potential users to build a computer that is designed for only specific forms of appropriation and use (Woolgar, 1991). These images of the "ideal user" are used to edit and limit the impact of feedback from real and thus not 'ideal' users. Similarly, in her paper "The De-Scription of Technical Objects", Akrich emphasizes how such identities, which she describes as 'scripts', can break down when the technologies come into contact with users (Akrich, 1992). For example, she discusses a French photoelectric lighting kit designed for use in Africa. The industrialists and designers who built the kit designed it to be simple: a photoelectric panel to generate electricity, a battery for storing electricity and a lamp for generating light from the electricity. However, when in use, various problems occurred: it was difficult to put the lamp in an appropriate position as the wires were too short. Replacement bulbs and batteries could not be purchased outside of the capital city. The kit was not designed to be installed by local electricians with their working knowledge. And so on. It became evident in use that the designers had developed a whole set of assumptions about the ways that users would use the technology that caused the technology to malfunction in use.

These three different kinds of user studies in STS are distinct in their emphasis, but all share an understanding of what constitutes a "user" and his or her use of technologies. There is a common theme in user studies in STS of celebrating the users and their reappropriation and modification of existing technology to suit their needs, a celebration of the David of the user pitted against the Goliaths of mass-produced technology. This is not the sole variety of user studies in HCI, but it remains a

common theme in the literature. As I'll show in the next section, this is significantly different to the approach taken in HCI.

2.4.2 User studies in HCI

So in STS, "user studies" refers to studies of technology use by end users, often involving reappropriation of the technology in ways that the manufacturer did not intend. By contrast, "user studies" in HCI is a phrase that refers to two different kinds of interactions with users and technologies. The first is some variety of observation of users, often users' interactions with a technology, to gather an understanding of their usage patterns; the second, and arguably more common, is a more-or-less experimental approach to testing and identifying problems with a novel user interface. Both senses of "user study" are an extremely common term in HCI, and are common enough to not require referencing. A quick search through all 556 items published in *Proceedings of CHI 2008*, the major conference and publication venue in the field, shows that some 20% of the publications include the phrase.

The first kind of user study is typically done at the early stages of research design. For example, in their paper *Mobile Multimedia Presentation Editor: Enabling Creation of Audio-Visual Stories on Mobile Devices*, authors Jokela et al. describe a "user study on user habits on composing, sending, and editing multimedia messages" (Jokela, Lehikoinen, & Korhonen, 2008, p. 65) in which ten participants – a set of friends and two family groups – were given a phone with multimedia messaging capabilities to send annotated images to others in the group for four weeks, and then were interviewed about the process. Similarly, Satchell performed open-ended interviews with 35 "technologically competent users, 18-30, living in Melbourne, Australia" as a user study that she analyzed using concepts drawn from cultural theory (Satchell, 2008). While these are not unusual or extreme examples of

"user study", this is a distinctly less common use of the term in HCI than its second use, meaning the evaluation of a novel technology.

This more common use of the term user study involves the evaluation of novel technologies, usually built by the researcher or researchers doing the evaluation. These can happen in a variety of manners, with a variety of conclusions, but all share the same basic pattern. For example, in their paper *Playful Toothbrush*, Chang et al. built a digital toothbrush for use by kindergarten children that displayed a representation of the child's mouth as a computer game where children "won" by brushing all of their teeth (Y. Chang et al., 2008). The "user study" in this paper consisted of 13 kindergarten children using the system once a day for 11 days. The authors used a plaque disclosing dye to measure the amount of plaque left after brushing and concluded that the system was effective in encouraging better brushing. This kind of before-and-after approach is one variety of user study. Similarly a user study consisting of the comparative analysis of two interaction techniques is discussed in *Exploring the Use of Tangible User Interfaces for Human-Robot Interaction*, in which the authors compare the ease of use of controlling a robot with a standard keypad interface and with a 'Wiimote', a commercially available "wand" (Guo & Sharlin, 2008). User studies at this stage can also be primarily exploratory, serving as preliminary evaluations of designs for future study, such as Kim et al.'s "exploratory user study" in their paper *Inflatable Mouse* which explored a prototype of a mouse which users could squeeze or press in addition to standard mouse input techiques (S. Kim, H. Kim, B. Lee, Nam, & W. Lee, 2008). All of these are ways to try to understand the experiences of users with a new technology.

The first kind of user study mentioned is closer to the understandings of user study that we find in STS: it explores practices around technology use. However, it differs from the user study found in STS in the intended use of the knowledge. User

practices are not just observed, recorded and analyzed; rather, the practices are used to inspire novel technology development. The second kind of user study is distinctly different from the use in STS, and is typically very constrained: it is common for such user studies to require users to perform particular tasks chosen by the researchers as particularly compelling examples with rhetorical strength.

Both of these instances of user study point to a particular understanding of how HCI understands the notion of the "user" in HCI, which is a contentious term in the field. On one hand, it is frequently used. Bardini & Horvath discuss the early development of 'the user' at Xerox PARC in the 1970s (Bardini & Horvath, 1995), and it has become increasingly common ever since. For example, there are 47 uses of the term 'user' in the titles alone of the 556 items published in *Proceedings of CHI 2008*; a search of the first 100 documents of those proceedings shows that every single document in that set contains at least one instance of 'user', and together they contain a total of 4511 instances of 'user', an average of over 45 uses per paper. On the other hand, literature in the field suggests that unthinking use of the term is inappropriate. One argument against the use of the word 'user' is that it assumes that the primary function of the person using the computer is to use the computer. For example, in his 1993 article, Grudin makes a case for the importance of not using "user", as it encourages the view of a person as an individual whose sole role is to use the technology in question. He explains:

> "Casual users" is a term often used to describe managers and executives-- who are often not "casual" at all. "Novice" or "naive" users are often expert or sophisticated at their jobs-- whereas the expertise of "expert users" may not extend beyond computer use. These terms simply assume that everything is in reference to a computer. (Grudin, 1993, p. 113)

Agre also encourages finding alternatives to the term as part of a better approach to system design:

> …the user is probably not wholly defined in terms of his or her use of a computer system: systems should be designed not for "users" but for clerks, lawyers, salespeople, engineers, waiters, drivers, and so on. (Agre, 1995)

"User" is sometimes felt to have negative connotations of helplessness and sometimes even stupidity. Woolgar quotes one of his subjects, an engineer in a medium-sized computer company:

> "He was a user but he seemed to know what he was talking about." (Woolgar, 1991, p. 73)

Even when "user" is not used as a pejorative term, it has implications of helplessness, lack of awareness and simplicity:

> Users, for example, are presumed not to understand the inner workings of the machine, to understand new machines through reactions developed using old machines, to attempt to minimize their effort, and always to have a particular task in mind and not an abstract interest in the machine itself. (Agre, 1995, p. 70)

This overview is not intended as a complete discussion of the uses of the terms "user" and "user study" in HCI: interested readers are referred to (Agre, 1995; G. Cooper & Bowers, 1995; Akrich, 1995) and to the discussion in Chapters 11 and 15 of (Suchman, 2007). Rather, my aim is to demonstrate a significantly different understanding of the terms "user" and "user studies" in HCI and STS. In STS, the user is lauded as reconfiguring and reappropriating technologies in novel and creative ways; in HCI, the user is a source of requirements or end-of-study evaluation, but is rarely seen as a creative force. At the same time, both see users as an important category of stakeholders in studying the ways that technology is used: Borg makes the point that 'the user' has been 'discovered' multiple times in multiple ways over the course of developments in technology design (Berg, 1998). Understanding these different 'users' in the two fields is an instructive way to compare the ways fields approach their work, but also highlights difficulties in combining such approaches.

2.5 Putting STS approaches to work in HCI

In this chapter, I have discussed how I draw from foundations in both HCI and STS. I have presented summaries of both fields, and gone into some detail about the particular term "user studies" used in both domains with significant differences in meaning. STS and HCI clearly approach the world in distinctly different ways, with different ideas of what constitutes scholarship, knowledge, validation, and so on. These differences can make it difficult to import methods, approaches and understandings from one discipline to another, particularly as the core differences – valuing critique, valuing building, and so on – are rarely stated explicitly.

However, I believe that there are ways these two disciplines can be combined productively. I will show how STS has tools for understanding the way knowledge is created by scientists that we can use to make sense of arguments and debates in HCI. It may well be the case that HCI has tools that could be of use to STS, but that is not my focus in this work. In the next chapter, I will discuss the notions of epistemology and epistemography drawn from STS and how they can be applied to understand not just the changing understanding of 'evaluation' in HCI, but also how these debates arise from changing ideas of what constitutes valid knowledge in the field.

CHAPTER 3: USING EPISTEMOLOGY TO UNDERSTAND EVALUATION[1]

3.1 Introduction

In Chapter One, I wrote that I would treat evaluation as an emergent category of HCI, and show how its meaning had changed over time. To do this, I will use some tools drawn from STS. In particular, I will use the concepts of epistemology and comparative epistemology. In Chapter One, I talked about the concept of task, and how some researchers in HCI found it a useful concept to explain what it is that people do when they use computers. In a similar way, researchers in STS find the concepts of epistemology and comparative epistemology useful concepts to explain what it is that people do when they create knowledge. Epistemology is the study of knowledge: it asks questions like "How do we know what we know?", and "What is the right way to make knowledge?" In contrast, comparative epistemology is the study of epistemologies, allowing you to compare different opinions about valid ways of knowing. It is, if you will, meta-epistemology.

I will now begin this chapter by going into detail about these two terms, and discussing questions around their application to HCI. I will then use them to explicate the changes in the term 'evaluation' in HCI's history, and demonstrate the use of epistemology by looking at a case study of text editor evaluation in the early 1980s. I will then finish by demonstrating how using comparative epistemology can help understand a comparatively recent debate in HCI: the Damaged Merchandise controversy.

[1] This chapter draws on (Kaye & Sengers 2009), currently under consideration for *HCI*.

3.2 Epistemology & Comparative Epistemology

At the beginning of this thesis, I described how problems with evaluating the VIO had caused me to question aspects of technology evaluation: how do we really know if a technology works? What does it mean for a technology to work? What is an appropriate way to study a technology and find out if it works – and how can you do that when you do not know what the results will look like? Questions like these led me to consider not just different ways of doing research, but different ways of knowing that the research I do and the knowledge I am creating is valid.

Creating knowledge involves making statements about things that we believe are true. We don't believe that certain things are valid or true *because* they are valid or true; we believe that certain things are true because we have been presented with some kind of evidence of a type we believe is appropriate to support that statement, or because we have had some kind of personal experience resulting in that belief. In his essay in *The One Culture*, Peter Dear has an example:

> If someone asks me why I believe the earth is round, it would little serve my case to reply that I believe it because it's true. I would likely adduce various empirical grounds of the kind employed by ancient Greek philosophers, to do with the disappearance of ships' hulls over the horizon or the change in apparent altitude of the pole star as the observer travels north or south, or else modern arguments to do with photographs from outer space. Whatever the evidence and arguments might be, they would count as at least part of the explanation for my belief, regardless of their plausibility to other people. Logically, the truth of the belief could never explain it, even if we were God and happened to know the absolute truth. (Dear, 2001, p. 131)

Epistemology is the study of ways of knowing, of understanding what constitutes valid knowledge in a given situation. A certain epistemological orientation or approach to knowing makes explicit claims about what is necessary for valid knowledge: in Dear's words, a "prescriptive study of how knowledge can or should be made". For example, there is a prescribed way for a laboratory technician to measure the quantity of sugar in a urine sample. This is considered to be a valid way to

generate knowledge about a particular urine sample. There is a different way that is appropriate for a chef to determine the amount of sugar in a cake batter. Both of these are valid kinds of knowledge for the situation, but would likely be inappropriate if situations were reversed.

More traditional uses of the term epistemology in philosophy use the term epistemology to imply a certain value judgment: such-and-such an approach does or does not produce valid knowledge. However, to study the different epistemologies inherent in HCI, I am using an approach known in STS as *comparative epistemology*[2]. This approach emphasizes understanding and comparing how people understand what constitutes valid knowledge, without making inherent value judgments about that knowledge. Comparative epistemology thus differs from epistemology, which involves a value judgment about what constitutes valid knowledge. It allows us to compare different epistemologies without making judgments about which is right and which is wrong.

For example, were we to formalize an epistemology of a particular flavor of HCI it might look like "Valid knowledge comes from a controlled laboratory experiment with at least fifteen users and a control group", or, conversely, "Valid knowledge comes from studying the use of a technology in a real-world context over an extended period of time." These kinds of statement carry implicit epistemological implications about the ways that 'real' knowledge comes about by, among other things, controlling or not controlling aspects of knowledge generation. Furthermore, such epistemological stances do not just impact how people evaluate the research they have created, but influence the entire process: the subject of research, the methods chosen to address that subject, the entire research process.

[2] Dear uses the term *epistemography* to refer to one construction of comparative epistemology in STS (Dear, 2001), but in the interests of simplicity and minimizing new vocabulary I will continue to use comparative epistemology.

For example, a classic example of scientific ways of knowing in HCI is Project Ernestine, a study of technology for directory enquiry telephone operators (Gray, John, & Atwood, 2005). In this study, Gray and his collaborators used a technique known as Goals Operators Methods Selection (GOMS) to characterize how directory enquiry telephone operators did their jobs. They were able to effectively and accurately characterize the existing system and develop a demonstrably faster new system, which is lauded for saving their clients multiple millions of dollars a year. Their study – quantified, statistically significant and economically justified – is a prime example of what is considered scientific knowledge in HCI.

By contrast, in other contexts other ways of knowing are considered valid. For example, Suchman studied users of a photocopier at Xerox PARC by leaving a video camera in front of the photocopier and recording its use (Suchman, 1987). She analyzed these recordings and showed how users misunderstood the interface and the current state of the machine. There were no laboratory studies or controlled experiments, but her work has been influential in the field and is emblematic of specific ways of knowing. Suchman's work is one example of a 'practice-based' approach to creating knowledge in HCI. These kinds of practice based approaches – so called because they on rely on observing the everyday practices of users – provide a particular kind of situated understanding of a situation, where the observer plays an active role in selecting, presenting and understanding the knowledge. This kind of situated knowledge can be seen as being in contrast to the supposedly context-free, generalized and generalizable kinds of knowledge created by traditional forms of science.

There is a barrier between these different epistemologies or of ways of knowing. If a researcher is used to doing experiments, and seeing research in terms of good experiments and bad experiments, then a good ethnography may look like a bad

experiment. One of the core tenets of this thesis is we can improve inter-episteme communication, and in the process improve the quality of the field as a whole, by making people aware of their own epistemological orientations, and thus able to recognize when others' epistemological stances differ. That is to say, a researcher who primarily does experiments needs to be able to recognize an ethnography as such, with its own appropriate standards of quality, even if those standards are unknown to the experimentalist. Similar arguments apply to practice-based researchers and experimental approaches.

Now we have an idea what epistemological orientations look like, I will now discuss how they are used as a concept in STS, before going on to raise some issues around importing that concept into HCI.

3.2.1 Using Epistemology in STS

In STS, epistemology and epistemological approaches to understanding a given area of research are common. For example, Pickering studied how particle physicists make knowledge (Pickering, 1984), Latour & Woolgar studied knowledge-making in a biological laboratory (Latour & Woolgar, 1986), and Lynch studied knowledge-making by neuroscientists (Lynch, 1985). Others in STS compare two fields and their different ways of knowing, as Knorr-Centina did in her book *Epistemic Cultures,* comparing the ways that physicists and biologists generate knowledge (1999). In such cases, the STS scholar is able to look at the field under study from outside, noticing how work is done and knowledge is created that may or may not seem obvious or unremarkable to those within the field. For example, in their study of a laboratory at the Salk Institute, Latour & Woolgar discuss how the lab is a machine that takes in animals, chemicals and funding and outputs articles (Latour & Woolgar, 1986). It is unlikely that someone from within the field would come up with that kind

of characterization, but it does give certain insights into the way the laboratory under question functions.

3.2.2 Using Epistemology in HCI

The change that happens when I import such an approach into HCI is that I can no longer claim to be outside the field. Even if I deliberately try to maintain an objective stance, I still have personal investment in the field and in its criteria for valid knowledge, as ultimately my work will be judged by those criteria. Under those conditions, it is difficult (and, arguably, unreasonable and ultimately counter-productive) to remain impartial throughout the research process. My solution in this work has been to be explicit about the different aspects of my role and approach at different points in the research process. While working in a historical phase, I deliberately remain impartial, and actively try to report epistemologies within the context in which they arose. By contrast, my conclusions about the preferred state of the field are far from impartial, and I am explicit about this distinction.

With those limitations and advantages in mind, I will now use the notion of epistemology as a tool to try and make sense out of the complexity of the broad spectrum of research found in the field. One way to understand the different ways that different researchers in HCI approach research is to look for evidence that different researchers have different epistemologies. So, loosely speaking, designers may share one kind of epistemology, experimentalists a second, and ethnographers a third. As I will show, different HCI researchers consider different kinds of knowledge to be valid, and they have different standards for considering whether a given piece of knowledge is or is not valid. As we will see later in this chapter, these differences in opinion can lead to difficulties in communicating within the field, and can lead to arguments which

can be hard to satisfactorily resolve without the concepts of epistemology presented here.

3.3 Approaches to the History of HCI

The nature of scholarship is such that researchers must engage with the current state of their chosen academic field on a day-to-day basis, engaging with the knowledge-making practices and values of the field as it currently stands. However, doing so can obscure the process by which the current epistemology in a field has come to be: it can become to be understood as the default, standard, and sole valid epistemology. Understanding the process by which a particular epistemology came to be understood as the default can provide an opportunity for recognizing alternative ways of creating and validating knowledge, and suggest alternatives to current approaches which may overcome apparent limitations to progress. In the interests of opening up this kind of opportunity, this chapter attempts to explicate the historical basis of HCI's current epistemological approaches. I do this by emphasizing three aspects of this history:

1. Identifying the epistemologies characteristic of the field at particular periods of time;
2. Looking at evaluation as the point in research at which knowledge is explicitly validated according to the appropriate epistemology of the day;
3. Looking primarily at the published literature in the field as a resource to understand these three areas, rather than, say, interviews, surveys, or other approaches.

This set of approaches allows me to show that the study of the epistemology of evaluation can both lead to insight into HCI's current understanding of what constitutes research, but can also propose alternate approaches that may themselves be fruitful for better understanding the field, and for producing better research within it.

Understanding the history of the field is important in encouraging a certain defamiliarization with one's assumptions about the 'default' way that HCI occurs, and

in recognizing that the current state of the field, and corresponding epistemological assumptions, are by no means inevitable nor fixed. There have been several approaches to mapping the history of HCI: Blackwell has concentrated on the use of metaphor in interface design (Blackwell, 2006), Shackel looked at the history of HCI in Britain (Shackel, 1997), while Myers emphasized the influences of changes in HCI technology (Myers, 1998) and Dumas looked at the development of usability as a profession (Dumas, 2007). Grudin has used a number of approaches to map the history of the field (Grudin, 1990, 2005, 2007) and has been instrumental in emphasizing the need for discussion of the field's history as part of HCI practice (Grudin, 2004, 2005); see (Grudin, 2007) for an in-depth review of the literature. These accounts emphasize that understanding the history of the field is an important and potentially powerful part of advancing the field by allowing for reflection and learning from previous efforts. However, my approach differs from much of these works in my approach to understanding the different factors that have influenced change.

A look at the study of technology in STS suggests three primary approaches. The first, technological determinism, views the changing nature of technology as a key driver of change. The second, social constructionism, sees social relations between humans as being a key driver of change. The third, actor-network theory, sees both humans and technologies as having the agency to create change. I will now discuss each of these three in more detail.

Technological determinism posits that socio-technological fields are primarily driven by the development of new technologies: new technologies create new opportunities for use in new contexts. This is a common approach to explaining causality in much of the technology industry and in technological research (Smith & Marx, 1994), although it is often not described as such (R. R. Kline, 2001). For

example, in his history of the field, Myers uses the ongoing progress of technology as a way to organize and motivate changes in the field (Myers, 1998), and Grudin uses the location of the interface to organize a history of the field (Grudin, 1990). Both do acknowledge the existence of other factors – Myers, for example, points out that "a companion article on the history of the 'human side'… would also be appropriate". However, in these articles both treat the changes in technology as the primary factor in movement in the field.

Arguably the opposite of this approach is 'social constructivism'. Social constructivism places primary emphasis on the influence of the actions of people as individuals and as a society. The social construction of technology (or SCOT) is developed at length in *The social construction of facts and artifacts* (Pinch & Bijker, 1984). This was modeled on Collins's approach which focused on understanding scientific communities (Collins, 1982), and was in turn modeled on Bloor's Strong program for the study of scientific knowledge discussed earlier.

A third approach to addressing the tension between social and technological emphases can be found in actor-network theory (Latour, 1996, 2007), which while it has no formal influence on this work is perhaps closest to the approach I have taken. Technological determinism argues that technological change is the strongest causal factor; the social construction of technology argues that social factors are the primary agent in determining change. By contrast, actor-network theory sees both human actors and technology as having agency to produce change or stability. New contexts for technology use and cultural changes can themselves call for the creation of novel technologies; furthermore, these new contexts can suggest other disciplines or ways of knowing that impact how we understand technology and its uses. There is no clear division between precedent and antecedent, and to understand historical events it can

be necessary to swap back and forth between looking at technologies and looking at people, at disciplines, at organizations and other influencing factors.

Actor network theory is not without criticism. Susan Leigh-Star, for example, argues that the assumption that humans and non-humans both have agency can diminish the agency given to groups of marginalized humans (Star, 1995, 1991). However, ANT provides an arguably useful framework for fields such as HCI, which examine situations in which both machines and people interact. ANT provides a way to address, for example, the increasing availability of smaller, cheaper and more powerful computers that led Mark Weiser to his vision of ubiquitous computing. This vision itself further inspired the further development of such technology. These kinds of circular causal relationships are one reason why an approach that recognizes the influence of both technology and people seems necessary to reason about HCI.

3.4 The History of Evaluation in HCI

Studying a history often requires finding some way to organize the past into coherent chunks or stages. The starting point for my analysis is Grudin's five stages of the history of HCI (Grudin, 1990). Grudin organizes his stages around shifts in the apparent location of the interface: from the hardware, to programming tasks, to terminals, to interaction dialogues, and to the work setting. Each time this location shifts, Grudin argues, we see correspondingly different kinds of users accomplishing different kinds of tasks and different kinds of design strategies appropriate for addressing their needs. Grudin's emphasis is on design and design strategies; I have found that for evaluation it can be helpful to expand the focus of analysis to the following three questions:

1. Who is evaluating?
2. Who are the users?
3. What are the limiting factors on users accomplishing what they aim to do with the machine?

These questions provide ways to characterize a given period of time by identifying given ways of looking at the computer, thinking about what it does, and evaluating it. From these questions a narrative for the evolution of evaluation arises: a narrative of waves of new researchers entering the field, bringing new notions of validity and evaluation with them, challenging the accepted wisdom of the time, and explaining their outlook to researchers following the dominant paradigm of the time.

This research does not attempt to be a complete history of the field, and I recognize that an emphasis on the dominant paradigm can miss out on contributions of minority traditions. In particular, in many of the stages I discuss, there are multiple traditions of evaluation and of validity, and it can be hard to separate out those traditions in historical hindsight. This paper views the history of HCI through a distinctly CHI-community-centric lens, when alternate views could emphasize, say, a human factors approach to HCI, or a view that emphasized the contributions of British and European HCI over the generally North American focus of CHI (c.f. Shackel, 1997). Furthermore, the emphasis on evaluation may undervalue contributions from disciplines whose notions of evaluation do not fit easily into an discipline that relies on publishing at conferences and in journals: design, with its emphasis on the drawn and built form rather than written description, is noticeably underrepresented in this discussion. In addition, I do not discuss HCI's sister field of computer supported collaborative work (CSCW). However, I believe the historical account to follow is a useful way to structure a discussion about the way HCI's current understanding of evaluation came to be.

The work that follows is the result of an extensive survey of the literature and history of HCI. I looked in particular at the changing meanings of the word 'evaluation' as used in articles in the ACM Digital Library from 1948 to the present (and particular around the beginning of the 1980s at the foundation of what I now know as CHI), and studied textbooks, proceedings, edited volumes and monographs on human-computer interaction and man-machine communication. I developed a framework, as described below, for clustering similar approaches to evaluation, and analyzed factors that likely led to shifts in approaches to evaluation. I corroborated and fine-tuned my account through discussions with historians both inside and outside the field and a number of key actors. I sent preliminary versions of my findings out to researchers in the field to see the extent to which my approach could be seen as a coherent retelling of their experiences, and presented preliminary reports to those in the field at ten universities, corporate research groups and local SIGCHI meetings, gathering feedback and changing the work to reflect that feedback.

3.4.1 Evaluation: Engineering

Early computers in the 1940s and 1950s were experienced by their users as fundamentally mechanical and electrical machines, characterized by the frequent failure and need for replacement of vacuum tubes and other components. Grudin describes this as the interface at the hardware, with engineers directly interfacing with the hardware itself, at the level of binary or octal or hexadecimal, dealing directly with specific registers and memory locations. Both users and evaluators were electrical engineers and mathematicians, although evaluation in the sense that we use today in HCI did not exist. The closest equivalent to evaluation in the published papers of the time is 'reliability,' since the limiting factor in determining how well a computer worked was how long it would do so. For example, John von Neumann brings up

reliability of vacuum tubes and memory storage seven times in his draft report on the EDVAC (von Neumann, 1945). But as the hardware became more reliable, a new breed arose: that of the computer scientist.

3.4.2 Evaluation: Computer science

Grudin's next stage is the interface at the programming task, a period starting around the beginning of the 1960s and continuing through the mid-1970s. 'Reliability' is still an important metric, although its meaning has altered: Holt (1960) for example, uses the term to refer to the degree to which a particular piece of hardware or software is ready for use. But at this stage, we start to see a meaning of 'evaluation' that we can recognize: it means 'testing', or 'appropriateness for task'. The first use I found of evaluation in this sense is Israel (1957) in which he develops a set of pre-packaged input data that can be fed to a program as part of a testing regime. Evaluation around this time focuses on what the computer can do, without reference to human users; Calingaert (1967), for example, defines throughput, turnaround and availability as fundamental measures of performance of a computer system. Similarly, Lucas (1971) refers to three major purposes for evaluating the hardware and software performance of computer systems: selection evaluation (deciding what to buy), performance projection (figuring out how fast it'll run once you have bought it) and performance monitoring (figuring out how fast it runs now that you own it.)

This notion of evaluation emphasized the speed of the computer. This is not evaluation in the way we have become familiar with in HCI, which sees the speed and ability of the human user as being a key factor in evaluation. One way to understand this shift is to look at the limiting factors on accomplishing tasks with a computer. A limiting factor is the slowest part of a given process. That is to say, given a chain of events that need to happen in sequence to complete a process, the limiting factor is the

slowest element of that chain, which slows all other components down to its speed. By the late 1970s, the computer was no longer necessarily the slowest part of the interface: the computer was spending a lot of time waiting for the human, rather than the other way around. But during much of the 1960s, the limiting factor was the speed of the machine. This stage was formative in the way that computer scientists saw, and in many cases outside of HCI, continue to see, evaluation. The users are computer scientists, the evaluators are computer scientists, and the evaluation is in MIPS, megahertz and megabytes, terms that computer scientists understand as giving them information about appropriateness for and speed of task execution.

3.5 Influences of Cognitive Science & Experimental Psychology

Grudin covers in some depth the divisions between three approaches to understanding computers and their users that were influential in early man-machine communication: human factors and ergonomics with their emphasis on data entry, managerial use of computing, and the discretionary hands-on use that became the characteristic object of study of human-computer interaction (Grudin, 2005). In summary, the main reason that users are absent from the discussion in the early stages of computing is that the vast majority of people – with the exception of a few researchers at universities and major research institutions (Buxton et al., 2005; Levy, 1994) – were not using computers in a hands-on manner. Batch processing meant that access to computers was at arm's length: a user would write his or her program on punch cards, submit it to the computer attendants, and then receive their output some time later. J.R. Licklider proposed the notion of interactive access to computing (1960), which was more fully developed over the course of the sixties and seventies (Buxton et al., 2005).

By the end of the 1970s, we started to see a rise in people we might recognize as 'users'. These are people who were using the computer as a tool to solve problems. They no longer understood what the computer is doing in the same manner as engineers and programmers did in earlier phases, and they did not care. They were still mainly government and corporate employees, and they were still doing single, focused tasks in support of their jobs. The speed of execution of those tasks, though, was becoming the metric by which systems were measured, rather than the speed of the computations that enabled that execution. As the human became an essential part of the human-computer equation, the balance shifted from an emphasis on the technology, to developing more balanced roles of computer and human working together. It became necessary to think about the evaluation of systems that included humans as well as computers.

Around this time, experimental psychologists and cognitive scientists started to enter the field and became the evaluators, bringing with them a new approach to evaluation and a set of problems they are equipped to solve, based on the experimental and psychophysical approaches from their home disciplines. So in publications of the time, we see an emphasis on, for example, the ergonomics of the keyboard, the legibility of different colors of text, and the role of timing in input and output. Grudin writes:

> Perceptual issues such as print legibility and motor issues arose in designing displays, keyboards and other input devices… [new interface developments] created opportunities for cognitive psychologists to contribute in such areas as motor learning, concept formation, semantic memory and action. In a sense, this marks the emergence of the distinct discipline of human-computer interaction. (Grudin, 1990)

3.5.1 Understanding the Influence of Experimental Approaches

So what effect did this influx of psychologists and scientists have on evaluation in the field? Or, to put it another way, what did experimental psychology

and cognitive science have to say about how knowledge was created and validated in HCI? In addition to bringing additional theoretical depth, these disciplines emphasized an *experimental* approach towards the evaluation of systems: they were accustomed to testing subjects in laboratory experiments to determine psychophysical parameters, such as response times to stimuli. More fundamentally, this approach encapsulated a belief that the experimental method was the most reliable way to acquire knowledge about the world. The result was a notion of evaluation that combines the system focus of computer science with the experimental approach of experimental psychology. The *limiting factor* addressed by this notion of evaluation was the ways and speed with which users could instruct computers to do what they wanted. This has become such a fundamental part of the notion of evaluation in HCI that it is worth going into detail on precisely what such evaluation entails, as a first in-depth example of understanding a single epistemology before we compare multiple epistemologies.

3.5.2 Case Study: The Evaluation of Text Editors

A quintessential example of experimental psychology and cognitive science-influenced evaluation is Teresa Roberts and Thomas Moran's study of text editors in the early eighties, in which they compared nine different text editors across a variety of attributes: the time taken to perform basic editing tasks by experts, the error cost for experts, the learning of basic editing tasks by novices, and the functionality that the program offered (Roberts, 1980; Roberts & Moran, 1982, 1983). Roberts & Moran explicitly state three criteria they used to create their methodology: objectivity, thoroughness, and ease-of-use. Objectivity, they write, "implies that the methodology not be biased in favor of any particular editor's conceptual structure"; their definition of thoroughness "implies that multiple aspects of editor use be considered". Ease-of-

use refers to the ease of using the method (not the editor itself), and they explain: "the methodology should be usable by editor designers, managers of word processing centers, or other nonpsychologists who need this kind of evaluative information but who have limited time and equipment resources" (Roberts & Moran, 1983). Mindful of the needs of system designers, Roberts and Moran are careful to use both novice and expert users, and they make a point of mentioning that they're evaluating text editors "from the viewpoint of the performance of their users" (Roberts & Moran, 1983, p. 266). Their expert users include one person who knows how to program and one who does not; novice users have never used a computer or word processor before. Expert users are given a set of tasks to do on an existing document; novice users are taught how to do those tasks. The idea is to create a totally generalizable set of criteria that can be applied to any text editor, as opposed to the evaluation of a single editor (i.e. Good, 1982).

Their ease-of-use criteria (again, of the evaluation system, not of the software itself) states that the evaluation needs to be easy enough for even 'nonpsychologists' to use. This emphasizes that the standard evaluator at this stage is the experimental psychologist, with an appropriate background in experimental design, timing subjects, and looking at the effects of, say, learning and error cost[3]. What's perhaps most interesting is that in designing an evaluation to be used by 'nonpsychologists', we're starting to see the first signs of a shift away from the psychologist as default evaluator of software, and the very beginnings of the next stage in our history of evaluation.

[3] Grudin quotes Thomas Green in 1984: "Text editors are the white rats of HCI." – a sentence that tells us more about the shared cultural background of HCI of the time than text editors themselves. (Grudin, 1990)

3.6 Studying Epistemological Clashes

This emphasis on the experimental method with its history in experimental psychology and cognitive approaches turned out to be problematic when applied to real-world problems. While it had strong explanatory power in the laboratory and in the research domain, it could be difficult to transfer knowledge to the field, and hard to reduce complex real life problems to simplified cases that could be studied under laboratory conditions. In this next study I will demonstrate how comparative epistemology can be used to understand clashes in the field.

3.6.1 Case Study: Damaged Merchandise

By 1995, there were at least three intellectual traditions being synthesized within the HCI community: computer science, with an emphasis on system building; cognitive science and experimental psychology, with an emphasis on experimentation and controlled laboratory studies; and usability, with an emphasis on experts and the evaluation of systems *in situ.* These different perspectives laid the ground for a discussion of who was doing evaluation the 'right' way. Studying this discussion in detail is useful both for understanding the specific split between the experimental psychologists and the usability experts, and for understanding how a novel intellectual approach must interact with the dominant paradigm of the field. Our aim in presenting an in depth study of this particular paradigm clash is not because it, above all other discussions, has shaped today's notions of evaluation in HCI. Rather, it provides an example of a way to understand discussions about evaluation in the field, not as a matter of 'right' and 'wrong' approaches, but as a clash of multiple ways of seeing, understanding, and doing.

At CHI'95, Wayne D. Gray organized a panel entitled *Discount or Disservice? Discount Usability Analysis: Evaluation at a Bargain Price or Simply Damaged*

Merchandise? (Gray, 1995). Gray presented research suggesting that the experimental and scientific basis for a number of studies comparing different usability evaluation methods was fundamentally flawed, and that the conclusions of these studies were invalid. Each of the studies he looked at had a roughly similar format. Typically, the study compare the results of multiple groups of evaluators using different usability evaluation methods to evaluate the same system. There were a variety of evaluation methods to choose from. For example, Nielsen's heuristics (Nielsen, 1993) emphasizes comparing a system to a pre-determined list of characteristics. Cognitive walkthrough emphasizes the mental state of the user and how that changes over time (Polson, Lewis, Rieman, & Wharton, 1991). Goals Operators Methods Selection (GOMS) builds models of tasks out of the smallest units of interaction – clicking, typing, selecting, and so on (Card et al., 1983). In the work Gray discussed, a typical study would look at the number and variety of problems found by using the different methods, and conclude that one or another method was the most useful.

The ensuing discussion resulted in a special issue of *Human Computer Interaction* entitled *Experimental Comparisons of Usability Evaluation Methods.* In their lead article, Gray and his collaborator Salzman review five experiments that compare a total of approximately 22 techniques for evaluation (Gray & Salzman, 1998a). They describe their reasons for this undertaking in terms of concern for the impact of possible errors:

> If the influence of these experiments were trivial, then such small problems could be safely ignored. Unfortunately, the outcomes of these experiments have been used to justify advice to practitioners regarding their choice of UEMs [usability evaluation methods]. Making such choices based on misleading or erroneous claims can be detrimental – compromising the quality and integrity of the evaluation, incurring unnecessary costs, or undermining the practitioners' credibility within the design team.

Gray and Salzman draw on the first two chapters of Cook & Campbell's (1979) discussion of various forms of validity as the basis for their claims. They identify four issues of relevance:

- statistical conclusion validity: having an inadequate sample size to justify the experimenters' conclusion that the effects were caused by the factors they claim
- internal validity: the impact of instrumentation (generally biases in human observation), of selection of experimental groups, and of setting.
- external validity: are the experimenters manipulating what they think they're manipulating, and are they measuring what they think they're measuring?
- conclusion validity: do the implications the experimenters identify follow on from their results?

The authors concluded were that there were major flaws along one or more of these dimensions in each of the five experiments they reviewed.

Gray and Salzman were addressing methodological concerns with the way knowledge was being validated in the field. However, they were also making a statement about the identity of the field itself. They point out later in the paper that "the implications we draw are of more than *academic* interest. They concern the entire HCI community" (emphasis in original). By defining the issue as one that concerns the community, they imply that the community is concerned about such issues. In other words, the implication is that if you felt that the issues raised were not relevant, then you are not or should not be part of the community. And, indeed, the community *was* concerned, but did not necessarily agree with Gray and Salzman's conclusions.

Ten responses from a wide variety of researchers were collected into the next chapter in the issue, *Commentary on "Damaged Merchandise?"* (Olson & Moran, 1998). John Karat defends the need for experiments in context, while Robin Jeffries and James Miller defend their use of 'real-world settings.' Arnold Lund and Ian McClelland each point out that there may be value in publishing site- or application-specific studies as they may be useful in practical rather than scientific ways. Bonnie John questions Gray and Salzman's emphasis on experimental methods, suggesting the importance of case studies to complement formal reporting of evaluation techniques. Andrew Monk points out the difficulties of doing experimentally valid research when the validity is based on criteria such as those in experimental psychology, and posits that such an approach does not work on the broad questions posed in HCI – although another respondent, Sharon Oviatt, disagrees and proposes instead a field-wide program of sustained, scientific, reproducible research to answer those very questions. Wendy Mackay emphasizes the need for triangulating answers within and across disciplines, and William Newman discusses the need for simulation in usability evaluation. Finally, Gray and Salzman finish the issue with a brief chapter, *Repairing Damaged Merchandise: A Rejoinder*, expressing pleasure at the fact that the field is at least seeing discussion of these issues, and proposing plans for the field on the basis of these discussions (Gray & Salzman, 1998b).

Why did this debate occur in the manner that it did, and why does it matter to us in understanding shifts in evaluation? Both Gray and Salzman had backgrounds in cognitive science, which comes through in their epistemological orientations to valid knowledge. What we're seeing in this debate between cognitive scientists focused on experimental validity and other kinds of HCI researchers focused on real-world results is a clash between approaches to understanding what constitutes knowledge; between cognitive scientists' and HCI and usability professionals' notions of evaluation. It is

not that the respondents to Gray & Salzman are not cognitive scientists or experimental psychologists by training, but rather that they are *choosing* to emphasize different standards of evaluation in the work, shifting their emphasis from the *experimentally provable* to the *experientially improved*. This is deeply at odds with the experimental nature of Gray & Salzman's approach, as shown in the penultimate paragraph of the section "Threats to Validity of Experimental Studies":

> There is a tradition in the human factors literature of providing advice to practitioners on issues related to, but not investigated in, an experiment. This tradition includes the clear and explicit separation of *experiment*-based claims from *experience*-based *advice*. Our complaint is not against experimenters who attempt to offer *good advice*. Rather, we are concerned with advice that is offered without the appropriate qualifications. Experience-based advice needs to be clearly and explicitly distinguished from experiment-based inference. Unless such care is taken, the advice may be understood as *research findings* rather than as the *researcher's opinion.* (Gray & Salzman, 1998a, p. 219, emphasis in original)

Note the change over the course of the paragraph in how Gray & Salzman refer to the knowledge of the usability professional: "experience-based advice" becomes "attempts to offer good advice" and then "the researcher's opinion." Usability as a discipline recognizes the role of expertise in creating valid knowledge, such as in Nielsen's heuristic evaluation, which relies on inspection by experts (Nielsen, 1993). In the context of our history of evaluation – particularly the question "Who's doing the evaluation?" – it seems hard not see this debate as a case of adherents to the dominant paradigm in the field debating their experiment-based notions of validity against a new intellectual tradition which included treating "the researcher's opinion" as a source of valid knowledge, regardless of whether it could proved in a scientific manner.

3.7 Epistemological reflection

For researchers in HCI, I intend the chapter so far to encourage a certain openness to alternative paradigms of HCI. It is my hope that realizing the history of

HCI can open up the current day research to the multifarious ways that history could have produced a different set of default approaches to HCI. My aim is to counter a casually technologically-determinist history of HCI in which technology moves inexorably forward, ever-improving, and replace it with a richer picture of a discipline where causality is rich and complex, where individuals and groups and technologies all have influence on the direction of the field. The question then becomes how to apply such approaches to one's everyday work as a researcher in HCI. Understanding competing epistemologies without choosing one as correct – the core of comparative epistemology – is a powerful way to understand a field. However, such an approach may not be useful for day-to-day practice of actually doing research in HCI, which requires that one has an understanding of the nature of the valid knowledge one wishes to create. However, an awareness of epistemological issues can, I propose, be a useful tool in effectively and thoughtfully doing research, evaluating that research, and evaluating the research of others. As such, it has significant value in the practice of HCI. In particular, an awareness of others' epistemological approaches can enable the researcher to engage in discussion not just about the validity of results of a study, but rather at the level of the underlying assumptions about what research should be about.

Some of the earliest discussion of epistemology in HCI has focused on the role of epistemology in teaching, such as in discussions of Piaget's notion of the development of children's epistemologies as they mature (Turkle & Papert, 1992). A closer approximation to the use of the term epistemology in this thesis can be found in the work of Winograd & Flores (1987) in which they question the epistemological foundation of rationalism underpinning cognitive science and much of computer science and propose instead a "new foundation for design" based on a phenomenological approach of Heidegger and Maturana (38). Similarly, Dourish (2001) emphasizes changes in epistemological approaches necessary to propose

drawing from the phenomenologists Husserl, Heidegger, Schütz and Merleau-Ponty (102). Epistemology has also been used as a tool to characterize and understand different approaches to shared tools, such as in Boehner et al.'s study of the use of cultural probes in HCI (2007).

An even closer use of epistemology can be found in work that directly addresses the use of multiple epistemological approaches in HCI. One example of this can be found in the proposal for the workshop **"**Reflective HCI: articulating an agenda for critical practice" held at CHI 2006 (Sengers, McCarthy & Dourish), in which the authors discuss the implications for research agendas of the incorporation of practices, methods and concepts from epistemological standpoints other than cognitive science. A more complete discussion of these different perspectives can be found in the paper "Three Paradigms of HCI" (Harrison, Tatar & Sengers 2007, in press) in which the authors describe three approaches to HCI: the first drawing from engineering and human factors, the second from cognitive science, and the third from a situated perspective closest to the experience-focused work I describe here. In this work, however, I build on this work in two primary ways. The first is an emphasis on evaluation as the stage in which knowledge is created and validated in HCI. The second is a call for *epistemological reflection*: understanding how we, individually and as a field, recognize valid knowledge.

The notion of reflection as a practice has some history to it. *The Reflective Practitioner* (Schön, 1983) outlined an approach to professional practice that encourages ongoing reflection by professionals in the course of their careers around critical incidents. In his construction of reflection as part of professional practice, professionals – notably nurses, teachers and urban planners – are encouraged to consider critical moments in their professional lives and think through the lessons that could be drawn from those moments. In our paper, "Reflective HCI" (Sengers,

Boehner, David, & Kaye, 2005) my colleagues and I drew from Schön's work to propose an agenda for HCI that encouraged a particular form of reflection: "bringing unconscious aspects of experience to conscious awareness." We wanted to encourage building technologies that encouraged such reflection by both builders and users. We proposed that encouraging such reflection should be a core value for HCI and emphasized the role that built technology can play in moving HCI further towards a reflective practice.

Epistemological reflection is one substantiation of a reflective HCI practice. Rather than building technologies that encourage reflection when designed or used, as we suggested in the "Reflective HCI" paper, epistemological reflection encourages the researcher to reflect on their own assumptions about what constitutes valid knowledge and how this impacts their work and the work of their peers.

I hope to show in this thesis that there is a valuable role for epistemological reflection in the course of doing one's own research in HCI. The need for this approach becomes particularly apparent in the context of research evaluation during peer review, which may require recognizing and evaluating knowledge claims from a different epistemological vantage point than may be their default. For example, a researcher may be asked to review a paper on household technology on the basis of personal experience in that domain, but their training and epistemological biases towards, say, an ethnographic approach may make it difficult for them to evaluate knowledge claims made by a researcher taking an epistemological approach drawn from cognitive science or experimental psychology. This does not render the reviewer unfit to evaluate such knowledge claims, but both research and reviewer may gain much more from the interaction by acknowledging epistemological differences, rather than just evaluating the work from the standpoint of their own epistemological biases. A valid response to a piece of research may indeed be to question the appropriateness

of the chosen epistemology for the given situation: it may be that the situated, changing nature of home life may be more appropriately studied by producing the kind of knowledge claims seen as valid by ethnographers than by cognitive scientists. What I claim is important, however, is recognizing the nature of competing understandings of what constitutes knowledge; an ethnography is not a poor laboratory experiment, nor a laboratory experiment a poor ethnography. Evaluating knowledge claims requires evaluating competing understandings of what constitutes a knowledge claim. The contribution of an epistemological approach is that discussions can then center on the underlying differences between researchers, rather than the superficial features of the research itself.

Epistemological reflection becomes particularly important when one is changing core assumptions about the field. For example, in this thesis I argue for treating experiences instead of tasks as the core elements of human-computer interaction. That change in focus requires rethinking assumptions about other elements of the practice of HCI, such as the epistemological factors of appropriateness of topic and marks of quality. Significant changes in emphasis like this are particularly in need of epistemological reflection precisely because of the changes in appropriate metrics of quality and the impact of those metrics on the entire research process. In the next chapter, I will take the epistemological approach presented here and use it to look at and help define the emergent field of experience-focused HCI.

CHAPTER 4: PRACTICES OF EXPERIENCE-FOCUSED HCI

4.1 Experience & Experience-focused HCI as Emergent Categories

In the previous chapter, I introduced the notions of epistemology and comparative epistemology, and showed how they could be used to understand the changing definition of evaluation in HCI. I then proposed epistemological reflection as part of the day-to-day work practices of epistemologically-aware research in HCI. In this next chapter, I will use an epistemological approach to unpack the meanings of experience in experience-focused HCI. We will start from the standpoint established in Chapter 1, where I established that experience-focused HCI can be read in contrast to task-focused HCI, and takes an open-ended approach to understanding technology, as opposed to the reductionist and analytical approaches of task-focused HCI.

To start to explore this emergent field of experience-focused HCI, and corresponding understanding of the meanings of experience in the field, I will now present an overview of relevant work in the field. This is primarily organized in terms of the *kind of practice* in question. HCI practitioners and researchers talk about their work practices in terms of 'iterative design'. Iterative design is a common feature of most design disciplines; while the exact features and their names differ in different substantiations, the general plan is consistent. First, the designer observes and studies situations or users, which inspires sketches and plans for the design of an artifact. Next, the designer builds or prototypes the artifact in some physical form. The designer then sees how well their design works in practice, generally by watching people use it. Insights from that observation then feed back into the next variation of the design as the cycle repeats, building off the previous iteration (Gould & Lewis, 1985; Dreyfuss, 1955; Cross, 1999, 2001, 2006).

I use these three practices as the basis of my organization, and I label them 'inspiring', 'building' and 'evaluating'. I also add a fourth practice, 'theorizing', which covers ways of creating knowledge that are not necessarily directly related to a building-based approach. Clearly, other divisions would be possible – separating out 'observing' vs. 'designing' for our first phase, for example – but these four practices end up being a useful way to divide up the research process of experience-focused HCI.

I began this literature review by drawing together literature that I felt was representative of the emergent category of experience-focused HCI. There were several criteria for this. For example, the works included frequently reference each other, forming a coherent sub-field. They also all take an open-ended approach to experience, in line with our working definition so far, and are frequently written either explicitly or implicitly as critiques of task-focused approaches to HCI. They make the claim or assumption that an experience is not reducible to the sum of its parts, and that experiences are created in the course of interaction and situated in a particular time and place, rather than having an abstract representation that adequately represents them. Finally, rather than attempt a complete overview of the field, I have generally focused on more prominent and influential work.

In the process of comparing these works, I found five themes that emerged from them. Not every single project or example illustrates every one of these themes, but together they bring together important points about the notion of experience in question and the nature of experience-focused HCI. The themes are the roles of affect, aesthetics, the built artifact, the body, and human practices. To introduce all these themes as briefly as possible: 'affect' refers to the increasing interest in the HCI community around the theme of emotions and the role that understanding, representing and questioning emotions can play in computing. 'Aesthetics' refers to

the role that questions of taste and beauty play in technological interaction. 'Artifacts' refer to the role of built form and the device as an object in interaction. 'The body' refers to the role of the human body, as opposed to the mind, in interaction. Finally, 'practices' refers to how people really do the things they do, rather than the ways that a book or manual or job description might say they should do them. These are not canonical categories, but rather, as I will show in this chapter, themes that emerge from the selected works.

For each of the pieces I have selected, I will begin by giving an overview of the work and how it manifests in practice. I will then discuss how this work places itself in the field, and in particular how it defines itself in relationship to task-centered computing. I will identify what the example has to say about experience-focused HCI and experience: sometimes this is explicitly in the paper or book in question, and sometimes this is implicit in the approach taken. Finally, I will discuss what the example has to say about the particular practice in question (inspiring / building / evaluating / theorizing), the themes to which it relates (aesthetics / affect / artifacts / the body / practices), and the epistemological commitments it implies.

4.2 Inspiring Experience-focused HCI

In this section I discuss the first variety of practice: inspiring experience-focused HCI systems. These are ways that researchers decide what to study or what to build, and generally consist of ways to find out what it is like for a set of users of some kind of technology in some kind of situation.

In task-focused HCI, these approaches are generally listed under headings like "problem identification" or "need identification". The implications of such terminology is that there is a user problem or need out there in the world that should be pinned down, focused upon and identified. By contrast, in the context of

experience-focused HCI, I am labeling these practices as 'inspiring' research, implying a process that is more open to serendipity. Needless to say, inspiration, as in any other field, comes from a wide variety of sources. I start by discussing the role of ethnographic observation in experience-focused HCI, and then continue to discuss three more specialized approaches to experience-focused HCI: bodystorming, the cultural probe and the technological probe. Each of these is notable for its manner of characterizing human practices in an open-ended manner suitable and useful for the design of experience-focused HCI.

4.2.1 Ethnographic Approaches

A relatively common approach to inspiring the design of experience-focused HCI systems is to engage in ethnographically-inspired observation of users or potential users of technologies. This is a common way to study the workplace in HCI's sister field of computer-supported collaborative work (CSCW) (K. Schmidt, 2000, 1991; Bannon, 1992, 1995; M. Robinson & Bannon, 1991), and is historically exemplified by studies of airports and air traffic controllers (Harper & J. Hughes, 1993; Berndtsson & Normark, 1999; Bentley et al., 1992; MacKay, 1999), office practices (Sellen, 2002; Suchman, 1983, 1987; Wynn, 1979), and subways (Heath & Luff, 1990) among many others. However, more recent work that is perhaps closer to the essence of experience-focused HCI can be found in studies of practices within the home. This is not because one 'has experiences' in the home and does not 'have experiences' in the office, but rather that much of the work around technology for offices has been focused on supporting the tasks of the office. This has in some ways allowed work on the home to focus more on experience instead of tasks, making this domain of study particularly relevant for our emergent definition and understanding of experience-focused HCI.

Ethnographically-inspired work on the home in HCI ranges from research on the almost startlingly mundane practices of mothers' list-making (Taylor & Swan, 2004) and keeping papers on the side of the fridge (Swan & Taylor, 2005) to in-depth studies of teenagers' cellphone use (Ito, Okabe, & Matsuda, 2006; March & Fleuriot, 2006; Taylor & Harper, 2002). In each of these, the authors show that what could be read as a simple task – a mother making a shopping list, as Taylor and Swan show in their paper – can and should be read as a much richer kind of interaction, an experience of reinforcing a certain kind of social order in the world, a 'right' way of being and doing. Mothers making shopping lists do so because they care about their families and want to provide for them in the best way that they can, reinforcing the social order of their home. Mothers both explicitly include and exclude items from their lists not only in accordance with some mechanical notion of replenishing foodstocks in the house, but also in accordance with the moral identity of the home: the eight-year-old in the home may have written 'chocolate' on the list but won't get it; the six-year-old will get mac'n'cheese because it's the only thing she will eat right now; the fifteen-year-old will get non-fat milk because she thinks she's fat and at least that way she's drinking milk. (Compare this to the almost standard vision of a networked refrigerator that automatically replaces items when you run out (Kaye, 1998, just for example.)) Others have observed the ways in which shopping manifests a certain moral order of the home, such as Miller's work on mothers 'making love in supermarkets' (Miller, 1998), but these works situate themselves within a technological context and make explicit points about the implications of such work for the design of technological devices.

Such ethnographically-inspired work is at the core of an experience-focused approach to HCI, as it emphasizes the ways in which peoples' actions are situated in very particular places and situations. By contrast, a laboratory study where the

characteristics of experience under examination are predetermined tends to produce gravitate towards a reductionist approach that treats experiences as the sum of their components. However, ethnographically-inspired approaches have their own difficulties. In particular, there is ongoing debate in HCI about the relationship of these studies to novel technology creation and to questions of what constitutes scholarship and valid knowledge in the field (i.e. Dourish, 2006, 2007, 2004a; Räsänen & Nyce, 2006; R.J. Anderson, 1994; Shapiro, 1994; Forsythe, 1999, 2002; Nyce & Bader, 2002; Chalmers, 2004a). These debates center around what can be seen as epistemological questions of what constitutes valid and, in particular, 'useful' knowledge. Some believe that the aim of ethnographic observation within HCI should focus on the development of improved technological devices, and as such the onus is on the ethnographer to present results in a way that is accessible to the technologist attempting to build such devices. These are the 'Implications for Design' that Dourish refers to in his paper by that name (Dourish, 2006). Others see ethnographic observations as having utility and validity in themselves, and indeed, they feel that limiting ethnography to being merely a tool for generating knowledge about potential designs is to miss the analytical nature of the anthropological ethnographic tradition. Räsänen and Nyce write:

> …designers and developers tend to use ethnography instrumentally as a form of data collection in order to identify and solve problems. Results of ethnographic analyses are expected to feed directly into the interests and issues of the technology development. (Räsänen & Nyce, 2006, p. 175)

These proponents of a more open-ended ethnographic approach, believe that observation without reference to a particular technological approach or solution allows for re-appropriation and produces better ethnographic observations that are not limited by the expected technological solutions (Dourish, 2006). In his 1994 paper, Anderson describes this tension as:

> [This] is the age-old (and tired) prescription versus description debate, with the ethnographers staunchly appearing to refuse to be prescriptive in the face of designers' demands for requirement specification. (R.J. Anderson, 1994, p. 153)

By including ethnographic approaches under the rubric of 'inspiring systems', I am in some ways able to skirt around these issues as they apply to experience-focused HCI. Novel technological systems can be designed in response to a focused implications – "shopping lists in the home should be visible to all the family" – or incorporate responses to much larger notions – "systems in the home recapitulate and provide sites for working out of domestic power relationships." I do see the value of the kind of careful and rich analysis of the anthropological variety, but I also see the pragmatic utility of smaller-scale ethnographic inspirations and implications for design.

4.2.2 Bodystorming

A second approach to inspiring design is generally referred to as bodystorming, although it is closely related to other performance-based techniques such as informances, role-play, and experience prototyping (Boess, Saakes, & Hummels, 2007; Boess, 2008; Buchenau & Suri, 2000; C. Burns, Dishman, Verplank, & Lassiter, 1994; G. Iacucci, C. Iacucci, & Kuutti, 2002; Oulasvirta, Kurvinen, & Kankainen, 2003; Svanaes & Seland, 2004; Wakkary et al., 2007). Bodystorming is an approach to innovating novel technological solutions by physically acting out potential problems and solutions. In their 2003 journal article, Oulasvirta et al. observe that 'all' user-centered design models follow three stages:

> 1. observation of user activities;
>
> 2. documentation of the observations; and
>
> 3. design based on the documentation of those observations. (Oulasvirta et al., 2003, p. 125)

They point out that observation methods "typically draw from anthropological and ethnographic research orientations" (i.e. Emerson, Fretz, & Shaw, 1995), and that documentation methods include storytelling (A. Cooper, Reimann, & Cronin, 2007), turn-by-turn descriptions of events based on conversational analysis (Hutchby & Wooffitt, 1998) and box-and-arrow diagrams (Beyer & Holtzblatt, 1997), and that the aim of these two stages is to provide sufficient information to inform the design stage. However, they point out three problems with such approaches.

The first is that because activities that are studied are complex, it's extremely difficult to capture the complexity in a written document, which if written in sufficient detail requires a great deal of time from the design team to read and absorb. Their second point is that since all documentation is based on individual observations, documents are inherently biased and hard to generalize from in a meaningful way. Researchers invariably pay attention to some aspects of behavior while disregarding others, providing meaningful interpretations of some activities and filling in information with prior knowledge. Finally, such misconceptions are rarely noticed – let alone fixed – without an additional round of observation and/or documentation.

The authors propose that the physical and non-cognitive and non-linguistic nature of bodystorming provides a way to overcome these limitations. They suggest four different ways that bodystorming can be implemented: bodystorming in the original location where users had problems that needed solving, bodystorming in analogous locations, bodystorming in an unprepared office, and bodystorming in a prepared stage space arranged in an office. So, for example, the first might involving visiting the actual bus stop used by residents of an old-age home, the second might involve visiting a different (but perhaps more convenient) bus stop, the third might involve pretending that you were at a bus stop, and the fourth might involve installing bus-stop-like seats and advertisements in an office location.

Bodystorming is not a core practice of much experience-focused HCI. As such, it may seem strange that I am including it here. However, bodystorming is important for our explication of experience-focused HCI because of its emphasis on the body and embodied ways of knowing, as compared with cognitive approaches. It represents in the 'inspiring design' phase a recognition of the value of learning from bodily interactions that we see elsewhere in tangible media, in mixed-reality games, in philosophical approaches such as phenomenology, and in disciplines such as martial arts and dance. In each of these, there is a recognition that the body itself has specific ways of experiencing interaction with the world that are not well represented in a written or spoken form; it's the emphasis on experience over rationalism, a reoccurring theme in this section and in this thesis in general.

4.2.3 Cultural Probes

Probably the quintessential example of approaches to inspiring design of experience-focused HCI is the cultural probe designed by Gaver and his colleagues, mainly at the Royal College of Art (Gaver, Dunne, & Pacenti, 1999; Gaver, Boucher, Pennington, & Walker, 2004; Gaver & Dunne, 1999). A cultural probe is a method for recording impressions of a situation – recordings are first completed by participants and then returned to the researchers.

Figure 1: A sample cultural probe. From (Gaver et al. 1999).

For example, a cultural probe for investigating a household might include a series of postcards, stamped and addressed to the researcher, containing open-ended questions such as “I was surprised today when…”. Often, cultural probes also contain a re-packaged disposable camera with instructions to take pictures (unlabelled and in no particular order) of, for example, “a situation that makes you uncomfortable”,

"your favorite technology in the home", "a dangerous place", "a safe place", and so on, depending on the scope of the cultural probe.

The products of these probes – photographs, drawings, maps, videos and the like – are then interpreted by the designers as providing a subjective and partial but rich and layered insight into the culture they are studying. The aim is not to produce a complete picture of relevant aspects of the cultural context of the person completing the probe. Rather, the aim is to embrace the impossibility of such an endeavor while seeking ways to provide understandings that allow interpretation of the situation by the designer of a technology.

Cultural probes' non-reductionist approach exemplifies an attitude towards the role of technology that is at the heart of experience-focused HCI. Cultural probes were developed in response to the limitations of a 'scientific' approach to HCI. In the original probes paper, the authors wrote:

> We approach research into new technologies from the traditions of artist-designers rather than the more typical science- and engineering-based approaches.
>
> Unlike much research we don't emphasize precise analyses or carefully controlled methodologies; instead, we concentrate on aesthetic control, the cultural implications of our designs, and ways to open new spaces for design. Scientific theories may be one source of inspiration for us, but so are more informal analyses, chance observations, the popular press, and other such "unscientific" sources. (Gaver et al., 1999, p. 24)

Later, under the heading "Inspiration, not Information", they continue:

> The artist-designer approach is openly subjective, only partly guided by any "objective" problem statement. Thus we were after "inspirational data" with the probes, to stimulate our imaginations rather than define a set of problems. (p. 25)

The authors are explicit about their rejection of many of the steps of 'scientific' research. For example:

> The probes were not designed to be analyzed, nor did we summarize what they revealed about the sites as an explicit stage in the process. (p. 27)

Despite this rejection of aspects of scientific approaches to ensuring quality, a recent critique of the considerable uptake of cultural probes in HCI argues that many researchers have embraced their use for data gathering while ignoring their focus on open-ended and experiential results (Boehner, Vertesi, Sengers, & Dourish, 2007). Boehner et al. detail the various ways in which probes have been adopted in the HCI literature: as a material form incorporating postcards, as a tool for data collection, as a tool to gather respondents' participation in the design process, or as a sensibility to an experimental and playful approach to research. They make the point that such uptake has often been partial or selective, ignoring the ways in which cultural probes were designed to subvert or undermine rather than supplement more traditional, reductionist methods in HCI, or the ways in which cultural probes embraced rather than aimed to eliminate ambiguity and uncertainty. The authors continue by pointing out how these tensions are characteristic of underlying tensions in the field of HCI. They identify problems around the role of interpretation in design – whether the process of design should be aimed at opening up space for possibilities or closing them down to a single, optimal solution.

Boehner et al. posit that the original intent of cultural probes was to open up the space for design, and this is the sense in which I see them being characteristic of an experience-focused HCI approach to inspiring novel systems. The nature of cultural probes emphasizes the ineffable (although not inaccessible) nature of experience, and how a representation thereof must inherently be partial and situated, but is not flawed because of that partial and situated nature. This has implications for our understanding of the nature of experience: it is neither rigorously delimitable and representable, nor entirely ineffable and abstruse, but rather somewhere in between.

We can represent aspects of it, but never all; the aspects we can represent are significant, and yet we must recognize that the aspects we cannot access and represent are also important.

4.2.4 Technology Probe

A technology probe involves building a new artifact and placing it in a particular situation as a probe. An important part of technology probes is that, in addition to any survey, interview or ethnographically-informed study, the technologies log their own usage, enabling rich evaluations that leverage both those logs and the contextual or interview information. A technology probe may appear similar to a product testing approach, in which a novel technology is introduced into an environment and its use studied, but the important difference is that the aim in a technology probe is not necessarily to improve the technology in question. There's a subtle difference here between "implementing a system in a context to find out about the system" and "implementing a system in a context to find out about the context". The two can be seen as related but distinct ways of framing research problems, questions, and kinds of valid knowledge. The former is not a technology probe and is more characteristic of a task-focused approach to human-computer interaction, emphasizing the role of the system; we will be focusing on the technology probes as an example of the latter to understand more about the nature of experience-focused HCI.

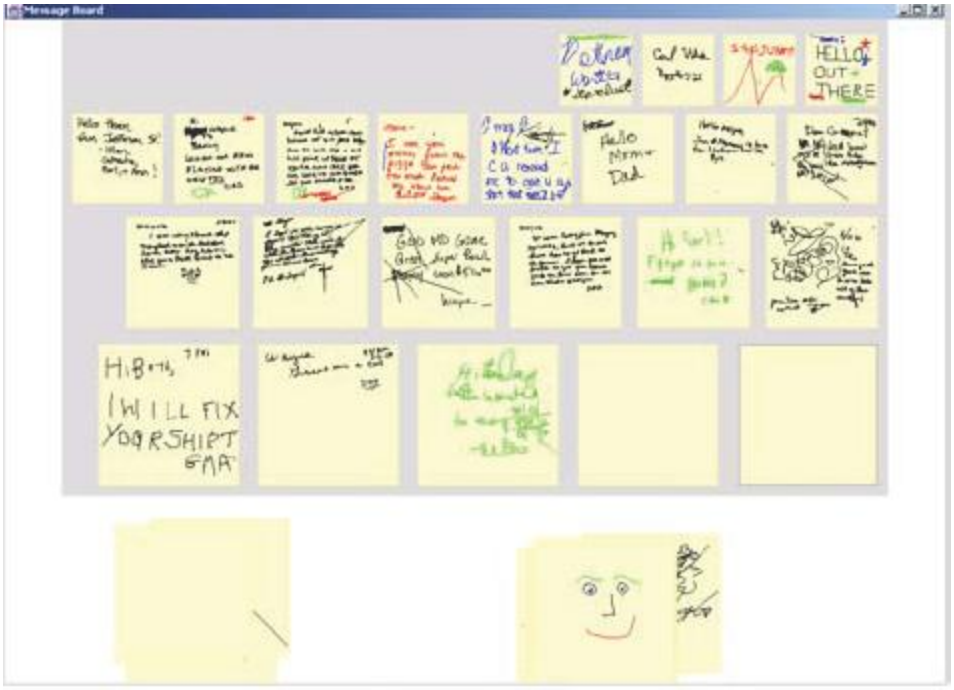

Figure 2: Messageboard Technology Probe. From (Hutchinson et al. 2003).

The original Technology Probes paper reported on two projects: connected shared whiteboard systems installed in the homes of an extended family living apart (Figure 2) and a simple video link installed at the homes of two related families that enabled them to easily send video postcards to each other (Hutchinson et al., 2003). They used the results from this technology probe to emphasize the importance and difficulties of family communication, as well as the importance of designing to allow for playfulness in family interaction.

Another example of Technology Probes can be found in the HomeNote messaging system, which allowed remote members of a household to send a text message back to the house to a display in a public area such as the kitchen (Sellen et al., 2006). We can see how this work functions as technology probe by examining the aims that the authors describe for their work. They provide four aims in the paper,

Figure 3: HomeNote. From (Sellen et al. 2006).

including studying person-to-place messaging and improving the particular substantiation of the HomeNote system, but also:

> To use HomeNote as a kind of "Trojan horse" to allow us to deepen our understanding of home communication and its relationship to the affordances of different kinds of communicational artifacts. (384)

As a technology probe, HomeNote keeps a record of all messages sent through it. This enables the production of a particular kind of knowledge. For example, the authors spend a third of the paper discussing a taxonomy of seven different kinds of messages that families leave for each other. These range from "calls for action" (requests to tape television programs or pick someone up) and "awareness and reassurance" (real-time updates by the father from the daughter's soccer game, or notes to say "Will be home by eight") to "reminders" for oneself or others ("Don't forget your hard boots") and "information store" (temporary storage for lists, telephone numbers, names and dates). Such a taxonomy is by its nature designed to be

relevant to contexts outside the original technological device itself, applicable to other situated messaging applications. It does suggest certain ways in which the technology in question could be improved:

> [W]e found that HomeNote would be better if it allowed people to respond to messages, and in particular to easily identify who was responding to any given message. It was also clear that more thought is needed as to how to make new messages more conspicuous, how to deal with important messages being occluded, and how to prevent the inadvertent deletion of important information. (Sellen et al., 2006, p. 391)

To convey an idea of relative weight, the authors spend three paragraphs discussing how the prototype technology or related such devices could be improved in light of these changes, as opposed to the three pages spent analyzing the practices revealed by the probe. It is because of this relative amount of emphasis that I included this paper as an example of a technological probe, rather than as an example of system building. It also serves to differentiate technological probes from cultural probes. While both are ways to explore a given environment, cultural probes emphasize a bigger picture – designed to represent, as the name suggests, the cultural aspects of a given situation. By contrast, technological probes emphasize human practices specifically centered around the artifact itself and contribute to our understanding of experience-focused HCI as an approach that does not eschew non-interpretive records of experience such as usage logs, but sees them as inspiration for interpretation in a particular context.

4.2.5 Common practices for inspiring systems

These four strategies for inspiring systems share a number of aspects. At perhaps the lowest level, they share a commitment to understanding the users. This is common in HCI outside of experience-focused HCI, which is arguably attributable to the influence of user centered and participatory design (Bødker, 1991; Greenbaum &

Kyng, 1991; Schuler & Namioka, 1993). Participatory design emphasizes the responsibility of the designer to characterize and represent the needs of the multiple stakeholders, and particularly the users, on a technology; as such, it embodies not just a practice for the design of HCI but also a larger point about the necessity for 'democratic participation in technological choice' (Asaro, 2000). However, a particular focus of exploratory or inspirational practices in experience-focused HCI which makes it distinct from perhaps more conventional practices (although arguably closer to participatory design's roots) is a commitment to trying to characterize a more holistic notion of 'users', rather than representing users as solely or primarily in the context of completing a particular task. We can see an example of this tension in Boehner et al.'s work on understanding the use of cultural probes in HCI:

> Moving from inspiration, or glimpses of particular lives as possibilities in a design space, to information that seeks to pinpoint exact requirements or needs of general communities is symptomatic of different stances on the ultimate goal of interpretation, in particular whether it should be open or closed. The former approach sees interpretation as opening up a variety of possibilities. The latter sees interpretation as a process of negotiation toward one single, correct, and unambiguous understanding; the need to establish a single interpretation then leads to a proliferation of methods to support a narrowing of and verification of the potential design space. (Boehner et al., 2007, p. 1082)

What these approaches – ethnographic observation, bodystorming, cultural probes, technological probes – have in common is that they afford an opening up rather than narrowing down of possibilities for design. In so doing, they raise concerns under a number of themes that we can see emerge from the work as a whole.

The first of these themes is the role of human practices and their representation in an open-ended manner that is understood and accepted as being incomplete. By human practices here I am referring to the things that people do in a particular situation that have some kind of bearing on the technological project in question, including their actions and, importantly, how they feel about their actions. (I will

discuss this distinction at some length the next chapter, particularly in the distinction between pragmatic and ethnomethodological approaches to representing human practice.) Cultural probes and technology probes both accomplish the representation of some aspects of human practices in different ways, but both create traces of human practices in a particular way. Deliberately setting out to create a representation that is incomplete may initially seem strange, but it recognizes that the complexity of human practices is such that any representation of them will necessarily be incomplete. As such, the representation is an inspiration for design, rather than a canonical representation.

The second theme is the role of the artifact. Artifacts do, of course, play a role in task-focused HCI – indeed, the nature of HCI is such that the eventual production of some kind of novel or improved artifact is at the core of the research practice. However, the artifact in experience-focused HCI plays a slightly different role. If the role of the artifact in task-focused HCI is to accomplish the task, then what becomes of it in experience-focused HCI? We start to see an answer by examining how technology probes engage with experiences as artifacts. The aim in that instance is not a simple translation of the task-focused approach – to build an artifact to 'accomplish the experience' – but rather to build an artifact that allows for exploration of experiences with that artifact. This is a distinction that we will explore further throughout this thesis.

The third theme is the role of the body, most clearly expressed by the discussion of bodystorming. While less common than some of the other techniques discussed, I include bodystorming precisely because it starts to open up discussion about different ways of knowing that are appropriate for inspiring experience-focused HCI. This emphasis on the body and the ways in which the body can be used to know and to understand aspects of experience is in deliberate contrast to the in-the-head,

cognitive approaches to problem-finding in task-focused HCI, such as cognitive walkthrough (Polson et al., 1991; Wharton, Rieman, Lewis, & Polson, 1994), and, as I will show in the next chapter, draws from a legacy in phenomenology that also emphasizes ways of knowing through the body over ways of knowing through the mind.

Finally, there is a theme about the role of aesthetics. Cultural probes embody a very specific aesthetic, and one of their aims is to capture a sense of the aesthetics, in a rich sense of the term, of a particular cultural situation. We will see discussion of aesthetics reoccur throughout this discussion of experience. My intent in identifying this theme of aesthetics is not to engage with the particular nature of those aesthetics, but rather to emphasize how they contrast to task-focused approaches that treat aesthetics as only peripheral to the task, rather than a core part of the process.

In summary, in this section we have seen four approaches to inspiring design of experience-focused HCI: ethnographic approaches, bodystorming, cultural probes and technology probes, and observed four themes in these approaches: the role of human practices, the role of the artifact, the role of the body, and the role of aesthetics. In the next section we will see how similar themes emerge in a practice centered around the building of novel systems.

4.3 System Building Practices

Perhaps the most common practice of experience-focused HCI is that of system building. In essence, in a system-building approach knowledge is gained through the process of actually building and using working (or nearly-working) technological systems. System building is often the default method of research in HCI, in both task-focused and experience-focused domains. As such, the studies I discuss in this section explore aspects of the differences between system-building in

both domains, and in particular show an emphasis on designs that are open to users' interpretations in a variety of ways.

In this section, I will present three types of work around the theme of system building in experience-focused HCI. The first, ambient display, is notable for its inherently non-task-focused approach to computing and its emphasis on design and aesthetics. The second, mixed-reality gaming, involves building systems where the interaction is characterized not just as between humans and computers, but additionally in the interaction of the system with a city, campus or building. Finally, I discuss a type of research around the theme of exploring affect in experience-focused HCI, and will then discuss the themes emerging from all three types.

4.3.1 Ambient display

Ambient or peripheral displays are an approach to conveying information that takes advantage of our ability to notice changes in our periphery. This often occurs in everyday life; if you are sitting in a room with a window, you may not be consciously aware of the conditions outside, but you would know if it started raining, even though you are not explicitly focused on the weather. Ambient and peripheral displays take advantage of this kind of awareness to display information outside of the confines of the computer screen. (Influential work in the field includes Weiser & J. S. Brown, 1996; William W. Gaver et al., 2003; Ishii et al., 1998; Ishii & Ullmer, 1997; Weiser, 1991; Matthews et al., 2007; see Matthews, 2007 for a thorough overview.)

A canonical example of such displays can be found in a paper called *Feather, Scent & Shaker* by Bill Gaver and his then-graduate student Rob Strong (1996). This consisted of three designs for 'minimal, expressive communication'. Strong and Gaver explicitly state that their aims involve alternatives to explicitly communicative, information exchanging and goal-led activities; each design supported the

communication of intimacy at a distance. *Feather* is a feather in a transparent cone with a fan at the base, and the wafting of the feather could be triggered by a remote travelling partner. *Scent* is an aromatherapy bowl with a remotely-controlled warming apparatus underneath it: the remote traveler can trigger the heating element, releasing the scent into the air. The last project, *Shaker*, is a shared tangible interface: shake one of the objects and the other vibrates sympathetically at a distance. The whimsical nature of these designs underscores their contrast to the keyboard, mouse and screen-based nature of much task-focused computing.

Another influential work of ambient display is Natalie Jermijenko's installation art piece *Dangling String.*

Figure 4: Dangling String.
From (Weiser & Brown 1996)

This used a brightly colored piece of wire attached to a motor mounted in the ceiling of a hallway. The motor was attached to a network cable, and when network data went through the motor would turn, making the string move and jerk. The activity level of the string thus represented the activity level of the network, making the otherwise invisible moving bits into visible moving atoms (Weiser & J. S. Brown, 1996).

Feather, Scent & Shaker, *Fields and Thresholds*, and *Dangling String* were very inspirational in the fields of ambient and peripheral displays, and they raise certain points about experience-focused HCI. Ambient and peripheral displays emphasize the importance of aesthetics and a holistic view of the situation in which people go about their lives, emphasizing how we relate to the world outside of the confines of the computer screen. In an early paper on the topic, Ishii & Ullmer wrote:

> Current HCI research is focusing primarily on foreground activity and neglecting the background. However, subconsciously, people are constantly receiving various information from the "periphery" without attending to it explicitly. If anything unusual is noticed, it immediately comes to the center of their attention. (Ishii & Ullmer, 1997, p. 235)

This shift outside of the screen-based graphical user interface can (but does not necessarily) result in a deliberate de-emphasis on the role of the task in technology use and a recognition of the importance of the experiences of users as a factor in their design. However, ambient and peripheral displays have not always been treated in an experience-focused way. For example, in their paper *Heuristic Evaluation of Ambient Displays*, Mankoff et al. develop a method for evaluating ambient displays that is based on a modified set of Neilsen's heuristics for usability. Neilsen's heuristics were developed for the usability evaluation of task-focused systems, and include parameters like "visibility of system status", "consistency and standards", and "recognition rather than recall". Mankoff et al. develop a modified set of these standards for ambient displays, including "'Peripherality' of display", "visibility of state", and, in the final version, "aesthetic and pleasing design", and demonstrate the utility of these standards by evaluating two displays. However, by modifying a set of task-focused heuristics for evaluation, the authors import a set of epistemological concerns based in that task-focused approach. For example, their study involves rating the factors on a scale of one to five, and a univariate analysis of variance test of the number of issues found

and their severity. By contrast, we could consider an experience-focused HCI approach to the same problem. This would explicitly question if those are indeed appropriate ways to think about evaluating ambient displays, and particularly if those are the metrics that matter to the users, and would instead seek an approach that is more open to the insights of users and their situated metrics of quality. We will see further discussion of this in Chapter 6 in an evaluation of a display that shares many qualities with ambient and peripheral displays.

The method that Mankoff et al. propose may well have a certain utility in designing a certain kind of display, but it brings with it epistemological baggage that is incompletely explored in their treatment of the work. Task-focused approaches bring with them task-focused assumptions about the nature of valid knowledge. As we will see in the discussion later in this chapter about experience-focused evaluation, there are a host of alternate approaches that engage with the experience-focused nature of ambient displays. Indeed, an open-ended, experience-focused approach to HCI may provide a more coherent way to understand the design and evaluation of ambient displays than a task-based approach.

4.3.2 Mixed-reality gaming

A second type of experience-focused HCI system-building falls under the category of mixed-reality games: games which involve the pre-existing built form of the city along with some kind of technology to change interaction with that built form. For example, in *Uncle Roy All Around You*, one player is out on the streets with a device that transmits their GPS coordinates back to another player back at the home base (Crabtree et al., 2004). The second player can then tell the first player where to go to find Uncle Roy, an actor in the game. By comparison, in *Feeding Yoshi*, players interact with the city by finding WiFi networks in homes and offices as they walk

around: closed networks appear as 'Yoshis', a cartoon character that appears on their PDA, and open networks are plantations that grow fruit to feed Yoshis (M. Bell et al., 2006). Players gain points by 'feeding' their Yoshis through finding open WiFi networks. Other related works include *Can you see me now* (Benford et al., 2006), *Fiasco* (M. Chang & Goodman, 2004), and *Savannah* (Benford et al., 2005).

Insights from these systems come through observing and understanding the experiences of the players. It's hard to even explain *Yoshi* on paper, and the interplay between the social and technological components to *Uncle Roy* only emerge in the process of game-play. Knowledge and insight are gained from the process of building and using such systems. Some small amount of insight or knowledge may come from plans for the system, from sketching the system on paper, from building flowcharts of interaction or system design, from the thought experiment of hypothesizing the system alone, but the overwhelming share of knowledge creation occurs from the interaction of those planned models with the complexities of reality. For example, players in *Uncle Roy* quickly learn the limitations of GPS in an urban environment, and how they can 'hide' from the GPS signal. *Yoshi* players learn that open networks are more likely to be found in more affluent residential neighborhoods and closed networks in office and commercial areas. Each of these emphasizes the importance of the learned practices of the players, rather than how the technology itself works.

These kinds of insights led to a theory of 'seamful design', which advocated deliberately exploiting the real-world gaps in what might be approximated as a theoretically continuous technological affordance (Chalmers, 2004b; Chalmers et al., 2005; Chalmers & Galani, 2004; Chalmers, Dieberger, Höök, & Rudström, 2004; Rudström, Höök, & Svensson, 2005). Seamful design observes that we might casually describe a given technology as being continuous, working everywhere: 'there is WiFi coverage all across campus', or 'GPS lets you know where you are anywhere

in the world'. In reality, however, such systems are rarely as all-pervasive as they may seem: GPS hardly ever works inside buildings, and even when used outside, the communication path to satellites can be blocked by standing in the 'shadow' of a building. Cellphones may not work in basements or in buildings with particularly thick walls. Seamful design suggests that as designers and users of technologies we need not pretend that such artifacts do not exist; rather, we can encourage engagement with the lived reality of these interactions, complete with their problems, limitations, and difficulties. It proposes attending to the transition between the working and non-working of supposedly continuous technological affordances. They use Heidegger's distinction between the ways that tools can become "ready-to-hand" – invisible to the process, like a skilled carpenter's hammer – and "present-at-hand" – consciously used and questioned, like a novice carpenter picking up their hammer for the first time. This is not the first use of Heidegger's distinction in HCI: it can be found in both Weiser's work on ubiquitous computing (Weiser, 1991) and Dourish's work on the phenomenological foundations of HCI (Dourish, 2004b), but Chalmers & Galani point out that while both acknowledge the existence of these two modes of interaction,

> They do not fully address the relationship between the two modes. In particular, how does a tool become invisible or ready-to-hand? (Chalmers & Galani, 2004, p. 245)

The very nature of seamful design rests on a foundation of system building as a practice to interact with the complexity of the real world as manifest in the learned practices of technology users.

4.3.3 Exploring Affect through System Building

The third set of system building practices I will discuss are around the theme of affective computing. Affective computing emphasizes the role of emotion as both input to and output from a computer system (Picard, 1997). Affective Diary

(Lindström et al., 2006) and eMoto (Sundström, Ståhl, & Höök, 2005) are two projects from Kristina Höök's group at the Swedish Institute of Computer Science that are designed to engage with the role of affect in communication in an experience-focused way. Affective Diary uses wearable sensors to track a user's movement and physiological arousal (such as blood pressure or galvanic skin response, a measure of how much the user is currently sweating). It then feeds those results back to the user for use in a diary application along with images taken by their cellphone for augmentation and reflection. The authors state that their aim is to "produce representations based on people's bodily experiences that feel deeply familiar but at the same time allow for open-ended interpretation and appropriation" (Lindström et al., 2006). In the eMoto project, the researchers developed a hand-held device like a large pen that could sense when the user was moving, shaking or gesturing with it. The researchers then built a system that allowed friends to send each other messages that incorporated this gestural input to convey emotion (Sundström et al., 2005).

Both of these systems are explorations of the use of emotion in technological systems, and demonstrate the opportunity for exploring factors like novel systems of input, including biological sensors, through building systems. There is considerable potential for incorporating some kind of understanding of emotional state in an approach to HCI that emphasizes the experience. However, emotion is not sufficient as a marker of experience-focused HCI: it is entirely possible to incorporate emotion into an HCI project in a manner than is reductive and treats emotion as yet another factor to be parameterized, such as in the FAIM (Facial Affect in Instant Messaging) system, which analyzes the sender's facial expression and correlates it to one of a set number of pre-determined facial patterns which are then transmitted to the receiver (Kaliouby & P. Robinson, 2004). What is important about both Affective Diary and eMoto, particularly when compared to work like FAIM, is their emphasis on

providing an open-ended approach for their users to both represent and reflect on their use of emotion in communication. Much as we saw in the section on mixed-reality gaming, these systems emphasize the practices of the individual over some the technological artifacts themselves.

These systems also need to be read in the context of other literature in the field. Since the publication of the book *Affective Computing* (Picard, 1997), there has been an increasing amount of work exploring the intersection of affect and computer technologies. However, as Boehner et al. point out, the dominant approach to using affect in computing systems is to treat it as a form of information, to be represented, stored, communicated, and transmitted (Boehner, DePaula, Dourish, & Sengers, 2005). By contrast, the systems I list here fall into Boehner et al.'s category of affect as interaction: rather than trying to parameterize and represent emotion, the systems listed here all 'support humans in producing, experiencing and interpreting emotions'. Affect as interaction, rather than as information, is a characteristic approach of experience-focused HCI.

4.3.4 Common practices for building systems

In his essay *Towards a Technical Critical Practice*, Agre talks about the importance of system building in the field of artificial intelligence:

> Whether explicitly or tacitly, [the researchers] opposed the falseness of bureaucratic life to the principled meritocracy of their craft. Building things was truly the end purpose of the hacker's work, and everything about the methods and language and value system of the AI world was organized around the design and implementation of working systems. This is sometimes called the "work ethic": it has to work. The "result" of an AI research project is a working system whose methods seem original and broadly applicable… (Agre, 1997b)

Many HCI practitioners share a similar emphasis on the built system as a primary practice of doing research. Where experience-focused systems differ from

task-focused systems is in the creators' understanding of expected use. I earlier highlighted the importance of seeing experience not just as a kind of extended task, larger in scope but out there and able to be delimited, but instead as a different kind of ineffable entity, uniquely created each time through the interaction of users and technologies and situations. As becomes apparent in this survey of system building practices, experience-focused HCI encourages designing for experiences, not for a singular extended task-like experience, by emphasizing the nature of individual practices.

So what would it mean to distinguish between an experience-focused and a task-focused approach to system building? The question is not necessarily one of underlying methods: both may involve, for example, software written in Python and C and Java, compilers, debuggers, soldering, embedded computers, network connections, and so on. Rather, the question of what constitutes 'good' research depends on what is valued. A more traditional computer science approach sees the constituent technical components as a site for innovation: 'good' research might be a particularly efficient implementation of a known algorithm, or an improvement on said algorithm that produces the same results with less processing time. In task-focused HCI, 'good' research produces an optimization of a known task: the user is able to find a telephone number faster, or is able to select items from a menu with minimum overhead. The difference in experience-focused HCI comes from improvements that are not necessarily focused any longer around known tasks, but around emergent practices and qualities of interaction. We do not care if the technology itself is clever. We care if the user has an opportunity to be clever, to be original, to be insightful, to express themselves. User-centered design approaches to HCI emphasize finding ways to support the wishes of the user, but what of the wishes they did not know they had? Not all experience-focused HCI can provide this kind of

interaction, but thinking about the role of system building for experience-focused systems provides ways to consider distinctly non-task focused approaches, such as giving feelings of enchantment (McCarthy & Wright, 2004a; McCarthy et al., 2006), or the sensation of touching the ineffable (Boehner, 2006; Boehner, Sengers, & Warner in press).

Let us now return to the discussion of themes in these works. The nature of system building is such that all of the projects mentioned have something to say about the role of the artifact in experience-focused HCI, and in particular how experience-focused HCI sees the artifact providing a kind of open-ended engagement with users experiences, rather than the constrained nature of task-focused interactions.

In the previous section, we saw how a theme of the role of human practices arose from the discussion of ethnographic approaches, cultural probes and technological probes. This is a theme that the work on mixed-reality games continues with its emphasis on the experiences that emerge in the process of playing a game, which emphasizes the importance of designing technology that can be appropriated by its users. These games also further emphasize the role of the body and how we act in an inherently embodied manner with the physical built form of the city.

We also saw the importance of aesthetics in inspiration, as raised by the work on cultural probes. This theme re-emerges in our discussion of ambient and peripheral displays. Indeed, given the importance of the aesthetics of ambient and peripheral displays, it seems that a task-focused approach to understanding them is unlikely to succeed. Similarly, eMoto and Affective Diary are both examples of a decision to emphasize aesthetics over considerations like displaying the complete data set.

In addition to these themes, eMoto and Affective Diary both engage with a novel theme that we have not seen in the study of inspirational practices: the role of affect and emotion in experience-focused HCI. Both emphasize an approach to

emotion that sees it as constructed in the course of experience, rather than existing *a priori* out there in the world for capture and representation. This emphasizes the kind of open-ended approach to understanding the interaction between humans and technologies that we find elsewhere in experience-focused HCI.

At the end of our discussion of system building practices, we have seen three kinds of work: ambient and peripheral displays, mixed reality games, and work on the importance of emotion in experiential systems. These kinds of work continue the themes observed in the section on inspiring design, namely the roles of human practices, the body, the artifact and aesthetics, and add a fifth theme of the role of affect in interaction. We will now see how these themes emerge in practices around the evaluation of systems in experience-focused HCI.

4.4 System Evaluation Practices

My next category of practice is system evaluation. As previously mentioned, system evaluation is a core practice of both task- and experience-focused HCI. It is rare that system implementations are presented without evaluation in the major publication venues of HCI. Furthermore, the aforementioned 'work ethic' mentioned in the discussion of system building practices applies to evaluation techniques as well, meaning that that evaluation techniques are rarely if ever presented abstractly without at least a sample system to which they have been applied.

As I will demonstrate, and as we have already seen with inspiration and building practices, a characteristic of experience-focused evaluation practices is their open-ended nature: the assumption is not that one has previously determined the metrics by which a technology will be evaluated, but that such metrics arise in a situated manner from the use of the system. By comparison, task focused approaches emphasize an approach to evaluation that involves making a decision early on in the

design process about the appropriate metrics of quality in a given situation, such as 'time on task', and empirically measuring those metrics (Gould & Lewis, 1985).

I will show this through four case studies. The first is the Sensual Evaluation Instrument, a set of abstract clay objects manipulated by users as they interact with technologies. The second is the work by Gaver and his colleagues about the use of cultural commentators to evaluate a set of novel technologies for the home. The third is the evaluation of a piece of installation art called the Influencing Machine with an emphasis on the end user experience, and the fourth is a system called Affector, a video link between two offices that allows for the representation of emotional states which also serves to help track the course of its own evaluation.

4.4.1 The Sensual Evaluation Instrument

The Sensual Evaluation Instrument (SEI) is one of the few examples of an approach explicitly designed to characterize users' experiences with technologies (Isbister, Höök, M. Sharp, & Laaksolahti, 2006). The Instrument itself is a set of white clay objects: a spiky one, a gently undulating one, and so on.

Figure 5: The Sensual Evaluation Instrument. From (Isbister et al. 2006).

The objects are designed to be non-representational ways to engage with aspects of the emotional state of a user interacting with a technology: the user chooses and manipulates the objects in the course of interacting with the technology, providing an interpretable and abstract alternative to reductionist and analytical approaches to measuring emotional states. Users are videotaped interacting with the objects while they use a technology and analyzed after the interaction is finished, usually by researchers and users together. So, for example, a user may pick up the spiky object if feeling frustrated by a puzzle in a game, but then put it down and pick up the sphere if they successfully solve the puzzle. Users may also manipulate the objects in different ways: a user might describe after the fact how they felt shaking one object allowed them to express excitement, while waving another expressed comfort. The point is that the meanings are not fixed and are entirely subject to interpretation.

The Instrument was developed to provide a non-linguistic approach to evaluation that valued the self-reflective contributions of the user and would be portable between different cultures while embracing expressiveness and ambiguity. This is in deliberate contrast to other ways of measuring affect that are common in task-focused affective computing, which take a more rationalist approach:

> Traditionally, affect has been ascertained in two primary ways: using questionnaires administered after an experience, which as the user to rate his/her feelings about what occurred, and analysis of videotaped sessions with users that typically combine interpretation of think-aloud commentary with deciphering of other cues of emotion (smiling, gestures and the like) to develop an impression of user's affective reactions. In recent years, additional tools based on biometrics have evolved – measuring galvanic skin response, detecting small movements of the muscles of the face, tracking pressure on the mouse. (Isbister et al., 2006, p. 1163)

Unusually for HCI, the Instrument was deliberately designed as an evaluation technique suitable for any experiential HCI project, rather than for evaluating a specific individual project. For example, in his thesis, Laaksolahti describes a use of the SEI to evaluate three different interactive storytelling games: *Fahrenheit*, *Full Throttle* and *Façade* (Laaksolahti, 2008). Laaksolahti provides a detailed analysis of player interactions with individual scenes in the games, and uses SEI to make comparisons both between different players' interactions with the same game, and between aggregate representations of users' experiences with different games. He writes:

> The real strength of SEI, and the reason that the method was created, lies in capturing the emotional experiences of the users. As we could see in the in-depth descriptions above, participants could talk about their SEI-objects and explain what emotions they portrayed in different situations. Through its purposefully ambiguous design the SEI objects are open for interpretation. They do not attempt to impose a meaning on the user. In addition users are free to use the objects in any way that they like. In the study the objects seem ambiguous enough to allow for many different emotions and shades of emotion experiences. (Laaksolahti, 2008, p. 160)

It is in this open-endedness and deliberate embracing of ambiguity that the SEI is an exemplar of experience-focused approaches to evaluation. It also emphasizes the ways in which users' experiences are ongoing, and yet users may not have conscious access to those experiences at all times.

4.4.2 Cultural Commentators

A set of influential projects and evaluations was developed by Gaver and his colleagues at the Royal College of Art as part of the Equator Project. These include the Drift Table, the History Tablecloth and the Key Table, all of which have a shared foundation in technological interactions with the weight of objects in the home (William Gaver et al., 2007). The first half of this paper looks at these three projects, their origins, and the technological issues around the practice of building them. However, I'd like to concentrate on the second half of the paper, which talks about methods of evaluating such technologies, under the subtitle 'Assessing ludic designs in the field'. The authors point out the need to move beyond "simple notions of 'success' or 'failure' in assessing designs", and propose the necessity of

> understand[ing] the activities through which people engage with the systems, how they accommodate them to their everyday lives, the sorts of values the systems support, and the ways people interpret the meaning of the experience in their own lives. (Gaver et al., 2007, p. 22)

To do this, the team decided to assess the designs using a combination of ethnographic observation and documentary film. Gaver's recent work is known for including innovative forms of evaluation, including evaluation by documentary filmmakers, ethnographers and journalists (Gaver et al., 2006, 2007; Gaver, Sengers, Kerridge, Kaye, & Bowers, 2007).

His 2007 paper *Cultural Commentators* addresses the question of evaluation directly, and proposes an interpretive approach to evaluation which questions what

evaluation can consist of, and underscores the possibilities for producing different kinds of knowledge through evaluation (William Gaver, 2007). His work suggests that evaluation can be an interpretive process aimed at opening up the full space of possibilities of interaction with a device, characterizing the practices through which users interact with technologies, rather than attempting to reach a clear conclusion on whether a given technology 'works' or solves a given problem. Gaver proposes four dimensions upon which non-task-focused designs can be evaluated:

1. Activities. Does the designed artefact serve as an arena for multiple activities? Do recognisable, characteristic activities come into existence in response to the introduction of the artefact where the artefact is systematically used as part of them?

2. Accommodation. Can the artefact be accommodated within the setting? Does the artefact show the requisite flexibility for its coexistence with indigenous activities?

3. Operation and interaction. Does the artefact have a method of interaction and a means of operation which intrigue people and incite exploration and/or speculation as to how it works or what it can do? Through this, does the artefact have the right kind of interactive and operational flexibility to sustain multiple activities?

4. Appreciation. Does the artefact come to be appreciated? Do those who engage with it become attached to it and value it aesthetically? (Gaver et al., 2007, p. 148)

These dimensions are in deliberate contrast to a task-focused approach to HCI: the authors contrast their approach to workplace computation that historically emphasized "utility and usability" (Nickerson & Landauer, 1998). They state explicitly:

> Given the difficulty of assessing experience, it is tempting to fall back on well-known criteria of utility and usability as determining the value of domestic technologies. Indeed, most visions of future domestic systems take utility and usability as paramount. As we argue below, however, placing utility at the heart of the domestic experience may distort the values people pursue at home. It may be more appropriate to explore the value of designing for non-utilitarian experiences, even if this requires the development of new forms of assessment (Gaver et al., 2007, p. 121).

This is a deliberate contrast to a task-focused approach to evaluation, which emphasizes success or failure (in published literature, usually success) rather than characterizing and interpreting interactions with technologies. This suggests a set of epistemological commitments to representing knowledge that are significantly different from those we have become accustomed to in task-focused HCI; in particular, it involves recognizing and engaging in a relativistic evaluation that is in stark contrast with scientifically-influenced notions of generalization. On the other hand, this fluidity of values allows for evaluations to be fit to an individual situation, which is at the heart of a move to experience-focused approaches to evaluation.

4.4.3 Influencing Machine

The Influencing Machine is a piece of installation art that projects child-like scribbles on a wall. Users interact with it by dropping postcards of different art images through a slot in the machine: the speed, color and form of the drawings change in response to the different postcards. The researchers who designed and built the Influencing Machine saw it as an exploration through technology that engaged with questions about the role of emotion and technology (Sengers et al., 2002). Somewhat unusually for HCI, evaluation of this project was explicitly distinct from the building phase of the project, and is discussed in a separate paper, *Sense & Sensibility,* in which the authors apply HCI evaluation techniques to study users' interpretation of the Influencing Machine as an artwork (Höök, Sengers, & Andersson, 2003).

In this evaluation subjects were brought into the room containing the artwork in small groups, videotaped interacting with the machine, and later interviewed about their experiences. In this way the researchers were able to get detail about the users' experiences in a manner that was open to new insights and observations, while

retaining the ability to ask specific questions. The authors propose this as a way for artists to fine-tune how they get their message across to their audience. They explicitly contrast evaluation traditions in HCI and in art:

> Grossly speaking, the major conflict between artistic and HCI perspectives on user interaction is that art is inherently subjective, while HCI evaluation, with a science and engineering inheritance, has traditionally strived to be objective. (Höök et al., 2003, p. 242)

This point, and the ways this works out in the course of the evaluation, has implications for the evaluation of experience-focused HCI in a number of ways. There is a provocative aspect of proposing to use evaluation techniques that emphasize the audience's reaction as impetuses for design choices, rather than the usual emphasis on the design choices made by the artist: an openness to appropriation by the end-user which does fit with experience-focused HCI's emphasis on opening up rather than closing down spaces of possibility. In addition, the evaluation emphasizes the experiences of the user with the technology over technical considerations of whether the technology worked as planned, without giving up the pragmatic need to ask specific questions about aspects of the experience that could be improved.

In addition to having implications for evaluation, this work also has specific implications for understanding experience. In particular, the choice of having users interact with the machine in small groups points towards an understanding of experience as something constructed in the experience of interaction both between user and machine and between different users. The paper includes descriptions of particular groups interacting with the machine, and how different people would develop theories of how it worked and test out those theories, and it is clear that the interactions between the different people in the room shaped the experience as much as the interactions between the machine and the people. This notion of experience

being constructed in interaction is a key point about the understanding of experience in experience-focused HCI.

4.4.4 Affector

Affector is a video connection between two spaces that manipulates the displayed video image to reflect aspects of the emotional climate (Boehner et al. in press; Boehner et al., 2005; Sengers, Boehner, Warner, & Jenkins, 2005). It is designed to connect the offices of co-authors Sengers and Warner, and consists of a camera and a screen mounted in each office. Each screen displays the output of the camera in the other office, providing a sense of connection between the two spaces. However, rather than simply display the video stream, the system modifies the output depending on the results of various settings built into the system and modifiable by the users. For example, it might change the color of different portions of the image depending on how much that portion has changed in the last minute or so, emphasizing areas that move.

While this project incorporated aspects of all four HCI practices, I have chosen to discuss it under the heading of evaluation due to the distinctly novel and important nature of the evaluation. The authors made a deliberate decision that they should be intimately involved in both building and evaluation, rather than making an effort to separate out design, building and evaluation phases. Sengers & Warner, the test subjects, were encouraged to make ongoing changes to the code to see what happened, and as part of a way to record and interpret their changing understandings of the system. In addition to these changes to the codebase as a record of use and interpretation, Boehner interviewed both of her co-authors on a regular basis and all three authors contributed to a shared online diary on which they kept thoughts and ongoing discussion.

One notable aspect of the paper is how all three authors found their interpretations and understandings of the system changing over the course of several months of the system in use. The researchers were explicit in the design of their evaluation that the evaluation itself needed to 'provide stimuli for ongoing reaction', as well as reflecting the multiple narratives of evaluation from the standpoints of the different researchers. This is a project that did not start with *a priori* decisions about the nature of the experiences that the users would have with the technology, and the evaluation method was designed to be open to these new kinds of experiences. Furthermore, given that the designers were also the users, and changed the technology according to their own understandings of their experience, the technology itself becomes a record of their experiences and responses to those experiences. This is significantly different to standard 'scientific' approaches to evaluation, which emphasize objectivity: think back, for example, to Lieberman's critique of HCI evaluation in which he suggests medical double-blind studies as a gold standard for evaluation (Lieberman, 2003). This takes the work mentioned above under 'Technology Probes' a step further: not only does the technology serve to record its own use, but the technology itself serves as a substantiation of those experiences.

4.4.5 Common practices for evaluating systems

To understand the literature on the evaluation of experience-focused HCI, it is necessary to see it in the context of its task-focused surroundings. There's invariably a dual purpose to any such experience-focused evaluation in HCI. The first is the stated purpose of evaluating the system under question: determining how it works or fails. The second purpose, however, is an epistemological claim that their evaluation method and methodology are valid approaches to HCI. There is a critique of more analytical, reductionist, and task-focused approaches inherent in all of these

experience-focused evaluations. In both the choices of the methods the researchers use and the parts of the socio-technical system that they choose to study, they make a value claim about experience as a lens on technological interaction, and, simultaneously, reject a reductionist approach that emphasizes a discrete and delimitable task over a richer characterization of the interaction. This is not a destructive critique for the field; quite the opposite. By proposing, justifying and explaining their alternative, authors provide not only an evaluation of their own work and work practices, but provide the potential for opening up the field to new kinds of ways of knowing. Such approaches do not rule out more traditional ways of evaluating, but by being explicit about their own criteria for validity they are in many ways engaging in the kind of epistemological reflection I suggest in Chapter Two. This further suggests that there may be value in seeing such explicit consideration of how one's work is valid in other domains, such as more task-focused approaches. In this way, I hope that experience-focused HCI approaches can have positive effects even on much more task-focused endeavors.

Let us conclude this section by returning to our discussion of themes in practices of experience-focused HCI. Evaluation techniques in experience-focused HCI engage with human practices across the board, as those practices are the primary objects of study. The particular emphasis of human-focused HCI evaluation on human practices is the unexpected and emergent nature of practices, and in particular how those practices emerge in interaction both with the system but also with other people. Those practices are indeed in dialog with the artifact, but the artifact becomes a probe to generate novel practices rather than behaving as a repository of knowledge itself. Similarly, we see engagement with the theme of affect: both the Sensual Evaluation Instrument and the evaluation strategies for Affector provide ways to think about the role of affect not just as a form of information, but as something that is created and

changed and experienced in the process of interaction. Finally, the Influencing Machine and associated evaluation directly address questions of aesthetics, aesthetic judgment and their role in evaluation of technological devices.

4.5 Theoretical Practices

The final major category of practice in experience-focused HCI is that of theory. This differs from the other three categories in that it is not necessarily focused around a particular technological system, and as such, it can be the hardest to pin down and the hardest to generalize about. However, there are certain practices and attitudes that seem to be common in theoretical approaches to experience-focused HCI, as well as significant differences.

The primary similarity of these practices is that they are all written in dialog with and in response to two dominant approaches to human-computer interaction. The first is a implicitly technologically determinist approach to HCI, which sees the role of technology as the primary factor to explain changes in the field of human-computer interaction. The second dominant approach is the cognitive/rationalist approach that is at the core of task-focused computing. As I will discuss in the conclusion of this section, the cognitivist approach is itself in many ways a response to technological determinism as it does emphasize the role of the human in interaction, but, as we will explore, experience-focused approaches see its analytical and reductionist emphasis as inappropriate for the rich interactions of humans and technologies.

I start this section with Dourish's work *Where the Action Is*, as an exemplar of phenomenological approaches to HCI. Phenomenological approaches to HCI, including but not limited to those inspired by ethnomethodology, emphasize the role of human practices. Dourish also emphasizes the embodied nature of computation, both in the form of tangible media, which emphasizes physical interactions, and in the

form of social media, which emphasizes how interactions rely on our bodily experiences as social beings. I then continue by discussing McCarthy & Wright's appropriation of pragmatist philosophers Dewey and Bakhtin in *Technology as Experience,* in which they build from a related tradition in twentieth-century philosophy, but emphasize the role of emotion and feelings in a way eschewed by those who rely on observable practice as the basis for their scholarship. I then continue this emphasis on affect and the body by looking at two papers that rethink the role of affect in interaction and question the role of the body in that process. I then switch tracks slightly and discuss research that examines the role of design in HCI. In particular, this work emphasizes a kind of knowledge encapsulated within and based upon the artifact, while addressing the role of aesthetics in HCI.

4.5.1 Phenomenological Theory-led HCI

Several of the more recently proposed theoretical approaches to HCI draw from a shared basis in the twentieth-century philosophical movement of phenomenology. While the exact understanding of the nature of phenomenology differ from philosopher to philosopher, and so do in their interpretations in HCI, these phenomenological approaches to HCI can be collectively read as reactions to the cognitive approaches mentioned before.

Perhaps the most well-known phenomenological approach to dealing with the question of experience in HCI is Paul Dourish's *Where the Action Is: The Foundations of Embodied Experience* (Dourish, 2004b). He draws from phenomenology to develop a notion of 'embodied interaction' that emphasizes the importance of natural practice over abstract cognition in making meaning through engaged interaction with artifacts. That is to say, there's an emphasis on the lived nature of interaction rather than a cognitive approach to building models that summarizes only small portions of

the lived reality of interaction. He addresses this lived nature of interaction by developing six principles for design:

1. Computation is a medium.
2. Meaning arises on multiple levels.
3. Users, not designers, create and communicate meaning.
4. Users, not designers, manage coupling.
5. Embodied technologies participate in the world they represent.
6. Embodied interaction turns action into meaning. (Chapter 6)

Dourish explicitly draws from Schulz's notion of intersubjectivity as the source of the life-world of lived experience, and upon Garfinkel's emphasis on members' organization of action, accountability, and the experience of the everyday world. Dourish emphasizes the notion of embodiment: how people and technologies participate in the world. He divides HCI work on embodiment into tangible computing and social computing, and makes the point that these are two elements of the same phenomenon. Our lived, felt experiences in the world are experienced through the medium of our own bodies, and our lived, felt experiences in the world are experienced through our social interactions with others. Tangible computing and social computing are two attempts to put these lived experiences back at the center of our interactions, and as such each can be read as a phenomenological response to cognitive accounts of HCI practice.

Dourish and others are building from the phenomenologically-influenced work of ethnomethodology to describe an approach to HCI that emphasizes the practices of technology users, the actions they take in the course of doing their jobs or interacting with technologies (K. Schmidt, 2000; Suchman, 1983, 1987, 1995, 2007; Winograd & Flores, 1987). I will discuss this foundation at some length in the next chapter, but will now move to looking at other theoretical foundations for approaching HCI.

4.5.2 Pragmatist Theory-led HCI

In their book *Technology of Experience*, John McCarthy & Peter Wright explicitly propose an alternative to more traditional, cognitive approaches to HCI (McCarthy & Wright, 2004b). They draw from the work of pragmatist philosophers of experience Mikhail Bakhtin and John Dewey as foundations for an approach to HCI that emphasizes the particular, lived, felt nature of experience. While McCarthy & Wright concur with others that cognitive accounts are not the most appropriate approach for HCI (Suchman, 1987; Winograd & Flores, 1987), they believe that many practice based approaches, such as those of ethnomethodology, understate the importance of felt life – the ways that we feel about things – in experience.

They present their thesis in the first chapter of their book in the form of six propositions that they believe will lead towards a deeper understanding of technology as experience:

> [I]n order to do justice to the wide range of influences that technology has in our lives, we should try to interpret the relationship between people and technology in terms of the felt life and the felt or emotional quality of action and interaction …
>
> [S]ocial-practice accounts of interactive technologies at work, at home, in education and in leisure understate the felt life in their accounts of experience …
>
> [I]t is difficult to develop an account of felt experience with technology …
>
> [P]ragmatist philosophy of experience is particularly clarifying with respect to experience, and … the models of action and meaning making they encompass express something of felt life and the emotional and sensual character of action and interaction …
>
> [T]he importance given to the emotional-volitional and creative aspects of experience in pragmatism prioritize … the aesthetic in understanding our lived experience of technology …
>
> [T]he revisionary theorizing of pragmatism is particularly valuable for understanding technology and design.
>
> (McCarthy & Wright, 2004b, pp. 12-20)

As McCarthy & Wright discuss in Chapter 5 of their book, there is a difficulty in thinking and talking about one's experience in that experiences are inherently dialogical. That is to say, if you are having a given experience, and are focused on having as rich an experience as possible, experiencing it in the moment, then you cannot be reporting on the experience at the same time. This is not an insurmountable difficulty, but this process – they use Victor Turner's term 'putting experience into circulation' – inherently changes the nature of the experience. There is no way to avoid this 'experimenter effect', and, they posit, neither is it necessary to do so. Instead, they argue that the narration of the experience can itself be part of the experience.

This is because the rehearsal of an experience into a narrative – or simply telling a story about something that happened to you – is not just a passive process of recounting, but an *active* process wherein the telling of the story changes the way that you understand it, and helps you find meanings within your own experience. In his introduction to the book *The Anthropology of Experience,* E. M. Bruner describes "a double consciousness in experience as we both participate and report: … we live an experience with the expectation that we'll explain it to others" (Turner & Bruner, [1986, p. 15], quoted in McCarthy & Wright [2004, p. 120])

Experiences are situated not just in the present, but in the history of similar or dissimilar experiences, *and* in the potential future experience of the recounting. As a tool to characterize this notion of experience, McCarthy & Wright describe a set of six processes of sense making, which occur in no particular order and with no particular intercausality: anticipation, connection, interpretation, reflecting, appropriating and recounting. I paraphrase their descriptions of these terms here. We are continuously *anticipating* what happens next, and our anticipation shapes our later experiences by retrospection back to the anticipation. *Connection* refers to the very initial, "pre-

linguistic, pre-cognitive sense" of an event: entering a house, do you feel a sense of calm, of fun, of concern? *Interpretation* is a sense of uncovering the narrative of an experience, finding what to do next, and the continual process of hypothesizing and rejecting or embracing one's interpretations. They describe *reflection* as occurring simultaneously to interpretation, but judgment-based: how does this "tally with our anticipation", how do we "feel about being in this situation"? We *appropriate* situations by referring them to ourselves, to our history, and to our future; we *recount* situations to ourselves or to others, placing them in context and making meaning from them (McCarthy & Wright, 2004b, pp. 124-127). In this set of processes the authors emphasize the ongoing and situated nature of any particular experience; any one or more of those relationships between a person and a technology can exist at (nearly) any point.

Technology as Experience does discuss particular technological systems, and factors related to the design of such systems; Chapter Six, for example, is a study of one airline pilot's system of notes and observations on how to pilot a particular kind of airplane. However, the emphasis on the book is on the theory of a particular form of experience-focused HCI. They write:

> Our aim … is to advance a critique of the way in which the turn to practice is playing out in the study of technology, to argue that it is still in many cases incurably and sometimes paradoxically "cognitive" treating the people who use technology as unlikely to experience technology resistance, doubt, ambiguity or suffering.(McCarthy & Wright, 2004b, p. 25)

McCarthy & Wright's book represents a significant contribution to an understanding of experience-focused HCI. Their emphasis on the role of emotion and feelings seems particularly relevant to non-task-focused systems that by their nature engage with emotions, and the approaches detailed above provide a useful resource for thinking about the design of experience-focused HCI. While it builds on other

practice-based work that does not emphasize emotion, it is written as a resource for a particular way of thinking about experience in HCI. We will now see some alternative approaches that see emotion as fundamental to understanding interaction.

4.5.3 Affect and the Body

Boehner et al.'s 2005 paper *Affect: From Information to Interaction* proposes a way to think about the role of affect in computing (Boehner et al., 2005). It is in response to an approach to affective computing that has been dominant in the field since the publication of Picard's *Affective Computing* (1997). They write:

> While the social and cultural approaches attempt to deconstruct conventional approaches to cognition (and in particular the underlying cognitivist computational claim on mind) the recent exploration of the role of emotions leaves traditional cognitivism intact, and in fact depends on it as the base for adding "emotional" understandings. (Boehner et al., 2005, p. 59)

By contrast, Boehner et al. propose an approach to affect in computing that sees affect as being constructed in and through interaction, rather than existing in some *a priori* sense in the world. They identify three characteristics of this approach.

> First, this approach sees emotions as culturally grounded, dynamically experienced, and to some degree constructed in action and interaction …
>
> Second … the interactional approach moves the focus from helping computing to better understand human emotion to helping people to understand and experience their own emotions …
>
> Finally, the interactional approach leads to new designs and evaluation strategies … Measures of success are therefore …whether the systems encourage awareness of and reflection on emotion in users individually and collectively. (Boehner et al., 2005, pp. 59-60)

The authors continue by explicating how this approach works in practice, and discuss two case studies from which they derive six design principles for affect as interaction (pp. 66). This is particularly relevant to our understanding of experience as created in interaction rather than existing *a priori* as our evolving understanding of

experience involves emotion as a key part. These principles allow us to understand more about the assumptions behind the kinds of affective computing that treats affect as information. However, that also tells us more about the underlying assumptions of those kinds of task-focused approaches outside of the domain of affect.

1. The interactional approach recognizes affect as a social and cultural product.
2. The interactional approaches relies on and supports interpretive flexibility.
3. The interactional approach avoids trying to formalize the unformalizable.
4. The interactional approach supports an expanded range of communication acts.
5. The interactional approach focuses on people using systems to experience and understand emotions.
6. The interactional approach focuses on designing systems that stimulate reflection on and awareness of affect. (Boehner et al., 2005, p. 66)

However, this approach is criticized by Höök et al. for inadequately emphasizing the role of the body in the construction of emotions (Höök, Ståhl, Sundström, & Laaksolaahti, 2008). Höök and her colleagues build from this approach to affective computing by emphasizing the role of the body in affect, something that they feel Boehner et al. understate:

> Lacking from the original description was a description of how our human, physical bodies can be an arena for embodied experiences … Emotions are not only cognitive phenomena, but are also experiences as physical, bodily processes, and are in turned influenced by our bodily processes. (Höök, Ståhl, Sundström, & Laaksolaahti, 2008).

They suggest modifying two of the previous statements to implement an embodied approach, resulting in:

1. The interactional approach recognizes affect as a social, cultural and bodily product.

3. The interactional approach is non-reductionist. (Höök et al., 2008, p. 653)

In their first change, the authors are emphasizing the role of the body in the production of emotions, both as a biological and a cultural entity. They emphasize the need to move beyond a dualistic body/mind approach, and rather see bodies, minds,

and social interactions as co-creating feelings, as we have seen emerge in discussions of our theme about the role of the body in experience.

Their reasoning for the second change is slightly more complicated. They argue that the emphasis on trying to avoid formalizing the unformalizable results in an inability to generalize from unformalizable behavior. Höök et al. argue that this makes it impossible to actually design products or devices to support such behavior. I believe that, at least as this applies to experience-focused HCI, this is not the case. Generalization and formalization are not necessarily the same, and are not even necessarily on the same axis: generalization need not imply formalization. Furthermore, generalization is not a weak form of formalization, and formalization is not necessarily an end-state of generalization. Both statements, "[t]he interactional approach avoids trying to formalize the unformalizable" and "[t]he interactional approach is non-reductionist" are attempts to represent responses to the same issue. Both capture aspects of the same problem, and both capture aspects if not the totality of the experiences of the user. In particular, both are in response to a task-focused approach that does attempt to both formalize the unformalizable and reduce the irreducible and both emphasize the impossibility of successfully achieving such a task.

I include this discussion here for several reasons. First, both the original list of parameters and the modifications are themselves useful guidelines for experience-focused HCI outside of affective computing. Second, it engages with our themes of affect and the body in an informative way. And third, it serves as an interesting case study around the uses of theory and how experiential theories in HCI are written in response to the dominant cognitive paradigm.

4.5.4 The role of design in HCI

A third theoretical contribution to experience-focused HCI concerns itself with the role that design plays in HCI. In the earlier discussion of ethnography, we saw the discussions in the field about incorporating ethnography as a method without reference to the analytical richness of the tradition it comes from. There is an analogous set of discussions about the role that design plays in HCI which we will discuss here. To summarize, some designers in HCI feel that designers are often called in at the end of the process to put a pretty box around a finished design. Designers feel that this misses the analytical depth of the discipline, which is the real contribution that design can make to HCI. This is similar to the complaints of anthropologists decrying HCI's adoption of ethnography as a method rather than recognizing the richness and value of the associated analytical disciplines. Theoretical work in this genre generally takes the form of working out how design ways of thinking, ways of doing, ways of knowing and ways of recognizing quality can be applied to HCI.

Thinking through these implications within the field of design has been common for some time and is known as 'design research' (Cross, 1999, 2001, 2006; Alexander, 1964; Coyne & Snodgrass, 1991; Jones, 1970). However, these are all cases of designers talking to designers, and these discussions then had to be ported to HCI by those familiar with both fields. The earliest examples of this kind of theoretical approach to design in information technology that I have found are in HCI's sister field of software engineering (Löwgren, 1995; Winograd, 1996). An early example of such work in HCI can be found in Löwgren & Stolterman's 1999 article "Design methodology and design practice" in *interactions*, a non-peer-reviewed but often scholarly and widely read magazine in the field (Löwgren & Stolterman, 1999). Since this point, there has extensive discussion around these themes (e.g. Fallman, 2003; Löwgren, 1995; Wolf, Rode, Sussman, & Kellogg, 2006; Nelson,

2003; Löwgren & Stolterman, 2007; Forlizzi & Battarbee, 2004; Zimmerman et al., 2007).

I have decided to concentrate on three of these works. The first is Forlizzi & Ford's "The Building Blocks of Experience: An Early Framework for Interaction Designers" (2000); the second is Fallman's paper "Design-oriented Human-Computer Interaction" (2003), and the third is Zimmerman, Forlizzi & Evenson's "Research Through Design as a Method for Interaction Design Research in HCI" (2007). I have chosen these three as they represent successive steps in thinking about the role of design in the field. In addition, the approach they take to understanding design is explicit about design research theory and the way it relates to HCI. This is in contrast to, for example, the paper "Dispelling Design as the Black Art of CHI" (Wolf et al., 2006) which concentrates on the practices of designers themselves. In additional, all three directly address questions of experience and the role of design in designing for experiences.

Forlizzi & Ford (2000) is a preliminary framework for approaching experience in HCI by drawing from work on experience in product, graphic and interactive design. They separate models of experience into three types: product-based models, often in the form of lists or checklists for designers to use when designing, user-centered models that represent the different components of users' actions, and interaction-centered models that explore the role of products in bridging the gap between designer and user. Their own framework takes an interaction-centered approach within a social context, describing a matrix of the three kinds of interactions that users have with products (fluent, cognitive and expressive), and three dimensions of experience (experience, an experience, and co-experience). Their three kinds of interactions represent differing levels of conscious engagement: fluent interactions are automatic and well-learned, performed without conscious effort. Cognitive

interactions require active engagement with the product itself: understanding a novel tool that does not match one's previous experience, for example. Expressive interactions help a user form a particular relationship to a particular product: customizing a software program, or restoring old furniture, for example. Ford & Forlizzi's other three categories or dimensions of experience represent increasing levels of involvement with experiences. They use 'experience' to represent the constant stream of self-talk with which we engage in doing everyday tasks. 'An experience' is a discrete interaction: a rollercoaster ride, watching a movie. A 'co-experience' involves multiple people creating an enhanced experience through their interaction with a product. Forlizzi & Ford also emphasize the ways in which emotion is at the heart of any human experience, and how emotion allows for scalability between different sized elements of an experience: the frustration of a poorly designed opening page for a website may be overwhelmed by an otherwise positive experience, but may also give a feeling of frustration to the overall interaction.

Fallman's (2003) paper builds on the initial work of Ford & Forlizzi, as well as an extensive discussion of the theoretical work in design research, and begins by discussing three different accounts of the role of design in HCI. He labels the first the "conservative account", which emphasizes the problems that the designer sets out to solve. He writes:

> From what could be called a conservative account, to be design-oriented is consciously to seek to intervene and manipulate, aiming to convert an undesired situation into a desirable one… the conservative account assumes that there is a 'problem' to be solved, and that descriptions of this problem can comprehensively and accurately produced … which is then fed into the design process … every step in the process is suggested as rational and possible to describe. (Fallman, 2003, p. 226)

By contrast, the 'romantic account' emphasizes the role of the designer:

> they are seen as imaginative masterminds equipped with almost magical powers of creation. … Designers are seen as creative individuals with unusual talents, who have to fight opposition in order to defend their unique creativity and artistic freedom … the design process is guided by the designer's values and taste, where the product becomes judged according to issues of quality and aesthetics. (Fallman, 2003, pp. 226-227)

His third category is the 'pragmatic account', which emphasizes the situation that the designer is designing for:

> design is about being engaged directly in a specific design situation … under the pragmatic account design takes the form of a hermeneutic process of interpretation and creation of meaning, where designers iteratively interpret the effects of their designs on the situation at hand. It is a reflective conversation with the materials of the design situation. (Fallman, 2003, p. 227)

He then discusses various limitations of these different ways of approaching design: for example, he questions the validity of claiming that design is or even should be a science, and emphasizes that design is never a truly transparent process. Fallman then suggests that the practice of sketching is the archetypal design activity: the iterative nature of sketching provides a way to think about design as a dialogic process. He proposes that the right way to think about design as a process in HCI is to keep in mind all three of the above explanations, but then to distinguish between "design-oriented research", which generates abstract knowledge, of the kind characteristically done by academic researchers, and "research-oriented design", which encapsulates knowledge in the form of artifacts, as done by working designers.

Finally, Zimmerman et al's (2007) paper builds off both Fallman and Forlizzi & Ford's work. They survey the discussions of design in HCI, and conclude that the characteristic feature of design in HCI is an attempt to produce "the *right* thing: a product that transforms the world from its current state to a preferred state." (pp. 493) They start by discussing the aforementioned notion of 'design research' as the theoretical side of design, and then discuss Fallman's framing of HCI as a design discipline and related work. They then present the results of interviews with nine

academic HCI researchers, each accompanied by one of their graduate students, and with six professional designers. The designers felt that design added three kinds of value to HCI:

> First…a process for engaging massively under-constrained problems that were difficult for traditional engineering approaches to address …
>
> Second… a process of integrating ideas from art, design, science and engineering, in an attempt to make aesthetically functional interfaces …
>
> Third… empathy for users as a part of the process. (Zimmerman et al., 2007, p. 496)

The authors build off these three themes and the notion of building "the *right* thing" and more fully develop as set of criteria for evaluating design work in HCI. I will discuss these in more detail in the next chapter about ways of knowing, but their emphasis is on ensuring that all of the above ideas are included in a design, and that building the *right* thing is not subverted by scientific ideas of value which emphasize "relevance" instead.

4.5.5 Common Practices of Theorizing

Of all the sections, it is perhaps hardest to say anything coherent about the shared practices of the theorists. So what are theorists doing? What is the value of theory to the field – particularly, if stated above, it has a dominant tradition that primarily values built systems as the preferred form of intellectual contribution? One key contribution of these theoretical works in experience-focused HCI is to substantiate alternatives to the twin dominant narratives of the field: technological determinism and a cognitive-science-based reductionist approach. The theoretical work discusses here emphasizes themes such as felt life, the naturally embodied nature of interaction, and the role of emotion in interaction. These are all aspects of

interaction that are seen as marginalized in cognitive-reductionist approaches to HCI at the expense of a rational account of thought processes.

In some ways, the reaction is against not just a cognitive account, but more against an analytical process that works by decomposing the whole into its component parts. These works share an emphasis on an open-ended approach to HCI which needs to be read in contrast to the reductionist and cognitive approaches that have been so very influential in HCI, as exemplified by the analytical approach proposed in *The Psychology of Human-computer Interaction* (Card et al., 1983). This is characterized by an emphasis on the role of individual cognition, attempts to produce models that accurately replicate human behaviors, the reducibility of real-world situations to laboratory situations, and the importance of generalizable knowledge as a metric of quality. In a recent article, Winograd characterizes this approach, which he refers to as 'rationalistic', as follows:

> [This] approach … aspires to model people as cognitive machines, whose internal mechanisms parallel those we build into digital computers. The clearest expression of this view is Newell and Simon's Physical Symbol System Hypothesis [9], which influenced a generation of researchers both in AI and in HCI ... Newell's conception was also the key inspiration for the founding text on HCI as a discipline of cognitive engineering [1], which remains influential in the HCI community today. A quick glance at the papers in the annual ACM SigCHI conference shows many papers that address interaction problems from an empirical quantitative perspective.
>
> The key assumptions of the rationalistic approach are that the essential aspects of thought can be captured in a formal symbolic representation. Whether or not it corresponds directly to a formal logic, it operates like a logic in that well-defined algorithmic rules can be applied to models (processes and knowledge) in the form of symbol structures. Armed with this logic, we can create intelligent programs and we can design systems that optimize human interaction. (Winograd, 2006, p. 1257)

The works I discuss here under the auspices of experience-focused HCI propose, assume or embrace a more embodied, phenomenological approach to computing which sees the human experience with technology as closer to being

irreducible, unmodelable, situated and unique. This engages with our theme of human practices, and these approaches are sometimes referred to as 'practice-based' in contrast to 'model-based' approaches. Again, I reference Winograd's characterization:

> The second approach is harder to label. It has affinity to those who call their approach "phenomenological, "constructivist", and "ecological" … the focus is not on modeling intelligent internal workings, but on the interactions between a person and the enveloping environment. Along with this shift of focus goes a shift in the kind of understanding that is pursued.
>
> A key part of the difference is in the role of formal modeling and explanation. In design, we often work in areas of human interpretations and behaviors for which we do not have predictive models. The question of "Does it work?" is not approached as a calculation before construction, but as an iterative process of prototype testing and refinement. (Winograd, 2006, p. 1257)

In addition to how these works are responding to a cognitive and rationalistic approach, there is a sense in which these works are in response, generally implicitly, to a casual, technologically determinist approach to HCI. As mentioned earlier, technological determinism – although rarely identified as such by its practitioners – posits changes in technology as the primary instigator of change. The theoretical approaches above (indeed, along with the cognitive approaches) propose that other factors may be more fruitful to investigate or study than improving the technology itself. By emphasizing the role of the human as individual and as social group, these theoretical approaches do in fact join the cognitive account in a valuing of the individual over the technology, even if they choose to emphasize different aspects of the human experience.

Interestingly, we see this response to technological determinism throughout the practices detailed in this chapter, not just in the theory section. The emphasis on ethnographic approaches for inspiration for technological devices puts the emphasis on the human and social part of the techno-social system; similarly, both cultural and technological probes emphasize human practices over technological needs. The

building practices discussed use technology as their medium, but, as the case of seamful design shows, the emphasis is on how the technologies are used, interpreted and appropriated by humans, not the technologies themselves. Experience-focused evaluation practices, once again, emphasize how users engage with and make sense of their experiences with technologies, rather than concentrating on how the technologies themselves work or do not work. And once again, the theoretical practices detailed above are explicit about how they emphasize a human-centered approach to understanding the world of human-computer interaction.

In addition to human practices, these theoretical works also engage with our other themes. Design clearly recognizes the importance of aesthetics as a core part of interaction, but it also emphasizes the role of the artifact as a knowledge-making and knowledge-conveying entity, rather than just a foil for written work. Boehner et al. and Höök et al. clearly both see the role of affect in interaction as core, even as they differ in the ways they treat the role of the body in its production and interpretation. Similarly, in the next chapter, we will see differences between the role of affect in ethnomethodologically-influenced work like Dourish's and pragmatist-influenced work like McCarthy & Wright's.

4.6 From Practices to Epistemological Orientations

Throughout this chapter, we have seen how we can explore the different ways in which experience-focused HCI differentiates itself from its task-focused roots in the field by looking at the kinds of knowledge it emphasizes. There are commonalities across different practices: for example, there is a recurring emphasis on open-ended approaches that allow users to define the issue at hand (be it design, use, or evaluation) rather than relying on an *a priori* understanding of the situation by the researchers. We

also see commonalities in the ways that these works are written in response to the twin dominant paradigms of technological determinism and cognitive rationalism.

From this work we can describe some emergent qualities of what constitutes an experience in experience-focused HCI. First is the assumption or claim that an experience is not adequately described by the sum of its component parts. Furthermore, experience-focused HCI claims that descriptions of experiences are inherently incomplete and that in the course of such a representation significant knowledge is lost. They recognize that experiences are to some degree ineffable; a representation or characterization of an experience will never be able to contain all the information that is in the experience itself. Perhaps more significant is the emphasis on the creation of experiences in the course of interaction; an experience does not exist *a priori* in some abstract sense but is created in the course of a particular interaction by particular actors and situated in particular times and places. To put that a little more strongly, the claim is not just that experiences are created in interaction by actors in a place and at a time, but that such factors are extremely important to the experience and to ignore them is to miss important parts of the interactions.

Having established a common understanding of what constitutes experience-focused HCI as a sub-field, I will now look at the differences between different ways of doing experience-focused HCI in the next chapter: *Epistemological Orientations of Experience-focused HCI.* This helps both further demonstrate how an epistemological approach can deepen one's understanding of a field, but also explains the differences in practices outlined in the first section: different epistemological tendencies or beliefs, such as an orientation towards producing generalizable or universal principles will produce different approaches to doing research.

CHAPTER 5:

EPISTEMOLOGICAL ORIENTATIONS OF EXPERIENCE-FOCUSED HCI

5.1 Introduction

In Chapter Three I proposed the comparison of different epistemological approaches to understanding HCI, and I demonstrated how this worked in practice by looking at a history of evaluation in the field. In this chapter I will look in more detail at the epistemological orientations of the field of experience-focused HCI that I outlined in the last chapter. In that chapter, I concentrated on the practices of experience-focused HCI, and how those practices intersected with various themes associated with them: affect, aesthetics, artifacts, the body, and human practices. In this chapter I will look at the same body of research and same authos, but concentrate on their knowledge-making practices. There is some intersection between these two approaches – in particular, theoretical work in HCI often involves making statements about knowledge-making practices – but in this chapter I will be explicit about a selection of epistemological approaches that helps understand both similarities and differences in practices of experience-focused HCI.

Epistemological orientations provide a way to characterize and understand the relationship that different researchers have to practice: their underlying approaches to knowledge-making and the implications of those underlying approaches for the ways they go about doing research. In this chapter, I will characterize epistemological orientations by looking at three aspects:

- the forms of knowledge that the orientation considers valid
- the marks of quality that the orientation looks for in research
- the role of generalization of results in that orientation

Understanding an epistemological orientation can help explicate the ways decisions are made about which research practices are emphasized and which have less explanatory or rhetorical power. For example, as we'll see below, while both ethnomethodologists and designers may build a new device and place it into a home, the role that that device places in knowledge-making is distinctly different. To complicate the matter, researchers do not invariably fall into one particular camp or another all the time: designers sometimes theorize about the nature of experiences despite their emphasis on the artifact, and ethnomethodologists sometimes conjecture about what's going on in their subjects' heads despite their emphasis on practice. Similarly, the external constraints of a situation can change the epistemological orientation necessary to work within it: the constraints of funding, of collaboration, of time. Those caveats aside, I hope to show that there's an explanatory power to epistemological orientations which answers very real questions about the ways practices are chosen and emphasized or marginalized. This is perhaps best illustrated by an example.

5.2 'UX': An Incompatible Epistemological Orientation

A given topic of study can be approached in significantly different ways while remaining within HCI. For example, we saw earlier how eMoto and Affective Diary approached the topic of affect and emotion in a very different manner than FAIM, the Facial Instant Messaging program. Thus, before discussing epistemological orientations that are compatible with experience-focused HCI, I want to outline an example that exemplifies a task-focused approach to a domain that has significant experiential components.

One comparatively recent approach to considering experiential factors in HCI is the User Experience approach, or UX. UX encourages the user experience designer

to consider emotional and hedonic factors in user interface design. This, on the surface, sounds similar to aspects of the experience-focused HCI approach I advocate in this thesis. Indeed, the object of study – an approach to doing HCI that recognizes the importance of emotional and hedonic factors – seems entirely compatible with an experience-led approach. However, the dominant epistemological orientation in UX is significantly different from those I'll discuss under the rubric of experience-focused HCI.

Hassenzahl, a leading proponent of UX, describes the UX approach as "an additive component-based approach, where particular processes (e.g., time, importance) operate on a structure of distinct components (e.g., usability, look & feel, hedonics, emotions, needs etc.)" (Mahlke & Hassenzahl, 2007).

UX proponents hold that the user experience can be broken down into several components, each of which can be treated as being distinct from the others. In their paper *Engineering Joy* in the software engineering journal *IEEE Software* (2001), Hassenzahl, Beu, & Burmester propose a number of concrete approaches that can be taken to incorporate joy and associated hedonic factors in a measurable and verifiable way into design. Their approach emphasizes ways of thinking about these measures that are designed to fit into the usability- and task- based orientations that are common in HCI. They write:

> There is an explicit difference between knowing that hedonic quality could play a role in designing interactive systems and actively accounting for it. The latter requires practical methodical support for both design (techniques for gathering and analyzing hedonic requirements) and evaluation (metrics and techniques to measure hedonic quality). As long as you understand their advantages and disadvantages, the following techniques can fit into a design process for interactive systems. (73)

There is a rhetorical move that happens in the paper: as will become apparent, the above paragraph's "practical methodical support" becomes, perhaps, "ways to

represent hedonic factors in numerical form". In particular, the authors propose three ways to 'engineer joy'. The first is "a semantic differential for measuring perceived hedonic quality": asking users to rate an interactive system on scales from 1 to 7 with labels such as "outstanding" to "second-rate", "interesting" to "boring" and "impressive" to "nondescript". They point out that while this approach is simple to use and "generally applicable", it fails to capture any underlying reasons for the decisions users make.

The second approach they propose is a repertory grid technique in which metrics for quality are determined in the course of evaluation by the users, and aspects of systems are compared to each other in terms of those metrics. They point out that this has the advantage of being "theoretically grounded", "efficient" and "structured" and applicable to "almost any set of software products", although they note that the process requires a great deal of effort on behalf of the experimenter.

Finally, they propose a system called 'shira interviewing'. "Shira" stands for "structured hierarchical interviewing for requirement analysis", and has participants pick important attributes about a system from a pre-determined pool including both usability and hedonic factors, such as "controllable" and "innovative". Participants then list the features of the software that match that attribute. The authors write:

> By repeatedly answering questions such as "what makes a home automation system seem innovative to you," they will generate a list of features that contain context and the attribute's software-specific determinants (for example, "user-friendly" and "not patronizing"). (75)

> Finally, the participants "produce recommendations for each entry… suggesting how the actual design could address the feature." The authors claim that shira "seems to provide detailed design-relevant data in a structured form that facilitates interpretation and integration of multiple personal perspectives." There are no real-life examples given of shira analysis in the publication; it's not clear from reading the paper that such a technique would be useful for anything other than the most technical of applications, as it requires end-users to have a deep understanding of the technical factors. For example, they example they give for the last recommendation is that users might suggest an "adaptive, learning, intelligent system that works more or less independently and requires little attention from the user" (75).

Regardless of the utility of these particular techniques for practical system design purposes, the selection of and approach to these techniques makes them interesting objects of study to understand the authors' epistemological orientation. The authors' analysis of these different techniques makes clear their desire to impose or find structure in unstructured responses. Overall, the aim in UX is to find a way to represent aspects of interaction that are seen as irrational and irreducible in the experience-focused HCI orientation in a rationalist and reducible manner.[4] This contrasts with the general approach detailed in the previous chapter, in which the assumption – or, indeed, the explicit statement – is that there's a value in eliciting rich representations of user experiences with irrational aspects of design that are lost in a rationalist and scientific approach. Furthermore, the reductionist approach at the core of UX is at odds with experience-focused epistemological orientations that embrace a more open-ended notion of experience.

[4] A note on wording: in some fields, 'reductionist' is used in a pejorative manner, and so it might seem offensive to describe others' work in this way. However, in the course of attending a UX workshop at NordiCHI'06, I found that the UX researchers use this term to describe their own work and are happy to label themselves as such. Consequently, I feel comfortable describing their approach as reductionist.

Now we understand the basic approaches characteristic of UX, we can look at how it is epistemologically incompatible with other orientations in practice. For example, the editors of accepted submissions to a workshop on UX called "Towards a UX Manifesto" were asked to rate all the accepted papers with a seven-point Likert scale on five axes, which were labeled as follows:

Table 1: "Five analysis aspects and associated dimensions." From (Law et al. 2007)

Aspect	Representative dimension
THEORY	Reductive --- Holistic
PURPOSE	Evaluation --- Development
METHOD	Quantitative --- Qualitative
DOMAIN	Work based --- Leisure based
APPLICATION	Personal --- Social

A chart representing these responses and subsequent analysis was included as an introduction of the workshop proceedings (E. L. Law, Vermeeren, Hassenzahl, & Blythe, 2007). I do not include this chart here with the expectation that readers of this text will follow every detail of it, but rather as an artifact for observation of certain points.

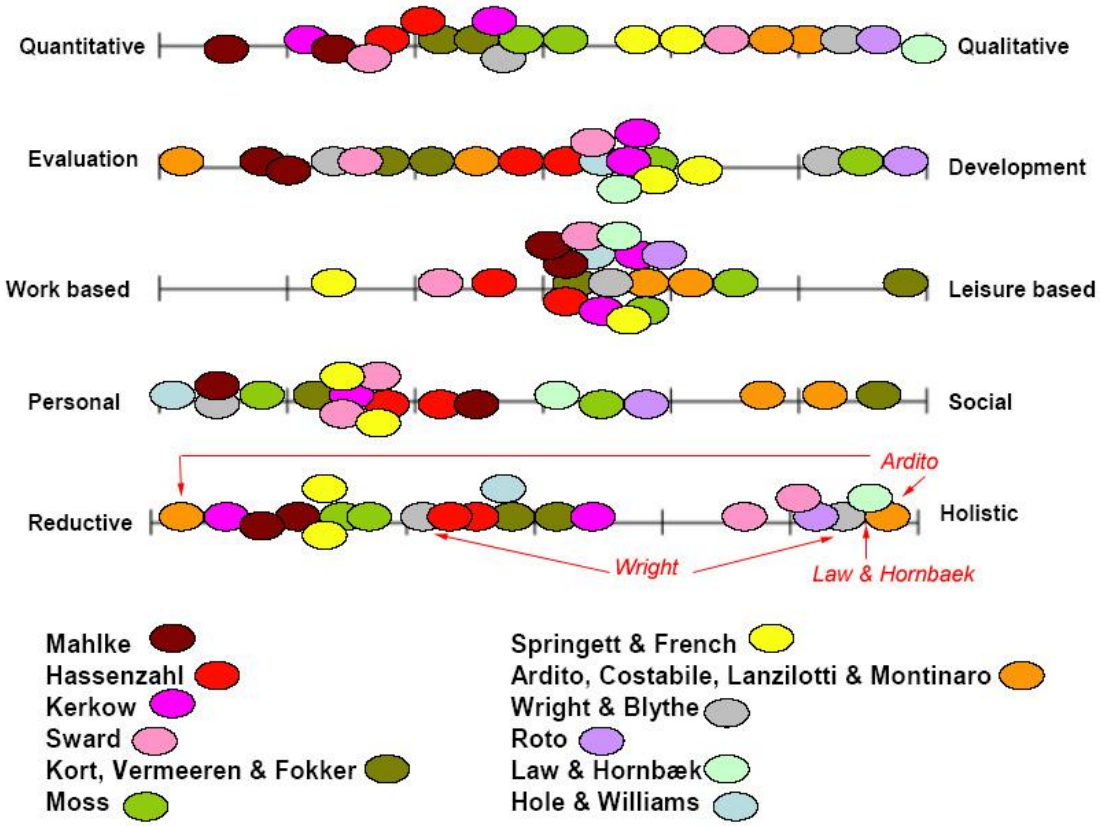

Figure 6: "Results of grid analysis." From (Law et al. 2007), annotated.

The first realization is that this analysis is a little strange under examination. For example, just looking at the reductive-holistic (bottom-most) scale, the paper by Ardito et al. (orange dot) is rated as both a 1 and a 7 on the by different editors, and the Wright & Blythe paper (grey) as both a 3 and a 6.5, suggesting perhaps that different editors have vastly different understandings of the terms 'reductive' and 'holistic'. Similarly, I would consider the paper by Law & Hornbaek (very light turquoise) to be extremely reductive in its approach, and yet it is rated only once on the reductive-holistic scale, as being 6.5 holistic. These problems aside, the editors identified two distinct clusters on the 'reductive/holistic' axis, which I would argue correspond to two distinct epistemological orientations. In the editors' analysis, they write:

> Two seemingly exclusive positions emerged from discussing these questions [of what an experience is, how it can be described or ... fabricated]: one phenomenological/pragmatist and one inspired by experimental psychology. The former is exemplified by McCarthy and Wright's notion of 'felt experience'. ... In contrast, approaches inspired by experimental psychology tend to deconstruct experience into single components.(E. L. Law et al., 2007, p. 3)

These exclusive positions seem to correlate to what we have been describing as epistemological orientations.

5.2.1 Epistemological incompatibility

The authors propose that the optimal solution to these 'seemingly exclusive positions' is to have both simultaneously. It is hard to see how this works in practice. In particular, it treats this question of epistemology as something that can be tacked on at the end of the research process, whereas, as we have seen, epistemological orientations are part of the entire research process from start to finish. Rather, I would suggest that the collection of papers may be more profitably read as a case study of clashes in epistemological orientation: a well-intended but ultimately failed attempt to integrate fundamentally different approaches to knowledge. I would also argue that the UX approach to understanding experience, at least as presented in the initial papers that emphasize reduction and rationalization, if not the more inclusive version that they claim in the workshop proceedings, represents a very real point of contrast to the more holistic epistemological orientations I will now present.

We see a similar clash between the kind of reductionist UX approach we saw earlier, and the kinds of epistemological orientations that we have seen in the last chapter and will now discuss in this chapter. We are beginning to see something about what it may mean for different orientations to be compatible or incompatible. Differences in combinations of the factors mentioned previously – the forms of knowledge considered valid, the marks of quality in research, and the role of

generalization of results – can make different epistemological orientations more or less compatible. By describing two epistemological orientations as 'compatible', I mean that they are willing to accept not just results from the other orientation as valid, but also the research process that led to those results. This is a point that is sometimes lost, precisely because HCI does not traditionally make explicit differences in epistemological orientations of research.

This notion of epistemological compatibility is complicated, and is a question for further study. For example, Wendy Mackay proposed using cross-disciplinary triangulation to improve research in HCI (1997); further research is needed to understand and characterize the epistemological qualities of such disciplinary approaches to understand the limits of epistemological compatibility. However, as I hope has become clear, the UX epistemological orientation has various factors that seem to make it incompatible in some fundamental way with the kind of approaches to experience-focused HCI we have discussed so far. By comparison, I will show that the varying orientations presented in this chapter – the design, pragmatist, ethnomethodological and reflective orientations – are compatible with an experience-focused approach to HCI. I will build off the work in the last chapter by showing that these orientations have a common core of assumptions about the nature of experience and its role in HCI. I will also show how these orientations differ from each other in the ways they depart from that common core to give a fuller picture of the emergent sub-field of experience-focused HCI.

5.3 Design Orientation

In the last chapter, I discussed the role of design theory in HCI, and particularly how those engaged in design in HCI have had to make an explicit case for design's particular metrics of quality. In this context of this chapter, that theory work

looks like a statement of epistemological orientation, and one that has become increasingly necessary as the pervasiveness of design increases in the field. One manifestation is the increase in design tracks at CHI and related conferences, and as well as specialized conferences that emphasize design in HCI such as Designing Interactive Systems (DIS) and Designing User Experience (DUX). The chairs of the Design Track at CHI 2006 discuss their understanding of the role of design in CHI in their abstract:

> While most of the HCI literature can be seen as part of an engineering-science practice (with an emphasis on the acquisition and interpretation of 'facts'), the CHI2006 Design Community focuses on how arts and engineering come together in the construction, study and interpretation of created objects (maybe more like the study of literature and criticism). (Gilmore & Höök, 2006).

As we have seen, unlike more task-focused HCI approaches that emphasize generalizable, absolute knowledge, or *'facts'*, the design orientation emphasizes instead 'created objects' or *artifacts* as a form of specific, situated, embodied knowledge, including provocative artifacts that encourage rethinking assumptions, artifacts that emphasize aesthetics, and presentations that demonstrate process. This role of artifacts is discussed in an influential essay, 'Designerly Ways of Knowing', by Nigel Cross:

> What designers especially know about is the "artificial world" - the human-made world of artifacts. What they especially know how to do is the proposing of additions to and changes to the artificial world. Their knowledge, skills, and values lie in the techniques of the artificial. (Not "the sciences of the artificial.") So design knowledge is of and about the artificial world and how to contribute to the creation and maintenance of that world. Some of it is knowledge inherent in the activity of designing, gained through engaging in and reflecting on that activity. Some of it is knowledge inherent in the artifacts of the artificial world (e.g., in their forms and configurations-knowledge that is used in copying from, reusing or varying aspects of existing artifacts), gained through using and reflecting upon the use of those artifacts. Some of it is knowledge inherent in the processes of manufacturing the artifacts, gained through making and reflecting upon the making of those artifacts. (Cross, 2006, p. 54)

Designerly ways of knowing have clear impacts on design in HCI. There's an emphasis on the built artifact as a product of research, and not just as an object of study, but as the end point of research, as a codification of knowledge. It's in the role of the artifact that the differences inherent in this epistemological orientation become clear. Researchers with a different orientation to knowledge-making may well still engage in the practice of building artifacts, but the artifacts themselves do not play the same central role in research. For example, an artifact may be a probe to understand a local situation (as discussed in the previous chapter's treatment of Technology Probes), a way to allow interaction with an technological idea, a clear demonstration of a specific design hypothesis, or a way to measure some human psychophysical parameter, but the artifact itself is not considered a significant repository for the knowledge that is created. In the design orientation, the artifact itself communicates knowledge. Zimmerman and his colleagues explain:

> The artifact reflects a specific framing of the problem, and situates itself in a constellation of other research artifacts that take on similar framings or use radically different framings to address the same problem. These research artifacts provide the catalyst and subject matter for discourse in the community, with each new artifact continuing the conversation. (Zimmerman et al., 2007, p. 496)

One of the ways in which this emphasis on the artifact causes problems in HCI is that published papers are the primary means of communication in academic HCI (although the same may not be true for HCI in industry.) A published paper may be *about* an artifact but it cannot *be* the artifact. Much of the epistemological work in HCI can be understood as a discussion of the right ways to manage this translation from object to words. For example, in their manifesto for design research in HCI, Zimmerman et al. (2007) make a case for the right way for authors to present and reviewers to evaluate design in HCI. They write:

> Many design researchers have made contributions using a research through design approach. While the idea is not new within the HCI and interaction design research community, there is no agreed upon standard of what research through design means nor what a high quality contribution should be. (499)

As a solution to this problem, the authors propose four criteria or 'lenses' through which to evaluate design research in HCI.

The first criterion they propose as important in evaluating design research in HCI is 'process'. Process means that the designer must provide sufficient detail for their process to be reproduced, and a rationale for the decisions they made. This is not because the same process will produce the same result in a design case, as might be assumed in a more scientific orientation, but because of the need for the evaluator to judge the rigor and rationale behind the decisions that were made.

The second criterion is 'invention': showing novelty through 'an extensive literature review' that situates the contribution in the field. Part of this involves understanding the changes in technology that support or are implied by the design, and the ways that such changes impact others' practices. The authors write:

> … interaction designers must detail how advances in technology could result in a significant advancement. It is in the articulation of the invention that the detail about the technical opportunities is communicated to the engineers in the HCI research community, providing them with guidance on what to build. (499)

The third criterion is 'relevance', which the authors explicitly contrast to scientific research's emphasis on 'validity'. As mentioned above, in scientific research, the process must be detailed in such a way that peers can reproduce the results. This is part of ensuring that results are valid: if a result cannot be reproduced, then it is not considered to be valid research. There is no such assumption in design; two designers given the same starting points may produce drastically different results. As such, validity is not a relevant criterion for design. Instead, since the design decision cannot be proven, the onus is on the researcher to show

> the preferred state their design attempts to achieve and provide support for why the community should consider this state to be preferred (499)

The authors suggest that the relevance criterion is missing from much work in the field today, and argue that it is a necessary part of evaluating design research:

> Today, many design research contributions claiming to follow a research through design approach neglect to cast the work in terms of relevance. The design researchers follow a design process, but the motivation for their work, the detail on current situation, and on the preferred state are missing. Without this critical component, a research through design approach appears to be a self-indulgent, personal exploration that informs the researcher but makes no promise to impact the world. (500)

Their final criterion for evaluating design research is 'extensibility': the ability for others to build on the resulting outcomes of research, be it replicating the process in a different context or learning from the knowledge encapsulated in the finished artifact. This is related to the previous criterion of process, but is explicitly about the affordances for the designer reading the paper to build on the knowledge presented. Zimmerman et al. are not creating an epistemological orientation from scratch. They're reporting on and formalizing a pre-existing orientation to make it compatible with and comparable to research within HCI under the auspices of other epistemological orientations. Their work is in dialog with ongoing discussions about the role of design and design research both inside and outside HCI (Cross, 1999, 2006; Fallman, 2003; Laurel, 2003; Schön, 1983; Wolf et al., 2006). It is also in deliberate contrast to the dominant, rationalist epistemological orientations of the field. As such, design researchers have had to be explicit about stating the terms of their intellectual endeavor in a way that is particularly easy to characterize as an epistemological orientation. As we'll see in later sections, it's not always as explicitly stated and can be harder to tease out.

5.4 Phenomenological orientations

Phenomenological orientations in HCI draw from various twentieth-century philosophical traditions, and particularly from the intellectual descendants of Husserl and Heidegger. They are positioned as a deliberate alternative to the scientific/reductionist orientation exemplified by the UX work discussed earlier. So what do these phenomenological orientations have in common? As a start, they share a common ground in phenomenological approaches to knowing. In his chapter *Postphenomenology*, Verbeek quotes the preface to Merleau-Ponty's *Phenomenology of Perception*:

> [P]henomenology can be practiced and identified as a manner or style of thinking. … It is a manner of describing, not of explaining or analyzing. Husserl's first directive to phenomenology, in its early stages, is to be a "descriptive psychology," or to return to the "things themselves" is from the start a rejection of science. … All knowledge of the world, even my scientific knowledge, is gained from my own particular point of view, or from some experience of the world without which the symbols of science would be meaningless. (Merleau-Ponty (1962), p.viii; quoted in Verbeek, 2005, p. 106)

Verbeek draws from several other sources to reinforce the point: phenomenology is a descriptive approach to knowing, in deliberate contrast to an analytical approach associated with scientific epistemological orientations. We see this in the phenomenological approach taken by Dourish, which I detail above, who explicitly labels his work as phenomenological. However, I would argue that we also see these approaches to understanding as characteristic of three phenomenological approaches to HCI which I will detail next – the pragmatist, the ethnomethodological, and the reflective – by showing their similarities and differences. In particular, I will show that while these approaches clearly differ in some of their metrics of quality, they share a fundamental epistemological orientation in terms of their notions of 'good research', of the form of knowledge, and of their attitudes towards generalization.

All of these orientations value particular kinds of knowledge and particular hallmarks of quality in research. For example, all value thick descriptions and an attention to detail: not necessarily an even-handed attention to detail across the board, but instead careful attention to particularly chosen moments in interaction. The written account and analysis of that written account – and a recognition that those two are inherently intertwined – is the primary form of knowledge, rather than the emphasis on the artifact found in designerly ways of knowing. None of the approaches listed treat generalization in the sense that might be associated with a scientific orientation as an important metric of quality in research. Dourish makes the point that such practice-based approaches are open to generalization based on extrapolation from the 'ethnographically mediated encounter', although they may well eschew generalization in the form of explicit implications for the design of a new technology (Dourish, 2006). In these ways that these approaches all share a roughly comparable epistemological orientation. But how do they differ, and in what ways are they coherently separate epistemological orientations?

5.4.1 The pragmatist orientation

McCarthy & Wright draw from the Pragmatist philosophical approach of Dewey and Bakhtin to propose an understanding of experiences, which uses a dialogic approach that sees experiences as holistic and irreducible, as set out at length in their book *Technology as Experience* (McCarthy & Wright, 2004b). I have discussed this book in the previous chapter as a discussion of theory, but here I would like to concentrate on what a pragmatist approach has to say about creating and validating knowledge and the role of evaluation in the design process. McCarthy & Wright address this question when discussing their fourth proposition:

> Our fourth proposition is that pragmatist philosophy of experience is particularly clarifying with respect to experience, and that the models of action and meaning making they encompass express something of felt life and the emotional and sensual character of action and interaction. (17)

They explain this in reference to the ways that pragmatist philosophies understand the process of creating knowledge:

> Pragmatism… sees knowledge as participative. According to this view, any knowledge we have is dependent on the technology, circumstances, situations, and actions from which it was constructed. It is knowledge in a community of engaged people, in a situation, from a perspective, felt, and sensed. For pragmatists, therefore, knowing, doing, feeling, and making sense are inseparable. (17)

This very situated notion of knowledge is characteristic of McCarthy & Wright's approach. For example, in Chapter 6 one of the authors recounts buying a case of wine from a website. His description of this transaction – which admittedly, takes place over the course of a few days – takes twelve pages of observation. The description is not a step-by-step listing of the actions taken ("then I clicked on the button marked 'Add to Cart'"), but it's an approach to representing knowledge that takes seriously his frustration with pop-up windows on entering the site (135), his frustration with the inability of the site to work with his Macintosh computer (137-8), the 'slight sleaze' implied by the color scheme (134), and his eventual decision to send the wine to his wife as a gift because of his concerns with what the neighbors might think (141). The authors argue that the pragmatist approach requires taking these emotions seriously because they impact in a very real way what it's like to engage with the technology in question.

Another example of the pragmatist orientation is Reed & Wright's 2006 study of waiting for the bus in York, England (Reed & Wright, 2006). The authors study the experience a bus passenger-to-be has in interacting with a novel technology: the 'passenger information panels' at bus stops that tell the passenger-to-be how long they

have to wait for the next bus. Reed & Wright argue that the panels have an emotional and not just informational impact: they reassure passengers that they are standing in the right place and that the bus will come. The authors consider that emotional impact in the context of other situational cues: the number of other passengers at the bus stop, the time of day, the ability to see the bus coming up the road, and whether the rider is experienced or a novice, in order to discuss the larger implications of modifying information design. Ultimately, these considerations affect whether car drivers become bus passengers, which in turn has implications for the environment, city-center congestion, and public perceptions of bus safety and convenience. The authors consider the differences in information necessary for experienced and novice bus users, and discuss the very real implications of such information design for encouraging car drivers to become bus passengers, in turn influencing issues of the environment, of city-center congestion, and of public perceptions of safety and convenience.

> This is not a 'standard' HCI evaluation of a technology *in-situ*. Rather, the authors look at the way that the technology shapes the 'realization of the bus passenger identity', and emphasize Bahktin's point that there is no innate meaning to a given technology, and thus any definition of meaning is transitory: "we must be happy with moments of transitory 'consummation' of meaning". This is a strong statement of a particular kind of epistemological orientation, and a far cry from a generalist scientific approach that seeks to uncover universal truths. There is not the design orientations' emphasis on communication through built form, but rather a commitment to knowledge gained through experience which is grounded in the real world: for example, there are clear implications from the bus study for public policy as well as for technology design. However, the pragmatist orientation does share with the design orientation a sense that a correct metric for a study is not validity in the scientific sense, but relevance, an emphasis on improving the world. Recall the discussion from Zimmerman et al.… the preferred state their design attempts to achieve and provide support for why the community should consider this state to be preferred. (Zimmerman et al., 2007, p. 499)

There are strong echoes of this in McCarthy & Wright's work:

> Pragmatism is a practical, consequential philosophy, a practice that is concerned with imagining and enriching as much as understanding. The test it sets itself is to improve things. (McCarthy & Wright, 2004b, p. 17)

In addition, this commitment to the emotional side of experience distinguishes the pragmatic account from the ethnomethodological approach I'll discuss next. Pragmatist and ethnomethodological orientations towards HCI share a commitment to detailed representation of the interactions of the user with a technology. However, they differ in their understanding of the role of emotion and feelings: pragmatist orientations treat the emotional components of felt life as an intrinsic part of experience. By contrast, an ethnomethodological approach sees emotions and feelings as relevant to the situation only so far as they influence observable behavior.

5.4.2 The ethnomethodological orientation

The ethnomethodological orientation has been influential in HCI and particularly in its sister field of computer supported collaborative work (CSCW), and examples of it can be found in the work of researchers like Alex Taylor, Richard Harper, Graham Button, Tom Rodden, Andy Crabtree, and Lucy Suchman among others (Button, 2000; Button & Dourish, 1996; Crabtree, 2003, 2004; J. Hughes, King, Rodden, & Andersen, 1994; Taylor & Harper, 2002; Taylor et al., 2007, 2006; Taylor & Swan, 2005; Suchman, 1983, 1995). So what is an ethnomethodological orientation? Ethnomethodology was originally developed by Harold Garfinkel and further developed by Harvey Sacks (Garfinkel, 1986, 1984; Sacks, 1995). Garfinkel was interested in the ways people make sense of the social world around them. The term ethnomethodology comes from *ethnos*, meaning people (as in ethnobotany, ethnomusicology, and the like), *method*, and *ology*, meaning 'the study of'. Ethnomethodology is therefore the study of people's methods (Garfinkel, 1974;

Lynch, 2006b). In particular, it refers to the study of people's methods for making sense of other people around them, and for showing they have done so. Unlike ethnography, a term with which it is sometimes confused in HCI, ethnomethodology is not itself a method; it is perhaps closer to a topic of study with an attendant analytical approach.

The early sociologist Emile Durkheim described the ways in which people make sense of other people around them as "social facts", and stated that they were concrete and objectively real, and proceeded to construct the foundations of the field of sociology upon this principle (Durkheim, 1897). Garfinkel's insight with ethnomethodology is to question that principle, and propose that instead of accepting that people make sense of the people around them, we should study how they do so. Garfinkel has proposed several features of an approach that are necessary for such an endeavor to be successful.

For example, ethnomethodology emphasizes the situated nature of action and the detail of practices through which such actions are accomplished. This is referred to in ethnomethodology as 'indexicality': how a given word or phrase makes sense in a local context. In addition, ethnomethodology emphasizes the importance of 'accountability': how one makes one's actions and interpretations intelligible to others. It encourages studying the 'missing what', the distinctive contents of an activity which distinguishes it from other activities. Other sociological approaches emphasize finding generalizable principles, and so seek to diminish the importance of the distinctive contents of any particular activity in the interests of making it generalizable to other situations. An example of this can be found in a classic ethnography by Howard Becker of jazz musicians (Becker, 1973). He details the ways the musicians work, dress, use language, and differentiate themselves from the 'squares'. However, as Garfinkel points out, there is no discussion of how they

actually go about playing jazz together: the role of improvisation, of technique, of rehearsal and the visual and acoustic cues necessary to perform together (Garfinkel, 1977, in Lynch, 1993). Playing jazz is the 'missing what'. Lynch gives more examples:

> studies of bureaucratic case workers 'miss' how such officials constitute the specifications of a 'case' over the course of a series of interactions with a stream of clients; studies in medical sociology 'miss' how diagnostic categories are constituted during clinical encounters; and studies of the military 'miss' just how stable ranks and lines of communication are articulated in and as interactional work. (Lynch, 1993, p. 271)

To be able to provide this kind of understanding, Garfinkel insisted on the "unique adequacy requirement of methods", meaning that to study a particular domain, one must master the methods being discussed, not just talk about them (Lynch, 1993, p. 274). Accordingly, studying the work of improvisation in jazz requires unique adequacy by becoming a jazz musician (Sudnow, 2001); studying the role of proofs in mathematics requires unique adequacy in mathematics by, for example, becoming a mathematics teacher (Livingston, 1986); studying the ways lawyers make sense of the world requires unique adequacy in law by becoming a lawyer (S. L. Burns, 2005). While there are other aspects of the ethnomethodological program, these will suffice to outline the orientation in comparison to the other orientations we have discussed.

For example, from these starting points we can say that ethnomethodology is a descriptive discipline; its focus (and source of some clashes with technologists attempting to learn from ethnomethodological descriptions) is on describing peoples' practices, not proposing ways to change those practices. It relies heavily on thick textual description of the practical reasoning and actions exhibited by people (or 'members') in the course of their activities together (Sharrock & Anderson, 1991). It also encourages careful interrogation of a recorded and/or transcribed text, as

exemplified by the related discipline of conversation analysis (Garfinkel & Sacks, 1970). The foundations of ethnomethodology are vehemently opposed to the kind of generalization that might be thought of as a normal practice in other epistemological approaches: Garfinkel describes this as the 'shop floor problem' (Garfinkel, 2002), as an instance of the intractable difficulties that arise when attempting to understand and organize work practices in terms of general schemes:

> "[The shop floor problem is] having to do with how generic descriptions of work settings, which attempt to specify the constituents of practice within those settings, confront 'details in structures' or coherences in embodied practices that cannot be anticipated by, and utterly defy, the generic descriptions." (Maynard & Kardash, 2006)

Perhaps the most well-known example of the application of ethnomethodology's principles to HCI can be found in Chapter 7 of Suchman's book *Plans and Situated Actions* in which she examined Xerox employees' use of a new and feature-rich photocopier (1987). To study these interactions with the new machine, and to study interactions with new prototype interfaces developed by her colleagues, Suchman videotaped users interacting with the photocopier for later study. She realized that when users engaged in complicated copying jobs, such as making double-sided copies of single-sided documents, they did not plan out the whole interaction with the machine from start to finish. Rather, they would start out with their best guess of the right action and then would react to the current state of the machine and respond accordingly as it moved through the process – a 'situated action'. This was unexpected: the photocopy machines were built on a model of mental practices that assumed that interactions happened in a methodical and planned manner from start to finish. Suchman's work has been very influential in the field, but the depth of observation and analysis precludes satisfactory discussion here, where the focus is on the epistemological commitments of the approach. Instead, I will

concentrate on a more manageable example: Taylor & Harper's (2002) study of how teenage use of text messaging functions as a gift economy.

Taylor & Harper studied a group of British teenagers at a sixth form college near London for four months. They noticed that the social rituals around texting had analogous features to the gift economies described by Mauss in his study of gift-giving practices in archaic societies. For example, text messages have obligations of reciprocity and embody particular meanings; factors such as the response time before replying and the composition of the method have particular meanings for particular people. At the end of the paper, Taylor & Harper include a design solution that explicitly provides implications for mobile phone design based on their observations. However, unlike the work we'd expect to see from a design orientation, this design solution is only an example and not an explicit embodiment of the knowledge they create in the course of the paper. They write:

> Our aim here will not be to provide one final solution, but rather to show that through a critical analysis of the relationship between technology and our social world, it is possible to articulate a number of design principles relevant to specific contexts of use. (440)

In the conclusion, they're even more explicit about what kinds of knowledge they're attempting to produce in this study:

> The aim of this work is, first, to investigate how technology mediates the deeply rooted social practices that we participate in. It is then to explore how naturalistic descriptions of everyday activities might be systematically interpreted to produce concrete design requirements that can be used to inform design. (446)

Taylor & Harper express the knowledge they have created in the course of this research as being implicit in the descriptions of practices and activities in the text, rather than in any technological solution; indeed, when in some of their later work with other colleagues they study the impact of novel technologies created for the

purpose of the study (e.g. Brown et al., 2007; Sellen et al., 2006), the aim is not to build an improved novel technology, but rather to use the technology as a probe to further and deeper understand the practices and activities of everyday life. This emphasizes the differences between the ways that phenomenological orientations and design orientations see the role of the artifact in knowledge creation.

5.4.3 Comparing ethnomethodological and pragmatist orientations

Where ethnomethodological approaches fundamentally differ from their pragmatist cousins in the phenomenological family is in their treatment of emotion. McCarthy & Wright foreground the role of feelings and emotions in their concept of felt life. (McCarthy & Wright, 2004b) They respond to practice-based approaches, drawing from ethnomethodology as detailed above, that emphasized the 'livedness' of interaction with technologies. For example, the first of their six propositions for understanding technology as an experience argues for interpreting "the relationship between people and technology in terms of the felt life and the felt or emotional quality of action and interaction" (12). They write:

> ... in order to understand the relationship between the friends texting each other across the world and their mobiles, or between the nurse and the hospital information system, we must understand what the experiences of texting and using the information system feel like for those people. We must understand the emotional response and the sensual quality of the interaction.
>
> Because the word 'experience' already expresses the *feltness* of life for us, when we write about experience of technology we have this felt quality very much in mind. **We have become used to interpretations that emphasize the *livedness* of experience in HCI, especially with the significant contribution of practice and activity theories since the 1980s. In this book, we prioritize feltness to emphasize the personal and particular character of experience with technology.** For us, *felt* experience points to the emotional and sensual quality of experience. (13) (Italics in original; my bold)

McCarthy & Wright continue this theme of writing in counterpoint to practice-based approaches such as ethnomethodogy that emphasize 'what people do' over 'what people think' or 'what people feel' in their second proposition:

> *Our second proposition is that social-practice accounts of interactive technologies at work, at home, in education, and in leisure understate the felt life in their accounts of experience.*
>
> Suchman, Lave, Susan Leigh Star, and others have convinced us that cognitive models of action are not the most appropriate models of human action for human-computer interaction. Instead of looking for an account of coherence of action in psychological processes in the head, they have convinced us to look to the particular social and physical circumstances of action and interaction for interpretations that are more relevant to understanding, designing and evaluating interaction …
>
> Our aim is not to put ourselves in some fruitless competition with practice-based approaches. Rather, we would like to build on what those approaches have already contributed to HCI by giving a more prominent position to feltness in an account of people's experience with technology than they do. In this regard, we part company with practice-based approaches and theories when they play down the emotional and sensual quality of experience. (14)

It is in this last sentence that McCarthy & Wright make clear their differences with the ethnomethodological orientation discussed above. They continue:

> Likewise, theoretical commitment to the primacy of circumstances and methodological commitment to *in situ* observation seem to constrain the treatment of individual differences in situated-practice accounts. We argue that this simplifies the concepts of self, person, and subject that are crucial to the reflexivity of felt experience. It may be that in order to interpret felt experience we have to inquire from the subject what the activity felt like as felt experience entails reflection, after the event, on the personal meaning of experience. (14-15)

McCarthy & Wright are reacting to the "turn to practice" in HCI, which eschews making conjectures about the mental states of participants in lieu of an emphasis on their externally visible practices.

> By comparison, ethnomethodology emphasizes descriptions of the actions: any descriptions of internal mental processes are only valid fodder for ethnomethodological description if they manifests themselves in observable behavior. Ethnomethodologists are fond of quoting Garfinkel's opinion on hypothesizing about mental processes: "... there is no reason to look under the skull since nothing of interest is to be found there but brains" (Garfinkel, 1963, p. 190).

This debate is particularly interesting to consider in the context of epistemological orientations. Other aspects of these two epistemological orientations are compatible: both produce written texts, both eschew scientific approaches to generalization, and both place import on thick descriptions of peoples' practices and their situations as part of the generation and communication of knowledge. However, they differ on this fundamental point about the role and representation of feelings, and it's a sufficiently important point that those whose practices are determined by these two orientations feel that a difference is made. In Chapter Three, I discussed the importance of the indifference of comparative epistemology: reading different groups' epistemologies without imparting one's own interpretations of their truth values. Both of these orientations share a basis in phenomenological approaches, and I can accurately class them next to each other due to this shared history. But the indifference required of relativist epistemology requires treating these approaches as distinct because their proponents consider them to be distinct, and because the approaches explicitly differ in criteria of quality. In the next section, I will discuss another epistemological orientation that draws from a phenomenological basis: the reflective orientation.

5.4.4 The reflective orientation

The final orientation I propose as a category is the reflective orientation, as described in the paper *Reflective Design* (Sengers et al., 2005), and exemplified by the work of Boehner, Sengers and, frequently, myself (Boehner et al., 2005; Sengers et

al., 2004; Sengers et al., 2006). In this orientation, a successful kind of knowledge is generated when it actively engages the reader – as well as, where appropriate, the user, the designer and the author – in reflection, particularly on the nature of the interaction between people and technology (Dourish, Finlay, Sengers, & Wright, 2004). Thus:

> … we argue that critical reflection itself, can and should be a core principle of technology design for identifying blind spots and opening new design spaces ... We argue that ongoing reflection by both users and designers is a crucial element of a socially responsible technology design practice. (Sengers et al., 2005)

This orientation draws from the phenomenological foundation detailed above but differs from them in this metric of success. For example, we describe a series of projects for encouraging reflection about the process of engaging with art in a museum (Boehner, Sengers, & Gay, 2005; Boehner et al., 2005). Museum guides are quite common projects in HCI (Just as a sample: Albertini, Brunelli, Stock, & Zancanaro, 2005; Benta, 2005; B. Brown et al., 2003; Chou, W. Hsieh, Gandon, & Sadeh, 2005; Damala & Kockelkorn, 2006; Ghiani, Leporini, & Paternò, 2008; Goren-Bar, Graziola, Pianesi, & Zancanaro, 2006; Kuno et al., 2007; S. Reeves, Benford, O'Malley, & Fraser, 2005; Wakkary & Hatala, 2007; Williams, 1987). However, they generally provide ways to augment the passive viewing of art by providing more contextual information, like an extended version of the cards found next to artworks describing the piece. Instead, the guides built by Boehner et al. aim to encourage visitors to engage with their own impressions of the piece, and to encourage conversation across visitors. This kind of involvement was explicitly stated as the aim of the technology, rather than perhaps more conventional approaches that might instead seek to measure the number of times that the technology was used as a metric of success.

A similar approach is taken in the paper *Making by Making Strange* (G. Bell, Blythe, & Sengers, 2005) in which the authors encourage defamiliarization as a strategy to encourage reflection on "politics and culture of home life … to develop new alternatives for design." Espousing the value of reflection also has implications for other aspects of this epistemological orientation: for example, it embraces the artifact as a form of knowledge precisely because of its ability to induce reflection, much as the design orientation. The particular kind of reflection the authors wish to see induced is a type of critical reflection, which they describe at some length:

> …bringing unconscious aspects of experience to conscious awareness, thereby making them available for conscious choice. This critical reflection is crucial to both individual freedom and our quality of life in society as a whole, since without it, we unthinkingly adopt attitudes, practices, values, and identities we might not consciously espouse. Additionally, reflection is not a purely cognitive activity, but is folded into all our ways of seeing and experiencing the world. Unconsciously held assumptions are not things we rationally know; they are part of our very identity and the ways we experience the world. Similarly, critical reflection does not just provide new facts; it opens opportunities to experience the world and oneself in a fundamentally different way. Even in mundane activities such as shaving one's legs, shopping for meat products, or navigating busy urban streets, critical awareness of feminism, factory farming, or racial issues alters our perception and interpretation of what is going on around us and the implications of our actions. (Bell et al., 2005, p. 50)

So what are the implications of advocating this kind of reflection for epistemological orientation? The reflective orientation has as a criteria for success producing a particular kind of change in the user; a different kind of felt life. Producing such change in feelings is not itself unique to reflective design; it is common for many designed artifacts to induce some kind of change. Rather, reflective design seeks to induce a particular kind of change in feelings: the critical reflection discussed above.

This is a different kind of knowledge – a verb instead of a noun, if you will – which frequently co-exists with other epistemological orientations and yet is distinct

enough to merit observation. It is not the case that such a metric is absent from the other orientations above: design practice, in particular, values reflection as a metric of quality. However, it is seen as one element among many. The reflective orientation makes an explicit statement about the values and outcomes of research being emphasized and embraced.

5.5 From Practices and Orientations to Case Studies

In the last two chapters, I have made two structural points. The first was to convince the reader that experience-focused HCI is a coherent field by discussing four practices: inspiring systems, building systems, evaluating systems, and theorizing. These four practices in experience-focused HCI are marked by a commitment to open-ended research, in contrast to the closing-down of possibilities inherent in task-focused approaches.

The second was to convince the reader that different researchers in this reasonably coherent field have different interpretations of the best ways to generate valid knowledge. To do this, I started by introducing the notion of epistemological incompatibility with the reductionist UX approach. I then introduced four epistemological orientations that I believe are compatible with an open-ended experience-focused approach to HCI: the design orientation, the pragmatist, the ethnomethodological and the reflective. We saw how these different orientations had different attitudes to forms of knowledge considered valid research – such as the role of thick description or of artifacts. Different orientations also have different assumptions about the role of generalization in creating knowledge. We also saw how different orientations value different marks of quality, such as the number of participants in laboratory studies or an explicit design process in design.

The experience-focused HCI orientations we see here place value on situated ways of knowing that create knowledge in context, instead of valuing abstract generalizations. The difficulty in doing experience-focused HCI comes precisely from the problem of trying to understand what aspects of the context of technology can and need to be characterized appropriately to allow a useful representation of technology use. For example, the great advantage of laboratory studies is that they allow the *a priori* selection of what constitutes context and what constitutes data; the great advantage of situated studies in experience-focused HCI is that the separation of context and data can be done *post hoc*.

My own take on the four experiential epistemological orientations presented in this chapter is that they all serve to address ways of knowing about experiences in valid ways. Each can add to what we might call a unified epistemology of experience-focused HCI. For example, we can draw from the design epistemology the importance of representing knowledge in ways other than the written word, incorporating aspects of aesthetics and the role of the body in knowing. The phenomenological traditions share an emphasis on thick descriptions and the written word, and a notion of ecological validity that emphasizes *in situ* observation over laboratory precision. From ethnomethodology, I draw an emphasis on understanding deeply rooted social practices and the role of careful observation. From the pragmatic approaches, I draw an emphasis on feelings and emotions. Finally, from reflective design I draw a recognition of the multiple levels and frames on which technology is experienced, while recognizing that not all objects or systems can be reflective. This bricolage of approaches is a sketch of an ideal; it's not clear that any given representation of an experience with a technology will necessarily include all of the above. But it serves as a way to emphasize the role that epistemological questions can play in understanding and encapsulating a given idea.

We now have a strong understanding of the emergent category that is experience-focused HCI, and the epistemological considerations that come in conjunction with that approach. This has been a primarily analytical and synthetic endeavor, based on close readings of others' work in the field. We have seen certain similarities in these works that are beginning to coalesce into a coherent approach. For example, there's a recurrent emphasis on open-ended approaches to studying and building interactions with technology; this is at least in part due to an appreciation of experience that emphasizes how experience is created in interaction between humans and technologies, not existing *a priori*. Similarly, we realized that representations of experience are inherently incomplete but not necessarily flawed because of that fact.

In the next two chapters, I will move from a primarily theoretical discussion of abstract understandings of knowledge to two case studies of my own work evaluating technologies within an experience-focused framework: the virtual intimate object or VIO, a technology for couples in long distance relationships to communicate intimacy, and the Ambient Ink Display, a system for serendipitous display of notes. In each case, I discuss how the practices and approaches that have been presented so far manifest in practice, and how these case studies serve to work through methods for understanding and evaluating experience-focused HCI.

CHAPTER 6: THE VIRTUAL INTIMATE OBJECT

6.1 Introduction

In the previous chapters I have introduced several concepts: evaluation, epistemology, practices of experience-focused HCI and epistemological orientations of experience-focused HCI. In this section, I will integrate these concepts in an evaluation of an experience-focused HCI research project. Rather than attempt to present all of the projects I have worked on in the course of this research (including B. A. T. Brown et al., 2007; L. Brown & Kaye, 2007; Gaver et al., 2007; Kaye, 2004; Sengers et al., 2005; Sengers et al., 2004), I have chosen instead to concentrate on two projects as case studies. In this chapter, I discuss the first project: the Virtual Intimate Object (VIO), a device for couples in long distance relationships to communicate intimacy (Kaye, 2006; Kaye, Levitt, Nevins, Golden, & Schmidt, 2005). In the next chapter, I'll discuss an evaluation of the Ambient Ink Display, a system built at Microsoft Research in Cambridge, which randomly displays handwritten notes (Gaw, Kaye, & Wood, 2007).

In this chapter, I will emphasize two different kinds of knowledge. The first is the methods that my co-authors and I used to generate knowledge; the second is the results of using these methods in detail. My aim in this kind of detailed reportage is not to unnecessarily burden the reader with information about the project. One important metric of an evaluation method in experience-focused HCI must by definition be the extent to which the method characterizes users' experiences. I take a phenomenological epistemological orientation in this work, most akin to the pragmatist orientation I identify in the last chapter. As such, I am interested in using these methods to characterize aspects of participants' felt life: understanding the practices of their use of the technologies in question along with their emotional

responses to the technologies. I therefore include this detail as a form of validation, demonstrating the utility of these methods in characterizing experiences.

This idea of validation is at the heart of evaluation in HCI. However, this occurs at multiple levels. At the simplest level, one is showing there is value in the technology itself, and it is on this level that evaluation in HCI is usually made explicit. However, there are other validations at stake. For example, as mentioned in the discussion of evaluation in Chapter Four, there is also a validation of both the topic of study and the methods chosen to approach the topic. We will see these multiple roles of validation throughout this chapter.

6.2 The Virtual Intimate Object (VIO)

The Virtual Intimate Object project started as an attempt to study the implications of Hiroshi Ishii's work in tangible computing (Ishii & Ullmer, 1997). Tangible computing proposes interaction with information technologies by moving and manipulating physical objects, taking advantage of our highly developed motor skills, proprioception and peripheral awareness.

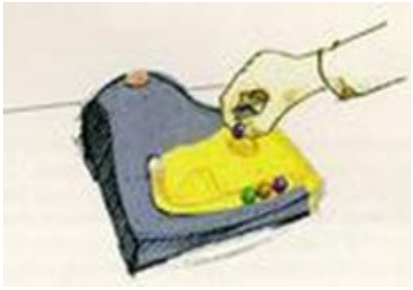

Figure 7: Marble Answering Machine. From (Crampton Smith 1995).

A classic example of tangible computing is Durrell Bishop's *Marble Answering Machine* (Crampton Smith, 1995). When a caller leaves a message, a colored marble is dropped into a tray at the front of the machine. Placing that marble

in one location plays the message; placing it in a second location returns the call. Placing it back into the machine deletes the message.

While tangible computing has been and continues to be a prolific line of research, evaluation of tangible computing compared to more conventional interaction paradigms has been limited. In particular, Ishii's experiments to determine the value of tangible computing emphasized task-centered metrics such as 'location recall' (Patten & Ishii, 2000). However, I believed that the real value of tangible computing was in its experiential aspects, such as the sense of enchantment felt by its users (McCarthy et al., 2006).

In the course of my Master's thesis work on computerized scent output, I had prototyped a device called *Honey I'm Home*, with which one member of a couple could cause a chocolate-hazelnut scent to waft across the desk of their partner (Kaye, 2004, 2001). While simple, this form of interaction was surprisingly compelling: there was something enchanting about the gentle nature of the interaction. I believed a good way to study themes of enchantment in HCI might be to study devices designed for couples to communicate intimacy, as I felt this aim would emphasize themes of enchantment and connectedness over tasks. In particular, I thought that couples in long distance relationships might particularly benefit from such technologies, as their interactions while living apart were already mediated through a variety of communication technologies.

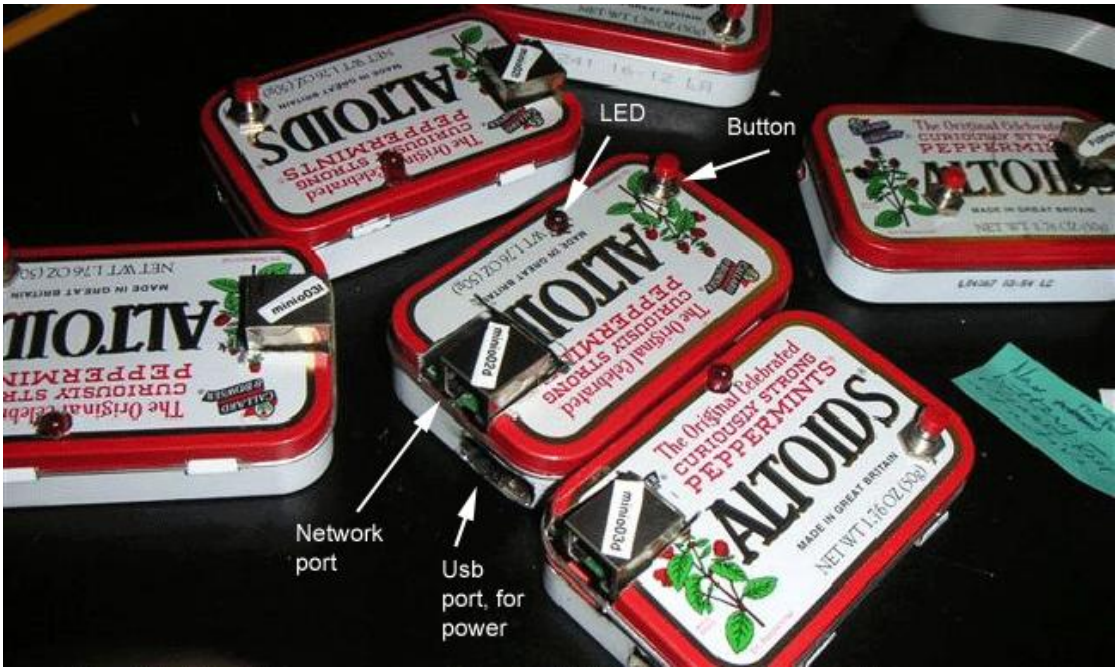

Figure 8: Physical intimate objects (PIOs).

The initial Intimate Objects designs built off previous exploratory work interviewing couples in long distance relationships that I had done with my colleague Liz Goulding, which suggested that a device that just communicated "I'm thinking of you" might be valued in long distance relationships (Kaye & Goulding, 2004). My team members[5] and I initially developed two devices for couples in long distance relationships to communicate intimacy: the Physical Intimate Object (PIO) and the Virtual Intimate Object (VIO). The PIO were produced in pairs and used a single-board Rabbit computer in a modified Altoids tin (Figure 8). PIOs have one large and one small light-emitting diode (LED) and a button. When the button was pressed on

[5] This study started as a class project in the INFO.640 *Advanced HCI* class, taught by Jeffrey Hancock and Kirsten Boehner. Much of the initial work was done in conjunction with my fellow team members in the class: Mariah Levitt, Jeff Nevins, Jessica Golden, and Vanessa Schmidt. This is the group referred to as 'we' in these pages. We wrote the surveys, modified Altoid boxes and recruited and managed subjects together. I wrote the server-side software and the PIO firmware and designed the support circuitry and hardware; Jeff wrote V1.0 of the VIO, and a team consisting of Richard Calvi, Vishal Desai, Matt Feusner, Wei Guo, Aakash Jain, Shantanu Shah, and William Yip wrote v1.1 and v2.0 of the client. Tom Jenkins designed the website.

one PIO, the large LED would brighten on the other PIO, which would then fade over time. At the same time, the small LED on the first PIO would brighten, as feedback to show you that your button press had been recorded. The PIOs in the figure are labeled in pairs, as they only communicate with the other half of their pair: "minio3d" (standing for "distant") in the foreground is paired with "minio3l" ("local") on the left.

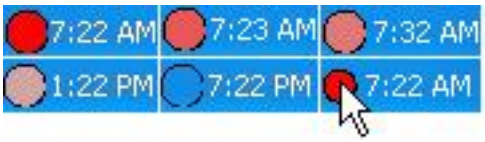

Figure 9. The Virtual Intimate Object

The Virtual Intimate Object (VIO) works in a similar manner (Figure 9). It appears as a circle in your Windows taskbar, or in your Macintosh Dock. During installation, users configure the system by entering their and their partner's names and a shared passphrase. Once set up, clicking on the circle makes your partner's circle turn bright red, which then fades over time, as shown in the first five images in the figure. Hovering your mouse over your circle reveals a smaller circle, the same color as your remote partner's circle, as shown in the bottom right image. Again, this provides a means of feedback that your button press has been recorded.

Our initial hypothesis was that the VIO would be used more frequently than the PIO, but the excitement and satisfaction of the users with the system would be greater with the PIO. That is to say, we expected people to click the circle, which was located on the screen that they used for much of the day, more often than the physical button, which would be located some distance away from the place they spent their time. (The PIO did require a connection to a computer through a network cable for connectivity and a USB cable for power, so it was less removed from the computer than we would have wished.) However, we felt that the physical and unique nature of

the Altoids box would give the user a sense of enchantment missing from the simple circle on the screen.

The technology behind both the VIO and the PIO was identical. I wrote a program that ran on a web server. When a user clicked their circle or pressed their button, a web request would be sent to the program with their name and the name of their intended recipient. The server would then store a timestamped message for the recipient. To see if the remote partner had clicked, the VIO or PIO would check in with the server every ten seconds to see what timestamp was on the file.

With this system in place, we were able to tell various facts about VIO use directly by looking at the server logs. We knew when our subjects were running their intimate objects, since we received an HTTP request every ten seconds including the name of the user and the name of their partner. We knew when they clicked the VIO, and we could tell whether the system at the other end was running or not (something that users themselves did not know.) What, of course, we could not tell was if someone at either end was actually at their computer, or actually noticing the changes in their VIO – until, of course, they actually clicked.

In internal testing, both the PIO and the VIO worked well. Unfortunately, the DHCP stack – the system by which the computer connected to a network – in the Rabbit embedded computer that we used to build the PIOs worked badly once we took the systems out of the lab. About half of our ten PIOs worked unreliably in the 'real world', meaning that we were only able to gather usable data from one or two couples. However, the VIO turned out to work reliably for all of our users, and has been the focus of my attention in these studies of evaluation.

6.3 Intimacy in HCI

This study contributes to a set of work around the theme of intimacy in HCI. There has been extensive research on building novel technologies in this domain. These are generally single, one-off projects where the emphasis is on the novelty of the design, although there are some exceptions. In particular, these projects were rarely evaluated in any convincing way, although many were compelling designs. I previously mentioned *Feather, Scent & Shaker*, a set of three designs for remote partners to communicate intimacy (Strong & Gaver, 1996). Others have designed ways to communicate intimacy from the bed (Dodge, 1997), within the family through routine ritual interactions (Hoog, Keller, & Stappers, 2004), through linked drinking vessels (Chung, Lee, & Selker, 2006), through shared décor (Tsujita, Tsukada, & Siio, 2008), through shared interaction with family history (Petersen, 2007), through shared sporting activities (Mueller, Cole, O'Brien, & Walmink, 2006a, 2006b; O'Brien & Mueller, 2007) and, notably, through communication of touch (Brave & Dahley, 1997; O'Brien & Mueller, 2006; Yohanan, Chan, Hopkins, Sun, & MacLean, 2005). A exception to the one-off nature of work on intimacy in HCI is the paper "Mediating intimacy: designing technologies to support strong-tie relationships" in which the authors designed a cultural probe and a 15 week series of interviews, focus groups and workshops to study the intimate relationships of six cohabitating couples (Vetere et al., 2005). Intimacy was also the topic of a one-day workshop at Ubicomp'03 about the design of ubiquitous intimate technologies (Bell, et al., 2003). Intimacy is also a common use of communication technologies designed for other purposes: for example, there's increasing amounts of scholarly work on the role of instant and text messaging in maintaining intimacy among teens (Grinter & Palen, 2002; Ito et al., 2006; Eldridge & Grinter, 2001; Grinter & Eldridge, 2001; Grinter & Eldridge, 2003;

Grinter & Palen, 2003; Grinter, Palen, & Eldridge, 2006; Berg, Taylor, & Harper, 2003; Taylor & Harper, 2002).

While this body of work is extensive, there are a few caveats to it. First, there is no agreed-upon definition of intimacy. That is in many ways not surprising; even in those studying intimacy directly rather than building technologies to support it have difficulty defining the term. For example, in their paper *Defining Intimacy in Romantic Relationships* in the journal *Family Relations*, the authors:

> conducted an extensive, computer-assisted search of scholarly publications and books for definitions of intimacy, and, through this process, found 61 definitions (Moss & Schwebel, 1993, p. 32).

With the aid of three judges with Ph.Ds in health and social sciences, they amalgamate seven themes found in these various definitions into a single definition:

> Intimacy in enduring romantic relationships is determined by the level of commitment and positive affective, cognitive and physical closeness one experiences with a partner in a reciprocal (although not necessarily symmetrical) relationships. (33)

Although seemingly wide-ranging, this definition excludes some of the uses of the term intimacy in HCI. For example, the Gustbowl is designed for communication within families, between mothers and sons (Hoog et al., 2004); similarly, the video communication devices deployed in the technology probes study were designed for intimate communication between different parts of families (Hutchinson et al., 2003)

A more important point is that such a approach assumes that there is an *a priori* definition of intimacy applicable across relationships. As we will see, we chose instead to treat intimacy as an emergent characteristic of particular relationships, rather than assuming one definition for all of our couples. However, questions of precise definitions aside, there is a second problem with the above array of work on intimacy in HCI as it applies to this thesis. Namely, there is no agreed-upon way to

evaluate technologies designed for intimacy. Indeed, this very fact has been a motivation for much of this work, as it requires careful thinking about the right way to evaluate when there is no stable definition of what is being evaluated. For this reason, in the next sections, I go into detail about how we chose to evaluate the Intimate Objects.

6.4 Evaluating the VIO

Having developed two technological systems for communicating intimacy in long distance relationships, the PIO and the VIO, the question then became how best to evaluate them. I felt it was important to study this system in use by real users in long distance relationships, rather than trying to replicate the situation under laboratory conditions. We wanted to build a technology that would be used in a casual, ambient manner in the course of everyday life. Phenomenological orientations emphasize the importance of situated practices: the context of technology use has a significant impact on the practices of its use. As such, ecological validity, "the extent to which a study comprises 'real world' use of a system" (Carter, et al., 2008), was extremely important, and approaches like a lab study or controlled experiment would not have been appropriate within the epistemological orientation we were using.

We recruited a total of ten couples in long distance relationships from the personal networks of our team. In each instance, one member of the couple was at Cornell and the other lived between 120 and 3500 miles away. All were between 18 and 30 years of age. We divided them into five couples who would be using the VIO and five who would be using the PIO. (This was not entirely at random, as the PIO required that the users had access to a router to plug in their PIO, which constrained our selection somewhat.) We then mailed or hand-delivered to each subject packages that contained our survey, pre-stamped return envelopes, and, where appropriate, a

PIO with appropriate cables. (We emailed one remote participant using the VIO the survey and a link to the software. She filled out her survey on computer and emailed it back to us, as she was living in Japan and we wanted to avoid postal delays.)

The combined results of our five couples' responses gave a rich understanding of our users' experiences using their intimate objects, and I present those results here in detail. I believe this level of detail gives an opportunity to understand the experience of using the VIO and the evaluation methods, and demonstrates how my colleagues and I were able to reach some of our insights about our users' experiences and choices we made in the design of the next version of the VIO. I have found that presenting aggregate data in this manner can make the responses seem anecdotal, and does not give a full representation of any given couple's experience. To address that problem, I will also include a fuller description of one couple's results.

When we conducted the study in the fall of 2004, Yumi and Sergio[6] had been in a relationship for two and a half years. Yumi was a translator living and working in Japan, while Sergio was spending a year in Ithaca as a graduate student at Cornell, although he had been living in Italy. They primarily communicate with each other in Italian. Both were in their mid-to-late twenties, and they lived apart about 85% of the year. They were the most enthusiastic users of the VIO, once clicking a total of over 700 times in a single day. Yumi & Sergio's story is not intended as typical of a couple using the VIO. There were definitely users who significantly disliked the VIO, whose comments I will present as part of the upcoming narrative. My intent is not to present a uniformly rosy picture of the VIO by highlighting the experience of one couple; rather, the example of Yumi & Sergio provides a powerful example of the role this simple technology can play in an already rich and complex relationship.

[6] Pseudonyms.

Evaluating the VIO was a multi-step process. The primary means of evaluation was a series of logbooks or questionnaires filled out by the users. These questionnaires were divided into three parts:

1. The pre-study questionnaire
2. The daily logbooks
3. The post-study questionnaire.

In addition, I also evaluated the technology in three other ways:

4. Analysis of the server logs
5. A 90-minute face-to-face interview with Yumi & Sergio
6. My own use of the VIO with my partner

I will now explain each step in turn.

6.4.1 Evaluation: Pre-Study Questionnaire

We started our study by having users fill out a pre-study questionnaire. This asked for some basic demographic information, and asked a few questions establishing the nature of the relationship: the amount of time couples spent together, and their reasons for being separated. We also asked our subjects what media they currently used to communicate with each other: all subjects reported they regularly used telephone, instant messaging and email. Yumi and Sergio also reported they used Yahoo Messenger with a webcam and a headset as a low-cost and simple way to chat when they were both at home. On average, couples rated the level of intimacy in their communication 6.1 on a 7-point scale: Yumi and Sergio both rated this 6. On average, couples rated current methods of communication 5.3 effective in maintaining intimacy; Yumi and Sergio also both rated this 6.

All users reported that voice was their favorite means of communication, whether mediated through land lines, cell phone, or, like Yumi and Sergio, through the voice feature of instant messaging. Subjects explained that they felt that phone conversations were more emotionally revealing than other media: "I can convey emotion over the phone",[7] or "I can actually hear her voice and convey more emotion than thru. the other methods", "subtleties of tone are impossible to convey over IM or email".

As we have seen, defining intimacy is difficult, even for those who make it the focus of their research (Moss & Schwebel, 1993). Therefore, as part of our initial enquiries, we asked users to define intimacy in their own words. Their replies seemed careful and considered, and reflected the different emphases users had in their understanding of intimacy: some emphasized physical factors, others emotional. One user wrote, "I suppose intimacy is based on mutual sharing and trust. It's a trust unique to the relationship, and those two people alone can understand it. It's also understanding each other, and accepting what you don't without judging them (too much)," and another saw it as "The bond people share: personally, emotionally, and physically and having a knowledge and respect for a partner and as a couple". Sergio described his understanding of intimacy as being "Intimacy is the chance to speak about our deepest enthusiasm and frustration, without fear. Also it shows how we feel to reveal our sentiments towards each other", while Yumi wrote "Well, for me intimacy is spend time together, talking and exchange ideas, laugh."

The last question in the pre-study questionnaire asked users what they missed most about their partner. Two subjects wrote cuddling, and snuggling. Another pointed out "I miss all the sensory aspects, like the way he smells, the way it feels to

[7] This and all quotes are quoted verbatim from the subjects' responses and are not edited for spelling or grammar.

snuggle, all the mushy stuff. I miss it more when we're talking than when I'm completely alone." Yumi felt "I miss to have a REAL date with him. Go out together, have a dinner and so on." while Sergio missed "Every physical contact."

The pre-study questionnaire gave us an initial entry into the worlds of our subjects. It also was the first sign of one the problems we were to wrestle with throughout the evaluation as a team. My own inclination was towards a phenomenological approach: the kind of characterization of experience that relied on rich descriptions and attention to detail. My colleague Levitt felt that an analytic approach would be more fruitful, and advocated including questions on the surveys like "How intimate is your communication on a scale of 1 to 7"? While this tension was frustrating at the time, I believe it ultimately was a net gain to the research, in that we both were forced to reflect on our own default approaches to knowing, and meant we were able to experiment with a variety of approaches to representing the experience of using the VIO.

6.4.2 The daily logbook

A primary tool for our evaluation was a survey or logbook that we asked users to fill out once a day. (A sample logbook and associated survey instruments is included as an Appendix.) Each day, the users first answered nine questions that were the same throughout the week. First, we asked them how many times they thought they had clicked their own VIO and how many times they thought their partner had clicked their VIO. Then they answered a series of questions on a scale of 1 to 7: three questions about their VIO use and two questions about the state of the relationship. Finally, we asked them to explain two of their answers to these questions. Then we asked them an additional two or three open ended questions.

I have categorized all of these questions and responses here into three categories: reflections on the technology, reflections on the relationship and reflections on the study itself. We deliberate interspersed these questions with each other, and this structure was not explicit in the selection or layout of the logbook itself, but the categories do provide a way to understand the results in aggregate.

6.4.2.1 Logbook: Reflection on the technology

My teammate Levitt developed a series of numerical questions that we would ask users each day with the intent of tracking changes in these numbers over the course of the week. Each day, we asked our users for their responses to three questions on a scale of 1 to 7 about the intimate object itself:

- What is your overall attitude towards VIO today?
- What is your overall interest level in VIO today?
- How comfortable do you feel with VIO today?

There was absolutely no noticeable trend in these values over the course of the study. The aggregate average answer to all three questions in our whole study was 4.3; Yumi and Sergio's ratings were higher, averaging out at 5.8 across the week. Sergio's ratings of the intimate object were consistently high; Yumi's rose from initial fours and threes to sevens across the board as she became more familiar with the technology.

Perhaps more revealingly, we also asked couples to explain their responses to one of the above questions each day, an approach which I thought might be useful to unpack our couples' numerical responses in more depth. Sergio was comfortable with the VIO from the very beginning: on his first day, he wrote "After using it a few times, I liked the simpleness of VIO. A very easy and fast way to say 'I'm thinking of you now.'" Yumi found the new technology more difficult to get used to: on the first day,

she wrote “I feel very strange with VIO installed in my computer. To see this red circle become more red or pink … I think I need more time to get use to it. I feel a little bit excited for this new thing.” By midweek, the VIO had been integrated into their communication routines: Yumi wrote, “At the beginning I feel a little bit uncomfortable with VIO. A new thing to experiment, I was a little bit ‘afraid’ about a thing I don’t really know. Now I feel really comfortable, and I have fun to use VIO.”

Yumi also pointed out something many of our subjects observed: the private nature of VIO communication. “It is strange but from when we start to use VIO, we really enjoy our time. […] Is something we can share only me and him. No one can see it or understand what it is this red circle. Is like a secret code. Often VIO for us is like a game.” We had noted a desire for this private type of communication both in our own and in others’ work on intimacy in HCI (Kaye & Goulding, 2004; Vetere et al., 2005), and other studies of secrecy outside of HCI have suggested that shared secrecy can increase feelings of intimacy and friendship (Merten, 1999).

6.4.2.2 Logbook: Improving the VIO

We asked users what one thing they would change about their VIO. Many of these comments were about the rapid timing hard-coded into the VIO: it faded four levels of red in the first five minutes after a click, and users felt this was too fast. Sergio agreed with this: “I would like to make more evident the difference between colors fading and I would like something more to define the "reddest color" (for ex: a yellow circle)”. Yumi was dissatisfied with the VIO being stuck in the taskbar: she wrote, “Well I can see Vio only on the bar down, so I have to see it looking down .It would be nice if vio will be something you can move around your desktop and put it where you prefer to be.” Only one user suggested a mobile version: he said he would change “the fact that I can only use it when I'm on my computer cuz if I'm home and

want to use it I have to turn it on and if I'm out I have to keep track that I want to click it."

We also asked subjects what was the worst intimate object they could think of. We felt that this would expand the field of possibilities that they would consider in thinking about what an intimate object might be. One user proposed "Something that is constantly with you - a button on your cell phone or other device that could be pushed and this signal transmitted to your partner at any time," while their partner wrote, "something you'd have to carry around that was large, cumbersome, and gaudy so it called others attention". It is interesting to contrast these answers to the mobile version of VIO suggested by another user above. Others played with the category of intimate object, answering "a spiky wet fish", "those Japanese man-pillows", and "a table." Yumi did not answer this question, but Sergio described "One which doesn't stimulate imagination, that doesn't help you thinking that you're closer." We were interested to see this response that emphasized the importance of reflection, which we had not stated explicitly in the logbook at any point.

We asked the users what sound they felt their VIO should make, were it to make a sound. One user wanted to hear her partner's voice saying "Hi", while he wanted to hear "A cutesy one like a female sigh or a fluttering heart beat or a simple

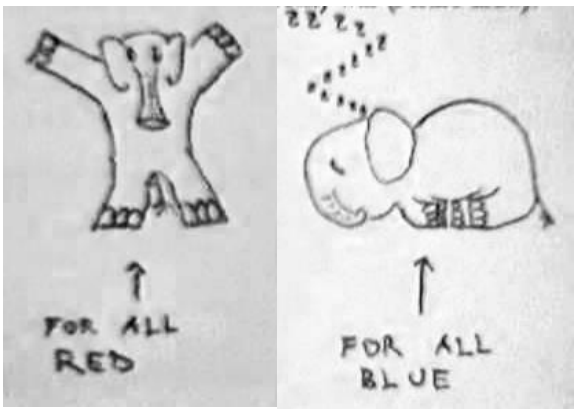

Figure 10. Sergio's proposed Intimate Object.

ever so friendly beep to let me know I clicked it." One couple both picked "a moo", although we do not know whether this answer was a topic of explicit discussion or a trope familiar to their relationship. One user wanted no sound at all, and another wanted a "kiss noise". Sergio requested "a soft whistle", while Yumi wanted "a short song I could pick myself." This diversity of results was significant in our decision to make it simple for users to specify the sound of their choice to accompany incoming clicks in VIO 2.0.

We asked users to draw what they wished their intimate object really looked like. Yumi, who was our only subject filling out her diary on a computer screen rather than on paper, wrote "A small heart."; Sergio suggested alternate visualizations of the duration since the partner's last click in the form of a continuum between fully alert and sleeping elephants in a diagram subtitled "My Favorite Animal" (Figure 10). This encouraged us to allow users to specify their own icons for each step of the change in VIO 2.0.

6.4.2.3 Logbook: Understanding VIO Use

We felt that the situated practices of VIO use – the circumstances and situations within which it was used – were important for understanding how the VIO fit into our users' lives. For about half our users, this was tightly tied to their computer use: both members of one couple noted they only used it when they were already at the computer, although one of them also added that it was a response to when the VIO looked washed out, rather than an explicit desire to communicate intimacy to their partner. However, for other users, their use of the VIO was premeditated: one subject wrote "… I try to keep track of the number of times she crosses my mind when I'm away + click it when I'm in …". Yumi was enthusiastic about the circumstances surrounding her VIO use: she wrote "Look down and see my

Vio and Vio partner pink near white. So I click on it and make RED! It makes me feel better and happy." Sergio wrote, "Anytime I was at the computer, because I wanted her to find it as red as it was possible, when she would have awaken."

We also asked users to name their and their partner's VIOs. One user named both VIOs "George"; another named their VIO "Bethie's Love" and their partner's "Dave's Love". Other names included "Runner" and "Flipper", "Elliot" and "Maude", and "Zit" and "Jacques". Sergio described his VIO as "The Mouse", and Yumi's as "Little Dumbo", no doubt inspired by his fondness for elephants. Yumi called hers "Topino" ('little mouse') and Sergio's "Pirilla" (a name she "made up".) Again, these were of limited utility in understanding users' experience, but did encourage our users to think of the VIO not just in terms of a communication task but as some form of presence.

6.4.2.4 Logbook: Enriching Quantitative Evaluations

We also used variations on more traditional quantitative techniques to characterize our users' experience with the technology. Returning to our original intent of studying enchantment, we asked users to rate how enchanting, intimate and embarrassing they felt the VIO was on a 7-point scale, from Absolutely Not to Absolutely. We found there was wide variation between subjects: on average, they found their VIO to be less enchanting than we might have hoped (an average of 3.7, with a standard deviation of 1.9). Some found it embarrassing, while others didn't at all (3.2, st. dev. 2.2), and couples found it only moderately intimate (4.2, st. dev. 1.6). Sergio found the VIO to be absolutely enchanting and absolutely intimate; Yumi rated it 5 and 6 respectively. Neither found it at all embarrassing.

We also gave users the opportunity to pick two of their own metrics and rate the VIO on that scale, from Absolutely Not (1) to Absolutely (7). Yumi rated the VIO

funny 7 and useful 6; Sergio rated it innovative 6 and useful 6. Perhaps more interesting is the richness of the feedback we received from the subjects who were not enjoying using the VIO. One disgruntled subject rated it "less exciting over time" 6, while another rated it as "helping my relationship" 2. Another did not see much of a future for the VIO, rating the statement "going to be a part of every LD relationship" as Absolutely Not. In addition, there were a number of subjects who wrote provocative statements but rated them in the middle of the scale: one user wrote that the VIO was "effecting our relationship positively" 4, while another felt it was "healthy" 4. Another user felt the VIO was "driving us apart" 4, and felt like it was "a requirement" 3.

These particular answers encouraged us, the designers, to reflect on the role that such questions play. Users asked to evaluate a system may feel pressure to be polite about the system, and therefore be less honest in their criticism than might be wished. This may be particularly true when the designers and the evaluators are the same people. The combination of fill-in-the-blank and rating – particularly in the near neutral ratings of provocative statements – may serve to provide a liminal space for criticism, allowing a 'safe' way for the subjects to critique the researchers running the study, a channel of communication usually obscured by the power structure of traditional evaluation techniques.

6.4.2.5 Logbook: Reflection on the relationship

We asked each couple questions about their relationship, as the technology was explicitly used in the context of that relationship, and, we hoped, the technology would benefit it. Perhaps the most valuable part of the relationship questions was the way they emphasized the existing strength and richness of the couples' interactions with each other, underscoring the fact that the VIO was at best a limited contribution

to a rich and established romantic relationship. In addition, each day, we asked our users to explain one of their answers to the three numerical questions about their relationship:

- How close do you feel to your partner today?
- How satisfied do you feel by your relationship today?
- How connected do you feel to your partner today?

Many of these answers were reflections on the experience of being in a long distance relationship, ranging from feelings of remoteness and separation ("Having a rather distant day … until we talked, but then it was even more evident that we're really far apart", "When I think about how connected we are I tend to feel more disconnected by contemplating the reality of our separation alone.") along with security and happiness ("He was really there for me when I needed him today"). Again, some of the most interesting responses were more critiques of the form of the survey itself, questioning our wording and assumptions: one user pointed out that "Satisfaction and closeness aren't as correlated as they seem," while another observed that "satisfaction is a strange way to assess a relationship". There is a level of intimacy in these responses (and questions) that is unusual for an HCI research project. We were careful to anonymize our subjects, but the fact remains that these can be quite intimate questions to ask and to answer. It is perhaps a question for later research whether it may in fact be necessary to engage in dialog about such intimate topics with one's subjects as so to build a technology that is itself appropriately intimate.

Many of the relationship questions had perhaps more emphasis on giving the user a sense of enchantment, irreverence and novelty in their experience of filling out the survey than informing us about their relationship. However, we believe that one benefit of the questions was in expanding the set of possible answers, much in the same way as asking the users about the worst possible intimate object. For example,

on the first day, we asked users If I were to do a dance about my relationship today, it would be a: Rumba / Samba / Tango / Waltz / Swing. Of the subjects that answered this question, three of them selected a waltz, while rumba, samba, tango and swing all received a single selection. One user did not circle any of these, writing "Dance is too energetic for today." Sergio and Yumi selected a samba and a waltz respectively. None of these answers have any particular value to our understanding of the relationship, the technology or the study. However, we were concerned that users would find filling out a survey every day boring and repetitive, which would both discourage them from filling out the survey and possibly impact their feelings about the VIO. We hoped this question's appearance on the first day would set a tone of novelty and gentle irreverence for the rest of the week and thus encourage our users to use the logbook every day as requested. In addition, these questions convey a certain intimate and friendly but irreverent aesthetic that we felt was appropriate for the study and, that we took great effort to ensure was consistent across the survey instruments, as perhaps best illustrated by the informed consent document included as part of the appendix.

We also asked the users what season represented their relationship. Seven of our 10 subjects, including Sergio, said the season that most represented their relationship was spring. Yumi described their relationship as summer. Only one subject felt it necessary to explain her choice of Spring by writing "You can sense that good times are coming, but you have to wait a little longer." The couple who used their VIO the least reported fall and winter for the answers, and both felt the need to explain their choices: one wrote "Fall - always changing", and the other, "Winter. You love to see the snow falling and fresh on the ground but it's pretty damn cold and those slushy freezing rain/wintery mix days are definitely present and really suck."

Similarly, we also asked users what TV show best represented their relationship. For some of our subjects, this produced rich and interesting responses. One user wrote, “America's Next Top Model, b/c we have all these "experts" (friends who've been thru it) giving advice and we have laughs and drama, whenever we're together we take pictures to remind us plus each week we get closer to being together long-term short distance + whether it'll work out once we get our contract is up to us!”, while their partner just wrote “Friends - Monica and Chandler” Another subject wrote “Something predictable, yet warm and heartfelt. A gushy romantic show full of dorky characters, I dunno,” although her partner, who was to show the most dissatisfaction with the use of the VIO over the week, just wrote “I don’t watch TV shows.” Sergio felt that Futurama represented his relationship, while Yumi wrote, “Is a comic Program in Japan called WANNAI. It is really funny, and even you do not understand Japanese you can understand it. I think that my relationship is really joyful and funny.”

We were particularly impressed by the level of analysis that users put into their answers to a question that asked what color represented their relationship. Users were not explicitly encouraged to explain or unpack their answers, but the vast majority did so at some length. One user wrote, “Purple - we have a more matured, aged relationship rather than a new, boundless one which would best be described by red. Purple is the more aged, ripened form of red”, while her partner described their relationship as “Amber/yellow --> do I proceed w/ caution or speed up to beat the red or slow down anticipating a stop.” This was the same couple who picked winter and fall for their seasons. Other choices were red, burgundy, and “a medium green”. Sergio saw his relationship as green, while Yumi enthusiastically described their relationship as being “Yellow! Like a sun, like a summer. I often laugh with Sergio especially in those days. Using Vio is really funny and interesting.”

I found these responses a strong argument in favor of trying to find rich and open-ended ways for couples to characterize intangible properties of their relationships. Questions like asking about appropriate dances, colors or television shows gave both us and them a way to potentially gain an insight into aspects of their relationship that may have otherwise remained unarticulated. Such diversity also gave us multiple opportunities to connect to our subjects: the subject who did not watch television was unable to relate to that question in a meaningful way, but may have had particular insight into the seasons as a metaphor for his relationship. In addition, these questions also served to further our intent of making the survey feel light-hearted and playful, a cultural-probe-like aesthetic that we wanted to encourage.

6.4.2.6 Logbook: Reflection on the Study

On the last day of the diary, we asked our users, "Tell us a better way to do this study." Users interpreted this question in a wide variety of ways. While still useful, this question could perhaps be broken down into separate parts in the future. Some users wanted different platforms for the VIO: "Design other intimate objects with differing qualities and have couples compare and rate which ones seem to promote intimacy best", and "I think this study is done pretty well, maybe a VIO that can be carried around or on a cell phone." Users critiqued ambiguities in the design and wording of the log book ("I'm a little confused between the difference between feeling 'close' and feeling 'connected.' I decided to assume the former was more geographic/physical and the latter emotional," and "The questions are really ambiguous. What are you testing?") and took the opportunity to question the design of the VIO: "The VIO should give some better indication of when/# of times it was pressed."

Yumi did not answer this question; Sergio looked for more context and feedback from us in the course of the study: “In between the steps, you could give some explanation about some procedures you are using or questions you are making. I'm just guessing. For example: after step 1 and 2 you tell why didn't want to reveal anything on the vio apriori. Or after we finish to write the logbook you hand the envelope with some (not necessarily complete) explanations.”

We also asked our users how many people they had told about the study, and why. We asked this to try to get at least a summary view of the social context of the experience of being in the study. Most of our users had mentioned it to their roommate, a few friends, to their parents, as it came up in casual conversation. One user explained why they’d discussed it: “Cause I had fun using VIO, or they asked what it was on my task bar.” Yumi had only discussed the VIO with Sergio; Sergio had told his parents and his roommate about the study. He explained why: “I told them because I was really excited to be both experimenting a new technology and be part of an experiment. I only told them because I didn't want to show this as a ‘trophy’.”

We asked the users conducting this research to give names to us, the people conducting the research. Answers varied from “The Man” and “operators” to “Match ‘sustainers’ (like matchmakers)”, the “Intimacy Dream Team” and “mad scientists”. Sergio described us as “mysterious watchers”, while Yumi saw us as the “Fathers and Mothers of VIO.”

We also wanted to provoke our users to question the research itself. Referring obliquely to the deception sometimes common in psychology experiments, we asked users to say what they thought the research was really about. Most of these responses were of the manner we expected – “Whether VIO promotes or enhances intimacy for long-distance couples”, and “how couples feel about intimacy when they are apart” –

although one user did accuse us of “Creating computer dependency and spreading and marketing it to the general public”. Sergio saw our work as “Understanding better the needs of long distance relationships by measuring the reactions to the vio prototype. Thus confirming or rejecting the issues thought by the developing team”, whereas Yumi wrote “It is a new way for communication.” We had, perhaps, hoped for more provocative answers than these, but they are nevertheless accurate and reasonable representations of our endeavors.

6.4.3 Post Study Questionnaire

After the subjects had finished with their logbooks, we asked them to fill out a post-study questionnaire. This was designed to ask similar questions to the pre-study questionnaire, with the addition of questions explicitly about VIO use. We first asked if the VIO fell short, fulfilled or exceeded their initial expectations, and asked them to explain their answer. All but one of our subjects said it fell short of their initial expectations, which seems reasonable: when told that you’re going to participate in a study about technologies for couples in long distance relationships, it seems like a letdown to be given a single dot to click. Yumi and Sergio’s answers are entirely typical for this question: Yumi wrote, “To be sincere at the beginning I was thinking about something more sophisticate like a machine or some software. When I see that it was a program to install, in a way I was happy, because it is more simple and fast.” Sergio was perhaps more positive than most, writing “For the first 10 seconds I was deluded. I thought "how can this be better than the rest or how can it say something new." Then I asked myself why it was thought that. By the end of the day, I was totally sucked into it, finding new and good reasons for its existence.”

We then explicitly asked for the three things the subject liked most about using their VIO. Answers were evenly split into two categories: comments about the design

– the color, the fading, the position and size on the screen – and comments about the effect on the relationship. For example, Yumi wrote two comments: "1. Color. 2. I can see my Vio and my partner's Vio color." This was typical of the users who commented on the design itself. Comments about the effect on the relationship praised the interaction possibilities mediated by VIO, as well as the opportunity for reflection. It was common for the three comments to draw from both of these categories, as in Sergio's three favorite things: "1. It is very simple, but effective way to send a thought. 2. Its concept, compared to the other communication needs. 3. Its simple shape"

We also asked which three things users liked least about using their VIO. These were nearly all related to design issues that needed addressing: the rapid fading of the initial bright red and corresponding difficulty in figuring out how long since ones' partner pressed the button. Users commented on how it can transmit feelings of isolation and being alone, as well as intimacy: "If it is not pushed and the circle is colorless this only contributes to a feeling of distance or emptiness". Both Yumi and Sergio commented solely on the design, noting the absence of sound and difficulty of reading the display. We also asked for general suggestions for improving the VIO, and received variations on these themes, including replacing the circle icon with photos of the partner. Sergio's response: "The core idea is perfect. Now maybe it could undergo some aesthetic modifications, sounds, and customizable shape and dimension."

Seven of the nine respondents filling out this portion of the questionnaire responded that using the VIO had made them think of their partner more often. About half stated that it felt like an optional activity, and half that there was an obligation to use it. This sense of obligation led us to think of VIO use in terms of the notion of a gift economy, with corresponding expectations of reciprocity and relationship-building

in the course of the transaction, similar to Taylor & Harper's understanding of teenagers' text messaging practices (Taylor & Harper, 2002). We also found parallels in Aoki & Woodruff's observations of feelings of obligation and demands for response in push-to-talk communication technologies (Aoki & Woodruff, 2005). All but one of our subjects said that using VIO had become part of their daily routine.

Finally, we asked users how they would rate the level of intimacy in their communication in general and in the last week. These averaged 6.1 and 5.9 respectively, implying a slight drop since the introduction of the VIO, attributable to a single user's low rating of this response; disregarding that user's response, there was otherwise no change. Users also rated current methods of communication 5.6 effective in maintaining intimacy, slightly up from the pre-test result of 5.3. Again, this suggests limited value in this question as a metric.

Following receipt of the logbooks from our subjects, we wrote each an email to thank them for their participation, and included a copy of our initial paper on the study (Kaye et al., 2005). Three of our five couples continued to use their VIOs for over six months after the completion of the study. Yumi & Sergio continued to use their VIO for over a year and a half until Yumi moved to a new office where she was unable to use the software while at work.

6.4.4 Server Data

After the study, we looked at the cumulative statistics on the server, and found that over the course of the one-week pilot study, couples used their VIOs 35 times a day, on average, although there were wide variations: one couple only used theirs an average of 5 times a day, while Yumi & Sergio together clicked the button 123 times a day. These kind of aggregate figures have some value in characterizing usage patterns, but they provide a very thin picture of what is, after all, over 800 individual uses of the

VIO in the course of the week by Yumi and Sergio. One tool we found useful in building a picture of VIO use was some software I wrote to visualize the log data. All web servers keep logs of usage, but it can be hard to see what's going on from looking at the raw text. For example, a typical line of log data from version 1.0 of the VIO looks like Figure 11:

```
128.84.22.23 - - [10/Nov/2004:12:08:14 -0500] "GET
/cgi-bin/generator.py?file=josephkaye&pw=timesince
HTTP/1.1" 200 6 "-" "-"
```

Figure 11: Server log fragment

This tells us that on the 10th of November at 12:08pm in Eastern Standard Time (GMT "-0500" hours), someone from the IP address 128.84.22.23 (which we know is somewhere at Cornell, as it begins with 124.82) connected to the program "generator.py" located in the "/cgi-bin" directory of the server and gave it two pieces of information: the program should use the filename "josephkaye" and the command "timesince". This instructs the program to reply by sending the length of time since the file with the filename "josephkaye" was created, which it did successfully ("200"), using a total of "6" characters to send the reply. This happens every ten seconds for each VIO in use. This means that our couples generated literally thousands of lines of log data every day. It is nearly impossible to interpret this quantity of data without some form of program to help interpret the results. The result of one such program I wrote is shown as Figure 12.

The chart is read left to right and top to bottom; each horizontal line represents one hour; each pixel represents ten seconds. When Yumi's VIO is running, we see a light red line, as on Day 1 at around 1200-1800hrs; when Sergio's VIO is running, we see a light blue line, as on Day 1 at around 1800-2400hrs. A purple line indicates that both were running at the same time, as on Day 2 at 0000-0600hrs. A red dot indicates

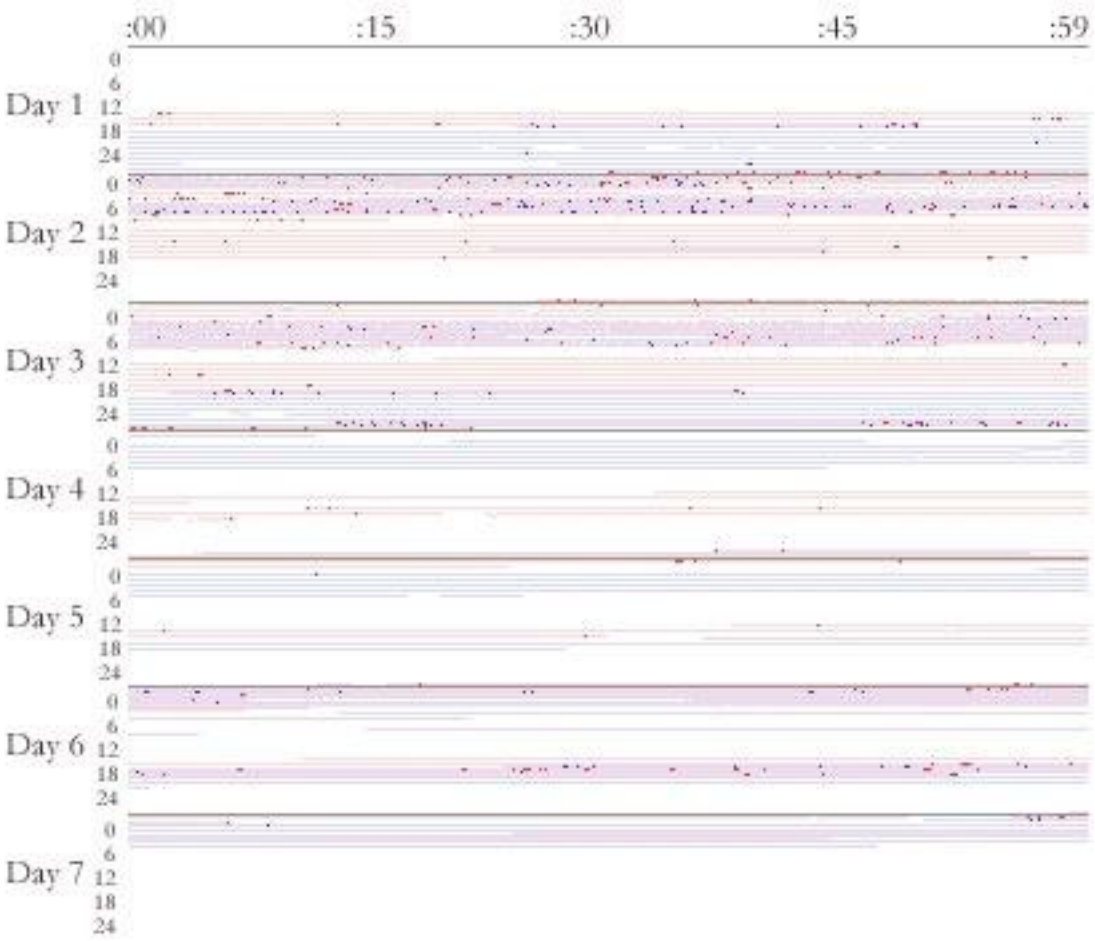

Figure 12: Yumi & Sergio's first week of VIO usage.

Yumi clicked her VIO at least once during that ten seconds; a blue dot indicates Sergio clicked his VIO. The times given are EST, local to Sergio, 14 hours behind for Yumi.

These visualizations can help understand users' experiences in multiple ways. First, as mentioned, they provide access to a set of data that is otherwise almost impossible to parse by hand. Second, they allow looking at the data on different scales, allowing generalizations about experiences. For example, using the above, we were able to tell that Sergio is online from about 6pm until about 5am which gives us some insight into an effect of this long distance relationship on his day-to-day life. We were also able to see various casual patterns of VIO use: the intensive back-and-forth

clicking evident in the early hours of Day 2 which one of our users described as "clickwars"; the exploratory click when the computer is turned on to see if the partner happens to be present evident in the middle of Day 4. Finally, and perhaps most importantly, they provide for discussion of these kinds of traces among the researchers and with users that generated these behaviors, and allow for co-interpretation of both the log data and the questionnaires to build a richer picture of the experiences our couples had with the VIO. The visualization I developed is not easy to read without coaching, and it appears to be optimized for at most a few weeks of data. However, similar visualizations could be developed for different time-spans: I developed a similar visualization for over a year's worth of cellular telephone calls in the course of my long distance relationship as part of my poster for the DIS 2004 conference (Kaye & Goulding, 2004).

6.4.5 Interviewing

I also had the opportunity to interview Yumi and Sergio together for ninety minutes when Yumi was visiting Ithaca in May of 2005. This was a distinctly unstructured interview: I had not expected to have this opportunity, but had fortunately included the possibility for an unstructured interview in the human subjects approval. Some of the time was spent showing Yumi and Sergio the improvements found in VIO 2.0 based on their and others' suggestions, and demonstrating the visualizations I had developed to understand their practices. I also learned of details that had arisen after the study had ended: for example, Yumi had moved offices, and the IT staff in her new office had been worried that the VIO, with its habit of 'phoning home' every five or ten seconds, was a virus or Trojan horse. She had had to stop using the VIO at the office and used it only at home, a significant change in practices. We also

discussed other alternatives for evaluation that they felt would give a different view on their experiences: video diaries, documentary film, and so on.

One particular insight that came out of this interview was the concept of cascading media richness. When Yumi or Sergio woke up, they would first click their VIOs, to say that they had woken up. If the remote partner clicked back, then they'd initiate an instant messaging conversation, and if both were available, then they'd initiate a voice chat over Skype. Details like this, which had developed over long-term use of the VIO, were simply inaccessible to us in the brief period of time covered by the logbook. While unplanned, interviewing Yumi and Sergio helped me understand in more detail the ways that the VIO fit into their lives on a daily basis.

6.4.6 Autobiographical use: my own use of the VIO

Another way in which I evaluated the VIO was through my own use of it. Although I was not one of the formal subjects of the evaluation, as mentioned at the very beginning of this thesis I originally designed the VIO because I was in a long distance relationship myself. While I took pains to understand how my long distance relationship was both typical and atypical, such as by interviewing others in similar relationships (Kaye & Goulding, 2004) and reading extensively in the long distance relationship literature (see, for example, (Guldner 2003, Chapter 22) for an annotated bibliography), much of my knowledge that went into the design and evaluation VIO must be credited to my own day-to-day experience.

On one hand, this is a very different picture from some classical notion of the detached scientist, observing his subjects in an abstract, unemotional, objective and disconnected manner. It also seems in some ways counter to the principles of user-centered design that have been so very influential in the field of HCI (e.g. Beyer & Holtzblatt, 1997; Cooper, 2004; Cooper & Bowers, 1995; Cooper et al., 2007;

Khalayli, et al., 2007; Vredenburg, Isensee, & Righi, 2001; Svanaes & Seland, 2004). User-centered design encourages designing for what users want, not what designers think they want, and thus requires discounting one's own assumptions.

However, as Sengers points out in her workshop paper *Autobiographical Design* (2006), there is a growing body of work that suggests that "rich experiences can be supported for designing for strange users, i.e. ones who are not the eventual target users for the system" (p. 1). This work includes work on lead users, who modify and change existing technologies for their own particular needs (Hippel, 1994), designing for extreme characters, such as drug dealers or the Pope (Djajadiningrat, Gaver & Fres, 2000), or drawing inspiration from practices, aesthetics and approaches of extreme users, even if they are not the intended audience for the eventual design (Holmquist, 2004; Hâkansson, Ljungblad, & Holmquist, 2003; Håkansson, Ljungblad, Gaye, & Holmquist, 2006; Håkansson, Gaye, Ljungblad, & Holmquist, 2006; Gaye, Holmquist, Håkansson, Ljungblad, & Mihalatos, 2004; Ljungblad, 2007; Ljungblad & Holmquist, 2007; Ljungblad, Hakansson, Gaye, & Holmquist, 2004). This absence of an explicit connection between the eventual end user and the users studied for inspiration opens up opportunities to rethink the relationship between the design and usage phases. By designing at least in part for myself, I need not explicitly claim that I am a typical user; rather, I can merely make the claim that there is something to be learned from reflecting on my own experiences.

That being said, the need for this argument, justifying the use of my own experiences, may seem strange to many outside of HCI. Anthropology relies on participant observation as a basic part of practice, dating back to Cushing's studies of Zuni Indians in the late 1800s (Cushing, 1967). McCarthy & Wright's take on pragmatism follows in a long phenomenological tradition of discussing their own experiences, such as the chapter on buying wine online discussed earlier (McCarthy &

Wright, 2004b, Chapter 6). A particularly thorough discussion of this can also be found in ethnomethodology, where importance is placed on having 'unique adequacy' in a domain of study. As discussed in the last chapter, unique adequacy refers to the need for those studying a particular social phenomenon to be competent practitioners of the social phenomena under question (Lynch, 1993, p. 274). So, for example, ethnomethodological approaches posit that studying the work of improvisation in jazz requires unique adequacy in jazz music (Sudnow, 2001); studying the role of proofs in mathematics requires unique adequacy in mathematics (Livingston, 1986); studying the ways lawyers make sense of the world requires becoming a lawyer (S. L. Burns, 2005).

Clearly, this kind of approach makes sense in many ways, particularly for the study of a topic as delicate and personal as long distance relationships. I was, I believe, sufficiently careful not to overgeneralize from my own experiences, as the inherent danger of participant observation is that one can lose track of the ways one does *not* understand one's subjects. This has been discussed at length in fields such as anthropology and sociology that engage with questions on the limitations of participant observation. For example, in a discussion of the limitations of participant observation, the anthropologist Clifford Geertz writes:

> So far as it has reinforced the anthropologist's impulse to engage himself with his informants as persons rather than as object, the notion of "participant observation" has been a valuable one. But, to the degree it has lead the anthropologist to block from his view the very special, culturally bracketed nature of his own role and to imagine himself something more than an interested (in both senses of that word) sojourner, it has been our most powerful source of bad faith. (Geertz, 2000, p. 20)

I also found that the opposite problem could also be true; in discussing the VIO with colleagues, I forgot that not everyone would be able to empathize with the particular difficulties and concerns of long distance relationships. In the course of

presenting the VIO through various talks over time, I was initially surprised to find that people who had never been in a serious long distance relationship often could not see the value in the kind of casual intimacy and sense of connection facilitated by the VIO, something that seemed obvious to me with my unique adequacy in long distance relationships.

Upon reflection, it is hard to distinguish between my work with the VIO as a researcher and as a subject. This is particularly apparent when addressed in epistemological terms: what did I know from experience, and what did I know from experimentation? Partly this tension was because I was invariably aware of the research side of my use of the system. When I sat on the couch while visiting with my long distance girlfriend at her apartment in Los Angeles, and we found ourselves clicking back and forth with our VIOs, I both enjoyed the experience of mutually performing intimacy for each other in a slightly ironic manner, but was also aware of how this was potentially valuable data about the reappropriation of the experience of the VIO. Similarly, we both enjoyed text messaging the word "click" to each other, as a private joke and ritual, but also as an ironic if often heartfelt representation of the VIO in another medium.

Much of what I knew about the VIO did come from personal experience; that being said, my published work rests almost entirely on representations of others' experiences. That is in part due to the complexities of the argument presented above; I would go so far as to say there is a stigma in HCI attached to presenting research on oneself. I would hypothesize that this is due to the intellectual and emotional legacy of the kind of user-unfriendly approaches to system design that emphasized the needs of the system over the needs of the user, which itself was a driving force for the formation of HCI. The user centered design approach arose in response to precisely these kind of interfaces, and I believe that writing about designing systems for oneself

still leaves a bad taste in some peoples' mouths, whatever the efficacy of doing so in a careful, reflective and considered manner.

6.5 Learning from the VIO

So what can we conclude from the case study of the VIO? What does it tell us about evaluation of experience-focused HCI, and what are the epistemological questions that it brings up? What aspects were successful and what aspects were not successful, and for whom? There are many conclusions that could be drawn from this study, but I would like to concentrate on three points that I think are important in this context. The first concerns the results of the evaluation of the technology, the second concerns itself with the methods used for evaluating experience focused HCI, and the third concerns itself with epistemological considerations.

First, the results tend to suggest that for at least some couples, the VIO was an effective and valued part of communicating intimacy in long distance relationships. Several of our couples used the VIO for several months; Yumi and Sergio used the VIO for several years, as did my partner and I until we broke up (for reasons, I should mention, unconnected to the VIO). The reappropriation of the language of the VIO into text messaging "click" to each other was one way in which the VIO became an intrinsic part of my own relationship. Similarly, I also received a note from a friend of someone who had seen one of my talks on the topic. Inspired by his recounting of the VIO, she and her close friends had started to instant message dots to each other to convey a similar message of intimacy.

Second, the stories collected through the questionnaires about VIO use suggest that the logbook was an effective way to characterize the experiences of our users in interacting with the VIO. The open-ended, cultural probe-inspired questions were useful in getting a rich picture of how the VIO fit into our users' lives. We found that

interweaving questions about the technology, about the context of technology use and about the study itself gave us a good understanding of many of the different ways in which we could understand the technology use, and gave us the information we needed to think about ways to improve the technology. These understandings were also aided by perhaps more conventional approaches such as visualizations of log data and interviews.

The VIO study did convince me, and I hope will convince the reader, that the notion of experience discussed in this chapter requires taking seriously not just users' practices, but also the emotional content of those practices and interactions. We saw evidence for this in the answers to the open-ended questions of reflection on relationships and the ways the technology encouraged reflection on relationships, and the very emotional nature of the relationship that was mediated at least in part by the VIO. For example, think back to Sergio's comment about making sure that Yumi woke up to a red VIO so she knew he had been thinking of her: "*...because I wanted her to find it as red as it was possible, when she would have awaken."* That is a very particular practice, motivated by Sergio's feelings for Yumi. We could have seen a series of unanswered clicks from Sergio on the server log followed by a set of clicks back and forth, but that tells us nothing of the motivations and meanings that those clicks had for the participants.

However, we can also conclude that the numerical questions were less uniformly useful than the open-ended ones. We did see numerical evidence that people became more comfortable with the VIO over time; other than that, we found little useful information from these questions. This may be because of the short length of testing, although (as both common sense and Bloor's Strong program will tell us) the same argument should be applicable to the open-ended questions, and that does not appear to be the case. Another explanation is that a scale of 1 to 7 is inadequate for

representing anything significant in response to a question like "How satisfied do you feel by your relationship today?" This finding suggests that methods developed to study task-focused interactions may not be appropriate or informative for evaluation of experience-focused interactions.

Third, this study raises a number of epistemological points. It is an example of an ongoing project of reflective epistemology, in which the study is used to work through assumptions about the right kind of questions to be asking, the right kinds of topics to be studying, and the right kind of knowledge to be generating. Furthermore, it suggests that HCI as a discipline needs to reexamine its epistemological assumptions about the role of autobiographical design. A mark of quality accepted by much of HCI for a long time has been testing on subjects *other* than oneself; this study is one example of the value of testing on subjects *in addition* to oneself while maintaining rigor and quality in evaluation. These are both points about the changing epistemologies of HCI, and the need for ongoing epistemological reflection about marks of quality in both one's own and others' research.

In the next chapter, I will present a second case study, of the Ambient Ink Display. Unlike the VIO, it was used in the workplace, and unlike the VIO, our conclusion was that the technology itself was not a successful fit for the environment in which we tried to place it. The study of the Ambient Ink Display is primarily based on a series of interviews, rather than the questionnaire-based approach of the VIO. However, it engages with a notion of the emotional content of experience, and is perhaps surprisingly similar in its emphasis on an open-ended approach to evaluation.

CHAPTER 7: THE AMBIENT INK DISPLAY

7.1 Ambient Ink Display

In the previous chapter, I presented the VIO, a project designed for couples in long distance relationships to use in their everyday lives. The VIO is a project that I designed, built, and evaluated. In this chapter, I present the Ambient Ink Display, which differs in two significant ways. First, I did not design or build the project; my role was primarily as an evaluator. Second, the Ambient Ink Display was designed for use in the workplace, a location that in HCI is often associated with a focus on task and task-focused computing. Both of these pose particular challenges for an experience-focused evaluation, which I will detail in the course of this chapter.

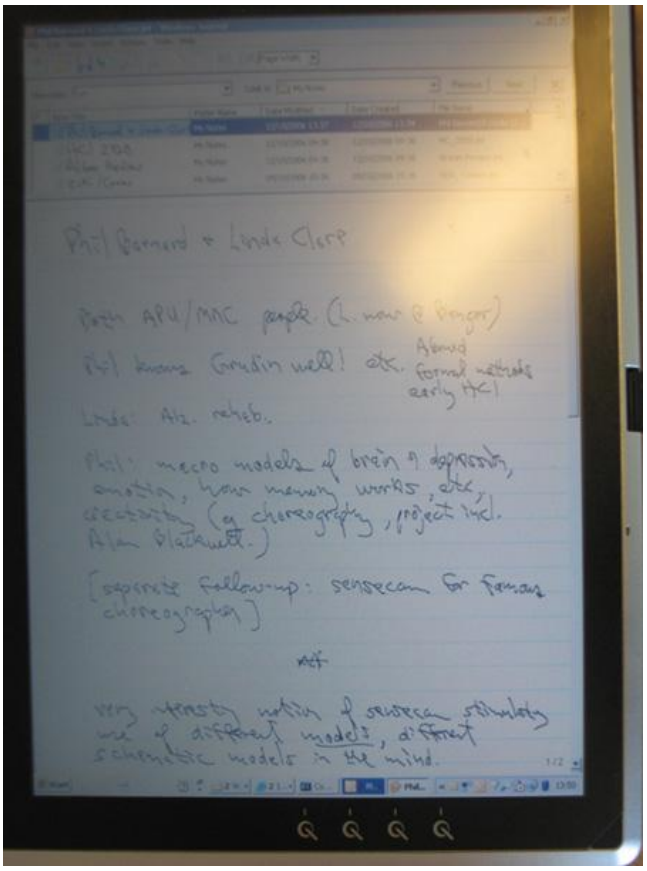

Figure 13: Tablet PC used to take handwritten notes. Photo by S. Gaw.

The particular piece of software we were interested in ran on a Tablet PC. Tablet PCs have the functionality of a laptop, but have a screen mounted on a special hinge that enables it to be twisted around so that the screen is on the outside when the computer is closed. The screen is touch-sensitive, and can be used as a writing surface using a special stylus. While handwriting is slower than typing, at least for tasks that are focused on writing, it has advantages for taking notes in that the user is not necessarily constrained to the text alone, but can include diagrams and sketches along with the notes. See Figure 13 for an example of handwritten notes on a tablet PC, using the Windows Journal program.

The original version of the Ambient Ink Display, as documented in the paper *Peripheral display of handwritten notes* (Hsieh, et al., 2006), displayed three or four quasi-randomly chosen paragraphs taken from tablet PC users' handwritten notes on a screen to the side of their desktop computer screens. This was designed to encourage a certain serendipity: notes on old conversations which might have relevance to present-day concerns would pop up, or two notes on disparate topics would be displayed simultaneously, perhaps to inspire novel thoughts on the interaction between them. Hsieh et al.'s paper only included a small, five user, in-house evaluation. I was working as a Visiting Researcher at Microsoft Research Cambridge, and Ken Wood, the head of our research group, asked me to help him work with an intern, Shirley Gaw, who was joining us for six weeks. We discussed various possibilities, and decided we were interested in performing a more in-depth evaluation of the handwritten notes display system, which was eventually published as Gaw et al. (2007).

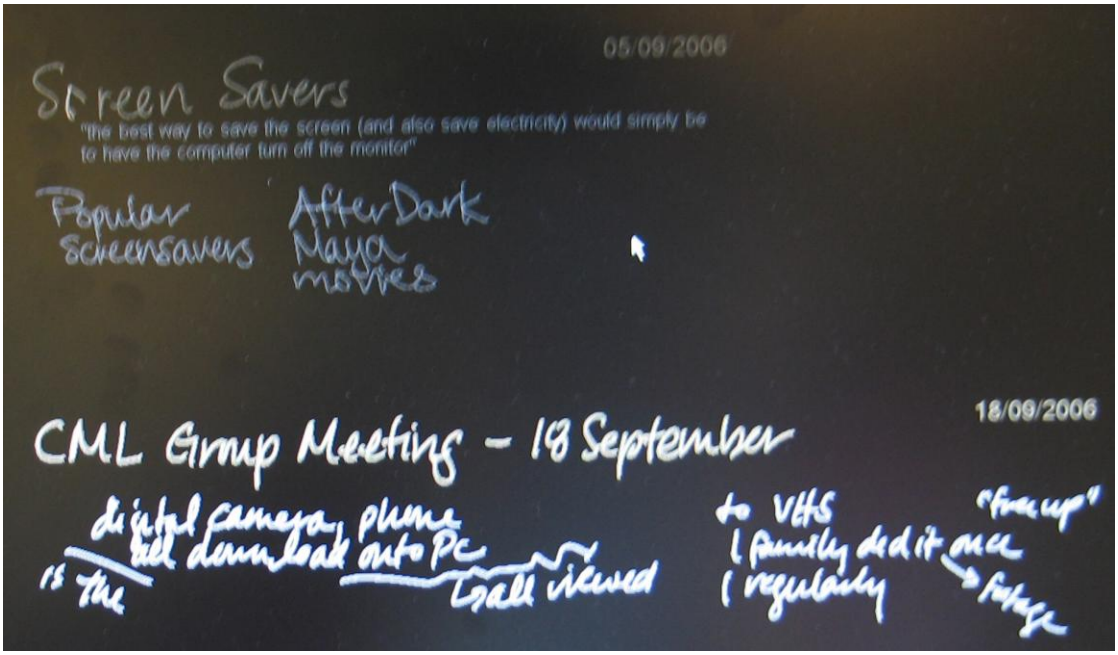

Figure 14. Detail of the Ambient Ink Display in action. Photo by S. Gaw.

My goal during my time at Microsoft was to be involved in evaluating experience-focused HCI systems, and the Ambient Ink Display was an interesting problem to address with an experience-focused orientation. As an ambient display it needed to work in the periphery of the users' awareness. Furthermore, the chances of the system successfully reminding the user of something that was serendipitously useful at any particular point in time was low, and so it would be hard to study the display's utility under a laboratory setting.

The original version of the software discussed in *Peripheral Display of Handwritten Notes* required users to devote an entire screen of their desktop computer to the display, which seemed like it might reduce the broad appeal of the system, as most computer users do not have a 'spare screen': if they have an additional screen, then they use it for more task-focused uses. The authors write:

> One user said during the interview that he probably would not pay the cost of a separate LCD to support our display, but he would definitely use something like this if it were a wallpaper or screensaver. Additionally, using the tablet PC's screen as the display while the user is engaged with their desktop in the office would allow the user to have the peripheral display without sacrificing display space. This latter approach would facilitate a much broader field study with dozens or even hundreds of participants, and is something we intend to pursue. (288)

We took this suggestion to heart, and worked with programmer Gavin Smyth to change the system so that it would work as a screensaver, instead of requiring a dedicated display. This enabled users to install it on their laptops and carry their Ambient Ink Display with them (Figure 14).

To evaluate this new implementation, we needed to find a large pool of tablet PC users who took notes using a compatible version of Windows Journal, a note-taking product included with most tablet PCs. As it was at a very early stage, we wanted to test the system on Microsoft employees, rather than looking for a pool of users outside of the company. We talked to the IT department, who we thought might know about the different kinds of computers in use at different parts of Microsoft around the country, and they told us that there was a large group of tablet users at Microsoft's corporate campus near Reading, England. We included a brief request for Tablet PC users to answer a survey in a newsletter sent out to Microsoft UK employees.

The survey asked if they used a Tablet PC, and if so, how often and with what notetaking software. (This was important, as the Ambient Ink Display only worked with certain notetaking software.) Finally, and most importantly, we asked if they'd be willing to help us with further research. We took a list of the Tablet PC users who answered positively to the last question, and Gaw went out to Reading to interview a

first batch of six or seven Tablet PC users, and then to offer them the Ambient Ink Display software to use[8].

When Hsieh et al. had performed the initial evaluation with users whose primary responsibility was being researchers, the overall response had been positive. However, when Gaw returned from the first set of interviews, she was disappointed in the reception the system had received: not one of the interviewees was enthusiastic about actually using the Ambient Ink Display. However, as Gaw and I discussed the responses she had received, we found that the Ambient Ink Display was fulfilling an important function that we had not anticipated. Discussing the display gave a focal point to discussions about tablet PC use, and served as a probe to uncover not just what the knowledge workers liked and disliked about the Ambient Ink Display, but also a much deeper understanding of what knowledge workers liked and disliked about their tablet PCs. We knew we had the impression that tablet PCs were used and understood in a different way than non- tablet laptop PCs, but we were unable to find any research that examined how this happened.

Our shift in emphasis was the result of epistemological reflection about the appropriate direction for our research. One option available at this point would have been to redesign the Ambient Ink Display in response to our potential users' lack of enthusiasm about the current design; a second would have been to find a new group of users who might be a better fit. Instead, we decided to continue exploring the reactions of this same group of users, changing in some ways the kind of knowledge that we were aiming to create.

In the course of discussing the results of the initial interviews, we identified several key themes. Gaw followed up on these themes in subsequent interviews with

[8] Quotes in this chapter are from Gaw's interviews, and I was greatly aided in searching through this mass of data by her rough transcriptions of many of the interviews.

other tablet PC users at the same field site. Gaw recorded the interviews and transcribed several of them; she also took pictures during each interview. In analyzing all the interviews, we found three particular themes that were supported by the interview data, all around the role of impression management: the importance of appearing 'on the cutting edge', the role of courtesy in tablet PC use, and the importance of separating (and keeping 'private') multiple identities.

7.2 Impression Management

In his book *The Presentation of Self in Everyday Life*, Goffman explores how people attempt to manage others' impressions of them (Goffman, 1959). He develops an extended dramaturgical metaphor, describing how actors 'performs' their chosen 'role' to an 'audience'. So, for example, he introduces the concepts of "front-stage" and "back-stage" to bring into relief the transition between how people act when moving more public to more private situations. There are several examples of using Goffman's notion of construction of identity to explain practices and behaviors in HCI. For example, Voida et al. studied how users of iTunes music-sharing software manage their presentation of self through the music that they choose to share and not share (Voida, et al., 2005). Aoki & Woodruff have shown how presentation of self is managed through mobile communication devices, and particularly how the ambiguity of whether messages have been received or not is used to maintain social relations, be polite, and give appropriate presentations of concern while maintaining privacy (Aoki & Woodruff, 2005). Hawkey & Inkpen have discussed the problem of multiple identities in the context of distinguishing between home and work use of web browsers (Hawkey & Inkpen, 2006). Finally, my own work with colleagues on issues of identity in archive use demonstrated how physical archives – displays of books, on blackboards in offices, on office doors, on noticeboards – are all used to portray

aspects of the archive owners' identities (Kaye et al., 2006). Each of these demonstrates how Goffman's notion of presentation of self can be used to further understand aspects of the experiences people have interacting with technologies by emphasizing the ways in which a task-focused approach does not adequately address the rich nature of such interactions.

In his summary chapter, "The Arts of Impression Management," Goffman describes three different practices of impression management. The first is 'dramaturgical loyalty', meaning behaving in a coherent way to sustain the impression being conveyed. The second is 'dramaturgical discipline', meaning having sufficient emotional distance from the impression being conveyed – that is to say, not getting carried away with making the impression. The third is 'dramaturgical circumspection'. This means taking the time to prepare and organize one's impression before it is performed for an audience. As I'll show, these constructions are a useful way to organize some of the behaviors performed by our subjects in this study.

It may seem a little strange to introduce yet another theoretical construct at this stage of the thesis. However, the relevance of Goffman's work in this context is twofold. First, Goffman's work on the construction of identity is clearly relevant to how our subjects used their Tablet PCs. Second, with respect to different approaches to experience-focused HCI, Goffman's work also clearly emphasizes how both the actions and the emotions of actors influence each other. As I'll show in the upcoming examples, this suggests that a phenomenological approach, including close attention to both practices and feelings, is most appropriate for discussing this topic.

7.2.1 Impression management: Cutting Edge

Many of the tablet PC users Gaw interviewed spent much of their time working closely with clients, identifying their needs and proposing solutions to their

information technology problems that incorporated Microsoft's products. Such users felt it was important for them to project an impression of working with cutting edge technologies.

> The customers expect us to be at the leading edge … . If we're not using some of the new stuff why should they be using it … we should be the ones that have got the latest stuff on the machine and when they say, 'Oh, Vista, people tell me it's not stable,' I say to them, 'it's what I've been taking notes on all morning. It works, have you noticed any problems?' … and that's the message I want to get to them. So, they turn around and say 'so if it works for these guys … why can't [we] use it in [our] organization as well?' (MS)
>
> In my role, given that I'm supposed to evangelize this stuff to customers, then, I … think it is inappropriate not to use our technology. (NU)

These participants found that tablet PCs were a key part of their identities as being on the cutting edge. They looked futuristic, exciting; multiple participants identified the moment when one swiveled the screen of a convertible tablet PC from laptop configuration to tablet configuration as a key moment in this presentation of novelty. Despite the forty-odd years since handwriting-based PCs were proposed by Alan Kay as the Dynabook in his early days at Xerox PARC (Maxwell, 2006) and the near twenty years since the commercial introduction of the GridPad (Barnett, 2000), our users seemed to feel that pen-based laptops continue to embody ideas of novelty and modernity.

Goffman's notion of 'dramaturgical loyalty' seems to characterize these behaviors. There's a loyalty to a certain kind of presentation of self, a person on the cutting edge of technology. They would use early, pre-released versions of software that were not yet ready for public consumption. This is a standard approach in many technology companies, known as "dogfooding", from the phrase "eating your own dogfood", meaning "using your own company's product inside the company" (Microsoft Corporation, 2000). It is a form of company-wide testing, enabling programmers to find problems with the software before releasing it to the general

public, while also allowing company members to use new features and software before they're available to the general public.

Using pre-release versions of software can also cause problems: precisely because they are not yet ready for the general public, such versions are sometimes buggy and unreliable. One of our subjects had been using an early version of Windows Vista, some six months before it was ready for release to the public, but then switched back to an earlier operating system. He said:

> I will be going back to Vista once it RTMs [release to manufacturing, i.e. goes public]. I went through a lot of the early beta builds and a lot of the early stuff and I - my productivity was through the floor. So I need to actually do some work for a while. (GG)

This commitment to being on the cutting edge takes time and effort. Another subject said:

> I've installed Vista 4 times in twelve months … Some of the guys on the team, they just do it once a fortnight. Just hit a button and reload the machine and pull up the latest stuff so they can see what's changed … I can take a bad machine and rebuild it ... and have all the office stuff on there in like two hours. (MS)

Gaw asked this subject what happened if the tablet running these unreliable software versions crashed, or "blue screened". Did he hide it from the client?

> I do explain I'm running all the latest builds … I haven't actually blue screened with this machine with a client yet. Um, only three months actually running all the dogfood and stuff on here and real mix of things, I haven't blue screened more than a couple of times. Although, regularly, not in the last two weeks actually, but regular there's a couple of weeks going through where PowerPoint kept whiting out and saying 'PowerPoint has stopped working; searching for a solution' …. But in all that, I only actually lost one document. … It always managed to bring back the data it had been saving in the - sort of every 10 minutes behind the scenes. So there you go, there's the data you've got. And that was the cool bit, that happened in front of a client and it crashed. And they started chuckling and it went down and it came back up. And then you weren't having to press the save button, it came back up and it got all the contents, sat there. I said, 'what do I need to do, it looks after itself.' <laughs> And that was actually a quite cool demonstration that we were doing a lot more to take care of the software. (MS)

There's an interesting sense in which the technology itself serves as a partner in this presentation of self; in the example above, when the technology crashes, it seems as if the computer has 'let down' the team – and yet it has in fact saved their work. We'll see this theme, around the role of the computer as a social actor, show up again in the section on the role of politeness and courtesy in Tablet PC use.

7.2.2 Impression management: Courtesy

We were surprised by comments from nearly all of our participants that they felt that the process of handwriting or 'inking' on a tablet PC was seen as more polite than typing on a laptop. One participant said:

> When I'm taking notes, it's quite rude, to type.
>
> Gaw: What do you mean?
>
> Well, it's quite rude if you're sitting opposite from me and I'm like this <hunched over keyboard>, 'oh, yeah? yeah?' I'm not looking at them… It's really rude. (GG)

Gaw pressed the participant on this issue to understand more:

> Interviewer: So when you were talking about it being, typing being rude and writing being less rude, is this like yourself, you feel it, or is it something that someone's remarked to you?
>
> No, you can tell from the way someone engages with you. You can see it. They don't actually say it. I mean this is England after all, people don't say what they really think [laughs]. You just pick it up in the meeting. It – you can drive a meeting far more positively when you have eye contact and you're more engaged with the person. (GG)

Issues of courtesy also dictated other factors of tablet use. For example, the process of rotating the screen from the laptop configuration to the tablet configuration came up more than once. One participant explicitly avoided doing this in meetings:

> I find that really ostentatious. I hate spinning a tablet in a meeting. 'Cause most people don't have Tablet PCs. If you're sitting there typing a note you look like it's just a regular laptop, but then, if I get up and I spin the laptop in the middle of a meeting, especially in the middle of a point – let's say I'm talking while I'm doing it – it is … I just find it's so 'look at me' … you know? It's just so "I've got a tablet and you haven't. Haha …. It's a bit slimy. (GG)

This suggests a certain dramaturgical discipline at play. The impression that the participant wished to convey was not primarily one of 'being cutting edge'. The primary impression he wished to convey may have reliability or competence or trustworthiness, but he felt that that primary impression would have been negatively impacted by showing off the functionality of his tablet in meetings; a deliberate consideration of and commitment to a very particular presentation of self.

Others felt that using a standard laptop could introduce a physical barrier a foot or more high between participants in the form of the vertical screen, a factor not found when using a tablet PC placed flat on the table:

> I think it's the whole, the way the body is when you're typing, you've got your face down, you're behind the screen, you're tip-tapping, it's almost like you're creating a barrier between yourself and the other people. Whereas as when you write whether on a paper notebook or a tablet, then it's much better in terms of those perceptions, I think. (NU)

There were also times in which typing was seen as more business-like and less personal than handwriting, a reason particularly cited by a respondent in Human Resources:

> So, for example today I had a very personal conversation with someone, she was very distraught about something, and she wanted to talk to me, and I just felt it would be very inappropriate to sit there typing. … If I was just a cold, callous, ruthless guy, I would just sit there in the computer and take notes or even record them, but it just feels really inappropriate for the –
>
> Gaw: So it's less intrusive?
>
> My judgment is that it would be seen as less threatening to somebody if I just had a little notebook with then either recording them or typing at the same time. (DG)

Interestingly, these observations were absent from any of the marketing material or any other material we were able collect about tablet PCs, all of which emphasized the qualities of the Tablet PC as a laptop, but not even specifically as a Tablet: the speed of the processor, the size of the hard drive, the weight of the laptop, but not the social affordances it provided.

Politeness and courtesy is not a common theme in studies of HCI. In particular, HCI has not to date engaged with the questions of how users can be polite or otherwise in their use of technology. Rather, discussions of the role of politeness and courtesy generally appear in one of two domains. The first involves discussion of how computers are seen as social actors, which has attendant demands upon the user to be polite (Reeves & Nass, 2003). For example, in his paper *Etiquette Equality*, Nass discusses the result of an experiment in which users were asked to rate the performance of a computer they had just used (Nass, 2004). One third of the users rated the computer using the computer itself, one third used a computer on the other side of the room, and one third used pencil and paper. People using the same computer rated that computer higher, which Nass suggests is because people feel the need to be polite to the computer and rate it accordingly higher.

The second way that courtesy is studied in HCI by is drawing from work on politeness as linguistic phenomenon (Brown & Levinson, 1987; Watts, 2003; Watts, et al., 2006), generally looking at the role of politeness in online discussions. For example, in the paper "Why do electronic conversations seem less polite?" the authors suggest that people hedge their comments less in electronically mediated (typed) conversation because of the added overhead of typing additional words (Brennan & Ohaeri, 1999). Other studies look at the efficacy of polite and impolite requests for assistance in technical forums (Burke & Kraut, 2008) or compare politeness of email and voicemail requests (Duthler, 2006).

All of these treat politeness as being expressed through something you say or write, rather than something expressed in non-lingustic practices These linguistic approaches are in distinct contrast to the phenomenological, practice-based approaches to characterizing experience, despite the way such courtesy was clearly important to our users. The form of courtesy for the Tablet PC users is distinctly 'politeness as something they do', not 'politeness as something they say'. They are deliberately making choices about their presentation of self, but such presentation is not based on utterance but action. This suggests that an experiential approach to understanding such uses, based on a pragmatist approach that looks at both practices and feelings, may be necessary to capture aspects of experience such as the need for courtesy.

7.2.3 Impression management: Privacy Issues & Multiple Identities

As part of their duties at Microsoft, many of our subjects worked with several large clients, perhaps specializing in a particular industry and splitting their week between two different banks. Notes taken in one context were confidential, and the subjects could not run the risk of confidential information being displayed in another context. One said:

> The problem [with the screensaver] would be that I work with so many clients at the moment which range from big banks that don't want anybody else to know they're looking at a particular area right now through to security services which don't potentially want anybody else to know what the security services are doing. So if the screensaver kicks in while I'm sitting on a site or something like that and one client site sees that … [Bank X is] having a chat about the right infrastructures and [meanwhile, Bank Y] meeting notes pop-up, that wouldn't be good. So, that would be a problem if I were using it. (Subject MS)

Some subjects talked about how the material in their notes was confidential enough that they could not risk even their own colleagues seeing it:

> That we've had a conversation and I've taken a note … that note is for me and me alone. … That may not even be for my colleagues -- that's purely for me. Even my colleagues can't see it. Or, certainly one of the partners can't see that data. I'm thinking, the worst case scenario here -- are we -- we have this thing running in the background during a meeting, I'm on the projector, and we stop talking for a while and maybe that kicks off and, hang on a sec, a [Company X] note goes up while I'm in a [Company Y] meeting. You know? You can't have that … I would get shot -- I'd be marched out the door. (GG)

Other participants were contracted to the Ministry of Defense, and some of their notes were covered by the Official Secrets Act. Yet others worked in sensitive areas such as human resources where they routinely discussed and took notes on private matters. One subject in human resources gave an example:

> So, I sat through a meeting the other day discussing – taking notes on some of the potential benefit changes that might be down the road. Taken out of context … if you were here and that was flashing up on the screen and it said something like – and this is purely hypothetical – 'we're taking away the [employee benefit X]' …. You know taken out of context without understanding why or what, that could freak some people out …. (DG)

The importance of privacy to these subjects far outweighed the advantages to them of being reminded of their note taking. Ensuring the privacy of client information is a core part of their job, although it's not clear that any of them would have listed that among their job functions, for example. In many ways, the Ambient Ink Display seemed to serve as a probe to uncover the importance of privacy in this particular workplace. Privacy is a topic of great interest to HCI and related fields and is extensively studied; see (Palen & Dourish, 2003) for a critical review of the field. Palen & Dourish discuss, for example, the delicate negotiation of the boundary between self and other that occurs in engagement with notions of privacy. This becomes particularly apparent in the negotiations of identity that participants engage in with respect to their explicit multiple identities as, for example, "bank employee" and "Microsoft employee".

7.3 Discussion

I chose to include a discussion of the Ambient Ink Display here for two reasons. The first is that I wanted to demonstrate how experience-focused HCI can apply to the workplace, despite eschewing an emphasis on the task. The second is that I wanted to demonstrate reflective epistemology in action by demonstrating how being open to unexpected results can derive potentially valuable knowledge from a project that did not work out as expected. I present three themes drawn from the interviews. The first two, the importance of appearing cutting edge, and the role of courtesy, are factors about tablet PC use that underline the importance of non-task aspects of technology use. The third result, the role of privacy in computer use and, in particular, the need for multiple privacies, has implications for a wide variety of both task- and experience-focused technology use. For example, current operating systems frequently are designed to facilitate user-switching and task-switching, but support poorly the need for one individual to switch between their multiple identities and attendant privacy concerns and needs.

This study also has implications for evaluation methods in experience-focused HCI. It emphasizes the potential for open-ended interviewing in understanding a rich picture of how technologies are used in the course of peoples' lives; in particular it demonstrates how a technology that was not as popular as hoped with a new audience nonetheless turned out to have real value as a research tool. That being said, one of the limitations of our study is that we relied on self-report in interviews and had little opportunity for actual observation. Gaw recorded interviews with a total of 18 subjects, many of whom demonstrated their note taking techniques and approaches, and she took photographs of their desks, work areas and often their Tablet PCs. However, with the exception of the single local user in the pilot study, we have no real-time observations of the use of Tablet PCs in use. Interestingly, this study also

demonstrates how technologies – in this case, the Ambient Ink Display – can function as a probe; not in the sense of a technological probe as discussed in Chapter 3 which logs its own usage, but as a way to provoke rich responses to a specific situation which would likely be difficult or impossible to discuss in the abstract.

This case study also differs from many case studies in another important respect. As I have shown, the Ambient Ink Display gave us a rich understanding of practices around Tablet PC use. However, we failed in our original aim of finding a large group of users who would want to use the Ambient Ink Display in the course of their daily work. I believe that this was a factor in the difficulties we had with publishing this work: HCI, like many other scientific disciplines, does not as a matter of course publish 'negative results'. The descriptions above contribute to understanding how these particular kinds of technologies are understood by their users. However, in an HCI context, this was apparently seen to be outweighed by the 'failure' of the technology itself to be adopted by users. I believe that we could have had an easier time publishing this paper had we claimed that we had created a probe to explore the habits and values of Tablet PC users, in the way that 'value probes' were created to explore the values of domestic environments (Voida & Mynatt, 2005).

This emphasizes a fundamental problem with evaluation of technology: the difficulty of determining what constitutes success and failure and in what ways. I see an analogy to the distinction between fieldwork and anthropology. One is a method; the other is a field or discipline that uses that method but then subjects the results of that method to analysis, producing the real intellectual contribution. Similarly, an evaluation of a particular technology can decide that the technology in question is good or bad, or fit for a purpose or otherwise, but the value in that evaluation comes in the analysis that accompanies it. This is a notion I will return to in the conclusion in the next chapter.

CHAPTER 8: CONCLUSIONS

8.1 Why This Project Matters

Having now assembled a set of theoretical foundations for experience-focused HCI, and seen their implications for practice, let us return to the big picture to remind ourselves why this matters. The field of human-computer interaction is constantly changing, in part because its topic of study – the human use of computers and related technologies – is constantly changing. All over the world, people are using technology in new and changing ways, and, while I am wary of proclaiming an unstoppable modernist agenda, this trend towards increased technology use, and increased diversity of technology use, looks likely to continue.

As such, one aim of the epistemological foundation I have chosen for this thesis is to provide a way for HCI to be able to adapt itself to these changing situations of technology use. The notion of experience discussed in these pages is one example of a change in technology use: a move from primarily task-focused approaches to ones that recognize a larger picture of human experience. However, I expect that technology use will continue to change, and an epistemologically aware approach to HCI in which researchers are aware of their own assumptions about metrics of quality and the basis for those metrics provides a way for the field to remain relevant to new kinds of technology and new kinds of use. Such an approach can inform the decisions we make about metrics for evaluation. When both technologies and usage patterns are changing, the primary criteria for an acceptable evaluation must be that it is fit for the purpose. This does not mean eschewing all other generalizations or metrics of quality for evaluation. However, it means making informed and thoughtful choices about the correct metrics for evaluation, and the correct metrics for judging the knowledge created in the course of evaluation.

In this chapter, I will summarize the main points in the previous seven chapters. I will begin by addressing the three primary themes of this work: epistemology, evaluation, and experience-focused HCI. I will then discuss three limitations of this approach. Finally, I will discuss my plans for future work in experience-focused HCI.

8.2 The Contributions of this Thesis

This thesis covers a large amount of material, from a history of the term 'evaluation' to a study of Tablet PC use, and a lot of ground in between. I believe it makes three primary contributions to HCI which answer three major research questions. The first is introducing epistemology and comparative epistemology as approaches from outside HCI that will be useful for the field, and proposing the novel concept of epistemological reflection as a way to use an epistemological approach while remaining in the field. This allows the field of HCI to directly engage with the difficulties of knowledge production and verification in a changing field. The second is a study of the term 'experience' and the ways it is used in HCI, and using that as a basis to explicate the emerging sub-field of experience-focused HCI through a thorough literature review. This draws together a set of research with shared but not necessarily explicit characterizations of their topics of study and metrics of quality. Finally, I present a series of methods for the evaluation of experience-focused HCI that are based around the use of cultural probes as a method for evaluation, and explicate the work that is done by evaluation as a rhetorical form in HCI. These methods provide a set of answers to questions about the right way to evaluate projects in experience-focused HCI.

8.2.1 Epistemology

My first contribution is the introduction of epistemology as a tool for making sense of the different ways that research is done in HCI. My usage of epistemology for understanding HCI is strongly influenced by the way that epistemology, and particularly comparative epistemology, is used in STS. Researchers in STS use comparative epistemology as a tool to help understand how different groups of scientists generate and validate knowledge. My use of comparative epistemology differs significantly from the way it is normally used in STS, in that I am a member of the field under study, with my own opinions about the right way to do things. This has required being explicit about the phase of work with which I'm currently engaged. For example, in Chapter Three I was careful to remain agnostic about any notion of the 'right' way to do evaluation, whereas in the case studies in Chapters Six and Seven I made explicit decisions about what I believed was the 'right' way to evaluate the VIO and the Ambient Ink Display.

These case studies, along with other aspects in this thesis, emphasize that the role of epistemology is not just a theoretical concern, but rather makes significant differences to how one chooses the work one does as a researcher and how one goes about doing it. The need for epistemological reflection as a part of research in HCI derives from the fact that HCI is, at its heart, a building discipline. By this I mean that the primary form of knowledge-making in HCI is the digital artifact, be it a program or web site or novel piece of hardware or some combination thereof. There is a certain set of information that is conveyed by that artifact itself, or by portions thereof – demonstrations at a conference, or listings of code, say. However, the form of that artifact will invariably hide aspects of its own production. Artifacts are manifestations of paths that were chosen and decisions that were made, but they often do not record the choices that were made, or the mistakes that occurred, before settling on the end

state as manifest in the artifact. The core epistemological concern of HCI is the need to create and document the forms of knowledge that occur along with the production of the built artifact.

Through this approach to HCI I am making three claims about the value of epistemology to the field:

1. We can understand more about how work is done in HCI, and by corollary, do better work in HCI, by understanding the different ways that knowledge is created and validated.
2. Epistemological orientations have impact throughout the research process, not just in the ways that research results are presented. They impact what is studied and who is studied and how it is studied, as well as how the results are presented and the constitution of those results.
3. There are multiple epistemological orientations in HCI. Clashes in the field, as writ large by the Damaged Merchandise controversy, and as writ small by clashes between authors and reviewers in the review process, can be made more constructive by recognizing epistemological differences when they occur. This, too, will help create better research in the field as a whole.

8.2.2 Experience and Experience-focused HCI

The second contribution of this work is to take a comparative look at the different ways that the term experience is used in HCI. I have done this in two particular ways. The first is to define a set of work that implies a certain set of understandings of experience, and the second is to enumerate what components of those definitions of experience that work has in common and where they differ.

We started with experience defined in opposition to the notion of task that is so pervasive in HCI. In particular, we began with the statement that the experience must

not be considered merely a larger kind of task. Task-focused computing assumes that user practices can be understood by breaking them down into their component parts and understanding those component parts. This assumes that practices are well approximated by the sum of those parts. By contrast, experience-focused computing assumes that an experience is not reducible to the sum its parts, and that in the course of such a process important details are lost. It treats the experience as something with fuzzy boundaries, where the lines between experiences and their context are blurred. It is not entirely ineffable and removed from description or manipulation or design, but any deliberately constructed component will invariably be only part of the end result. Experience in experience-focused HCI manifests not as a thing that exists *a priori* in the world, but something that is created in interaction. There is no canonical "the experience"; rather, multiple instances of "an experience" each situated in a particular time and place.

We then looked at four different practices of experience-focused HCI: inspiring, building, evaluating and theorizing, and discussed examples of each and how they contributed to an emergent definition of experience. In the first three practices we saw a consistent theme of open-ended research in experience-focused HCI. That is to say, in each practice, the emphasis is on methods and approaches to research that opened up possibilities for the next phase of work. This approach requires a certain degree of humility and openness on the part of the researcher: the assumption that one does not know the result one will get from research one is about to undertake, and the willingness to be open to surprise and change in the course of that research. Conversely, some might argue that there is a degree of hubris in stating that rich and meaningful parts of everyday life, like feelings of intimacy or beauty, can be adequately represented by a number chosen from 1 to 7.

We see this commitment to opening up the field of research in cultural probes, which provide opportunities for designing and building a far wider variety of responses to those probes than, for example, a standard survey might allow. Similarly, eMoto and the Affective Diary allow for a particularly rich and open-ended reflective engagement with one's own emotional state and representations thereof. The Cultural Commentators discussed in the evaluation section deliberately open up not only novel understandings of the form and role of evaluation, but also a wide array of future possibilities for design responding in turn to those cultural commentators. By contrast, in task-focused approaches one must at each step one close down the possibilities for the system to ensure it fits appropriately and manageably into a representational model. One might argue that this is necessary in task-focused models because of their reductionist approach: only a small fraction of the features of a given experience can be measured or are viable candidates for meaningful measuring. As such, this results in an inevitable reduction in complexity at each stage: the task must be defined; the system to support the task must be defined; the metrics by which success will be measured must be defined.

The fourth practice of experience-focused HCI we discussed is the development of theory for HCI. These theories characteristically embody an explicit critique of two dominant intellectual approaches in the field: the technologically determinist and the cognitive/rationalist approaches. Theoretical work in experience-focused HCI joins with cognitive theoretical approaches in emphasizing the role of the human part of human-computer interaction, rather than pointing to inevitable technological improvement as the driving force of changes in HCI. However, it differs from the cognitive/reductionist approach, in that it emphasizes ways of knowing that take into account the social nature of humans and how the body is involved in knowing and understanding. This critique of technological determinism

and cognitivism is not in any way confined to the theoretical approaches, but the nature of theory is such that it makes such critiques explicit in a way that is often implicit in other practices.

In the course of this work, we have also seen a number of recurrent themes in the study of human interaction with technology. In particular, we discussed the reoccurring nature of discussions around five themes which together constitute an understanding of the features of experience in experience-focused HCI:

1. affect
2. aesthetics
3. artifacts
4. the body
5. human practices

It is the conjunction of these themes that has defined a notion of experience that seems most relevant to experience-focused HCI. A definition of experience needs to incorporate the emphasis on human practices drawn from ethnomethodology, the emphasis on the artifact and the aesthetics drawn from design, the emphasis on the body found in phenomenological approaches and on the body and felt-life drawn from pragmatist approaches to HCI. This definition, while chimeric, is far from arbitrary, but rather reflects a characterization of experience that seems to be shared in the literature I discuss here. At the same time, it is not needlessly panoptic in scope; these five features are clearly reoccurring features of experience-focused HCI.

8.2.3 Evaluation

The third contribution of this work is in its work on evaluation. This contribution takes two distinct forms. The first contribution is a method for evaluating experience-focused HCI, as discussed at length in the case study in Chapters Six. The

second contribution is the analysis of the epistemological work being done by evaluation in HCI.

I propose several concepts for the evaluation of experience-focused HCI. One concept is an emphasis on open-ended questions that allow the designer or researcher to learn from the unexpected experiences of users with a technology or situation. A second emphasizes rich characterizations of users' experiences instead of easily summarizable or reducible representations. Such rich characterizations can involve leveraging cultural knowledge that is shared between users and designers to provide a rich source of referents. The evaluation of experience-focused HCI also involves taking seriously the five themes that emerged from the literature review: people's feelings about their experiences, the importance of aesthetics, the role of knowledge embedded in artifacts, the importance of the body as part of experience and the rich and situated nature of human practices. These concepts are demonstrated in two case studies.

The logbooks for evaluating the VIO are a reappropriation of cultural probes, a technique designed for inspiring rather than evaluating systems. The logbooks we created may be a somewhat media-impoverished reappropriation of cultural probes, bereft of the maps, diagrams, scrapbooking and photographs that are a feature of many cultural probes; a clear path for future work would be to incorporate such elements as part of an evaluation strategy. However, we were careful in the design of our open-ended questions to attempt to capture both the inspiration and aesthetic qualities of the cultural probe, as well as encouraging our users' defamiliarization with their own experiences. In addition, we also emphasize the themes discussed above around the understanding of experience: the importance of taking peoples' emotions and feelings about their lives and their interactions with and through technologies seriously, of respecting how artifacts represent particular approaches to knowing, of taking great

care with aesthetics, and of learning from the practices of our users. The rich feedback and characterizations of experience we received with the logbooks would, it seems, been impossible to achieve with more task-oriented approaches to evaluation.

The evaluation techniques used for the Ambient Ink Display were in many ways more standard: in short, we interviewed potential users. However, the contribution to thinking about the evaluation of experience-focused HCI in this case study comes from an approach to thinking about knowledge-making that is open to novel understandings in a way entirely commensurate with experience-focused HCI. If we had set up our metrics in advance and used them to study our novel technology, the result would have been a failure. (This is the approach taken by many 'program evaluation' techniques used elsewhere in applied social science.) However, by being open to new information in the course of the study, we ended up with insights into the experiences and practices of Tablet PC users. It is in this sense that this work makes a contribution by recognizing the epistemological work being done by evaluation in HCI.

Evaluation is traditionally seen as a process of confirming or denying expected results. However, taking an epistemological approach to HCI demonstrates how evaluation is also a process of multiple levels of validation. One of these levels is the level upon which evaluation is generally assumed to occur in HCI: validating your technology as having a given utility. However, at the same time, evaluation is also a validation of the topic of study and the methods chosen to study it and the epistemological orientation from which you have chosen to approach the topic. This does not mean that experience-focused evaluation lets researchers invariably redefine their parameters to trumpet success by moving the goalposts. Rather, it challenges the researcher to take a reflective epistemological stance by questioning their own assumptions about what constitutes success or failure in a particular domain, rather

than assuming that there exist ordained golden standards of success. An epistemological approach to experience-focused evaluation means that metrics of quality for evaluations must above all fit the purpose of the technology and determine if that purpose is itself justified. A recurrent point in different orientations to experience-focused HCI is an explicit concern with making the world a better place: criterion for implementing a novel technology, say, should be that that implementation will make the world a better place. The reflective design epistemology discussed in Chapter Five is one substantiation of this: the authors believe that the world would be better if there were more critical reflection, and propose to design technology for this general aim.

8.3 Limitations

In this section, I would like to discuss the limitations of this thesis. I will first discuss the limitations of this particular study, and then of the applicability of the open-ended research strategies it exemplifies. Finally, I will discuss a published critique of a whole host of experience-focused research strategies.

8.3.1 Applicability outside of academic HCI

One limitation of this research is that it is rooted in academic HCI design research, primarily in the English-speaking developed world, and therefore its recommendations and approaches may not be useful for other domains. Even the research around the Ambient Ink Display discussed in Chapter 7, which happened in an industrial setting, was distinctly design research with only potential application to commercial applications. This is indeed a relevant criticism. However, I believe that within the domain in question, there is real value to the three categories of contribution discussed here – an epistemological awareness of the kinds of knowledge that the

researcher is creating, a commitment to a representation of experience that recognizes the importance of factors such as aesthetics, the body and feelings, and a strategic approach to evaluation that attempts to represent such an experience. Indeed, in my experience, non-academic work often takes far more note of such factors than is common inside the academy. That being said, the applicability of this work in industry is distinctly a topic for further research.

8.3.2 Problems of open-ended research strategies

A second, related, criticism is that the open-ended approach to research at the heart of experience-focused approaches is simply impossible to pursue in the constrained settings within which most research must by necessity occur. Whether the constraint is building a new product for a client, prototyping a new interaction paradigm for a particular device, or working within the constraints of a particular grant or research group, it is rare that any researcher has unfettered choice. This makes open-ended research approaches hard to implement. On the one hand, particular constraints can make particular decisions simply impossible. On the other hand, this is a false comparison. Nearly every one of the projects discussed was under some constraint, and yet all engaged with open-ended research at each state of their iterative design. Once again, I hope to continue this study by trying to understand more about how such limitations can shape the research process.

8.3.3 A case against an experience-focused approach

In her article *What Makes Good Research in Software Engineering?* Shaw claims that an "indication that ideas are maturing is a shift from qualitative and empirical understanding to precise and quantitative models" (Shaw, 2002). As I am working within HCI, I do not claim 'unique adequacy' in software engineering, and I

do not pass judgment on this claim. However, Newman and Vincenti explicitly extrapolate Shaw's claim to the field of HCI in their article *On an Engineering Use of Engineering History* (2007). They see open-ended research strategies in HCI as a naïve exploratory approach, which will eventually 'mature' into a quantitative discipline.

This rests on an inherent value judgment which makes an epistemological assumption that quantitative representations and understandings are more precise, more accurate, more closely represent some notion of reality, and furthermore that such an attempt is a 'good thing'. As we have seen in the case studies and discussions, experience-focused HCI, drawing from a wide legacy of practice-based approaches, embraces the complexity of lived experiences and states that there is a richness to human experiences than cannot be quantified. Rather, I posit that an indication that ideas are maturing in a field that involves human interactions is a shift from the assumption that human interactions are reducible and quantifiable to embracing the fact that human interactions are rich, complex, and irreducible to component parts without doing irreparable damage to the representation. It is possible to misinterpret this as an issue of quantitative vs. qualitative research. To be more precise, this can be misinterpreted as saying that we should not do quantitative research and should do qualitative research.

The intent of an epistemological approach to HCI and to evaluation is to ensure that the research approach taken is fit for its purpose. Counting the number of times that the VIO was used by different couples does give some information about usage patterns, but it took the couples' thick descriptions to explain the implications to them of the last click of the evening or the first click of the morning. These kinds of experiences confirm that there appears to be little justification for assuming that the right way to measure aspects of a situation is to do quantitative research. Similarly,

we should not assume that the right way to measure aspects of a situation is to only do qualitative research, but, for various reasons, this is a much less common assumption in HCI.

8.4 Epistemological reflection and Future Work

The topic of this thesis is experience-focused HCI. However, as we have learned from our epistemological study of evaluation, such work is invariably about other claims as well. It makes a case that experience-focused HCI is a reasonable thing to concentrate on, that it is a fit topic for study, and most importantly that it requires its own set of epistemological metrics of quality. I have argued that one cannot take task-oriented metrics of knowledge creation and apply them to this field. I believe that experience-focused HCI, with its emphasis on those exciting and complicated factors that make us human has enormous potential to contribute to building technologies that will let us more fully express ourselves, collaborate and communicate and stay in touch with colleagues, friends, and loved ones, and actively and consciously aim to make the world a better place.

I believe that there is a great deal more work to be done in the experience-focused approach, as it has become increasingly common in HCI. We have not yet agreed as a community on the defining metrics of quality for work in experience-focused HCI. I have suggested some possibilities here, but in many ways their success must by definition be a function of their uptake in the field. In particular, the notion of epistemological compatibility is tricky to characterize and explain in a satisfactory way, and yet seems important to explain problems like the gulf between the reductionist UX approach and the more situated phenomenological approaches.

A second question that is in need of careful consideration is understanding the meanings of success and failure in experience-focused HCI. This is not to say that it is

necessarily clear what the criteria are for success and failure in task-focused HCI, but rather that due to its critique of the status quo, experience-focused HCI makes it particularly important to consider and discuss such criteria. In particular, this becomes an issue because of two problems: stakeholders and values.

In the first instance, the difficulty arises because there are multiple stakeholders in a situation with different criteria for success, as Ramage noted in his study of CSCW (1999). The question of whether a project is a success can only be answered with "for whom?" The user of the technology and the researcher may well have different answers to that question: for example, a good result of a study for a researcher may reveal something about the social order of a situation, while a user may determine success based on a technology helping them solve a particular problem. Those are not necessarily orthogonal values, but they make blanket statements of success questionable.

This brings us to the second problem which needs further explanation in HCI: values. Values are increasingly being discussed as a way to explain these multiple criteria for success (Brown et al., 2007; Cockton, 2004a, 2004b, 2005, 2006; B Friedman, Kahn, & Borning, 2006; Batya Friedman, 1996; Gilmore et al., 2008; Light, Wild, Dearden, & Muller, 2005; Voida & Mynatt, 2005). However, there seem to be two meanings for the term "values". In an unpublished paper submitted to the CHI'07 workshop "Value, Values & Worth" (Gilmore et al. 2008), I argued for a distinction between "big-V" Values and "small-v" values. Big-V Values exist in the abstract: "privacy", "security", "redundancy". Much of the work of researchers like Helen Nissenbaum proposes and demonstrates designing for Values such as these (e.g. Flanagan, Howe & Nissenbaum 2005). By contrast, small-v values refers to the elements of an experience that users find they value in the course of the experience, but would not have proposed as something they were looking for *a priori*. So VIO

users did not know they would particularly value the experience of intimacy caused by the first click of the morning, but they found that value in the course of the experience.

I believe that this focus on small-v values has potential to allow us to explain and characterize the parts of an experience that are important to the user, and therefore can be considered successful or unsuccessful for that user. Clearly, this is only a sketch of an answer to the question of determining success, but preliminary work suggests that it has promise (Voida & Mynatt 2005).

My own future work will focus on three aspects of the work presented here. The first is the role of (small-v) values in determining success, as discussed. The second is an ongoing discussion with the field about the changing nature of peer review in an interdisciplinary environment. I believe that the epistemological approach I advocate here, in which one is explicit about the intellectual choices and metrics of quality that one endorses, has great potential for providing continued intellectual coherence to a widening field. I have shown this in some small way in co-chairing the alt.chi track at CHI 2008, in the course of which I developed a software system for managing reviewing that encouraged reviewers to be explicit about the reasons behind their ratings of various forms of quality, not just about their ratings. My future work will also involve the continued development of projects within an experience-focused framework. My work to date has concentrated on academic research; while I fully intend to remain an active member of the research community, my immediate intent is to concentrate on the application of this work to an industrial research environment.

Finally, I would like to once more return to a bigger picture to put this work in perspective. Susanne Bødker gave the keynote speech at the NordiCHI 2006 conference in Oslo, Norway (Bødker, 2006). In discussing the transition of the field from second-wave HCI, with a focus on social and group applications of technology,

to a third-wave HCI, which she preliminarily defines as non-work, non-purposeful and non-rational, she wrote:

> The second and the third wave seem to be stuck on either side of the divide between work on the one hand and leisure, arts, and home on the other; between rationality on the hand and emotion on the other. While development on either side may lead towards a true third wave, I don't believe that we get there until we embrace people's whole lives and transcend the dichotomies between work, rationality, etc. and their negations.

It is my belief that experience-focused HCI, with its emphasis on epistemological approaches, on recognizing the importance of representing the totality of users' experiences, and with due care taken that evaluations are fit for purpose, is a fit answer to that call. Furthermore, I believe that epistemological reflection allows HCI to change appropriately for the new challenges of third wave HCI, and to future waves as well.

APPENDIX: VIO SURVEYS

These survey instruments have been lightly edited
to comply with the formatting requirements of this thesis.

Stamp

Intimate Objects Study
Cornell Information Science
301 College Ave
Ithaca NY 14850

Informed
Consent
Booklet

Intimate
Objects
Study

1

Informed Consent Form

Please sign below, indicating that you give your full informed consent to participate in the Intimate Objects Study and acknowledge any risks that may result.

Signed: _____
Date:_____

Please note: You need to sign the above portion before beginning this study.

(Optional):
Please sign below if you give your full consent to the researchers to photograph and/or audio/videotape your interviews and use them in publication.

Signed: _____
Date:_____

Instructions for sending this booklet back to the test administrator:
At this time, please close this booklet and staple or tape the open ends together. You can use the lines provided on the edge of the cover page as a guide for placing the staple or tape. This packet is already pre-addressed and includes proper postage. Once the packet is stapled, simply drop it into a mailbox so it can be received in a timely fashion.

Informed Consent Booklet

It is essential that we have a signed Informed Consent Form from you as soon as possible**.** This Informed Consent Booklet contains the Informed Consent Form and instructions on how to return it to the test administrators.

Please read the information on the next pages, and sign and date the last page of the booklet, indicating that you have read the consent form and agree with its contents.

After you sign on the last page, please **send it back** to the test administrators immediately following the instructions on the last page.

*R*eminder*:
If you have any questions or comments about the experiment at any time, please ask the researcher present or contact::

Joseph Kaye
jnk8@cornell.edu
301 College Ave.
Ithaca, NY 14850

Professor Jeff Hancock
jth34@cornell.edu
320 Kennedy Hall
Ithaca, NY 14853

Any further concerns should be addressed to the University Committee on Human Subjects (UCHS):
Email: uchs@cornell.edu
phone: (607) 255-5138
website:
http://www.osp.cornell.edu/Compliance/UCHS/homepageUCHS.htm

Informed Consent Form for Intimate Objects (v4.0)

Research Description

We are interested in understanding the role that technology plays in interactions within couples. It is common to use tools such as telephones, email, and handwritten notes to convey information and emotion within couples. However, these tools are rarely designed to encourage reflection on the effects of the tool on the couple's relationship. This research is meant to better understand intimacy between couples as mediated by technological devices. We have built a number of prototype Objects that allow for a very limited expression of intimacy between members of a couple. You and your partner will be instructed in the operation of the specific device and should feel free to ask questions at any time.

Technological Overview

Your Object may require power and an Ethernet connection. If you wish, we will install the device for you to ensure both proper operation and compliance with appropriate networking requirements. If you prefer to install it yourself, simply plugging in the power and then inserting the Ethernet cable into a spare port on your router or an activated Ethernet jack on your wall should do the trick, as the device will automatically configure itself. It is designed to operate as simply as possible, behaving like a small web browser. Every fifteen seconds, your picture frame will connect to a web server (alice-waters.jofish.com) and check to see if the button on the other device has been pressed. If so, it will perform the appropriate output. In addition, if you press the button, it will connect to the same server to leave a message for the other picture frame to perform its appropriate output option.

Your Participation

We will also provide you with a logbook. At the end of each day, we ask you to write down the date, your estimate of the number of times you pressed the button, your estimate of the number of times your partner pressed the button, and to answer a short list of questions. We'd also like you to write down when during the day you thought you used the device – what you remember, not doing it as you go – and any thoughts about the relationship and the device that have occurred to you, or discussions about the device you have had with your partner. If you wish, we are happy to telephone you or email you at the time of your choice to remind you to fill in the logbook.

The server will also record the time and date of any button press. A graph and copies of this log data will be made available to you after the experiment is finished.

At the end of the testing period, we will return to take back the equipment and to interview you about your use of the device. This will likely take no longer than half an hour. We may also request a brief follow-up interview in person or by telephone after we have had a chance to review your logbooks.

Risks and Benefits

The potential benefits of being in this study are that you may gain a deeper understanding of your intimate relationship with your partner. Your personal experiences may help to futher emotional satisfaction for all loved-ones separated by distance, as well as for yourself and your partner.

Possible risks occur because the subject of intimacy is inherently very personal. Any discomfort caused is a result of contemplating and sharing such personal information. Risks may include personal embarrassment or a lessening of intimacy shared with your partner. You may feel unhappy or embarrassed about your or your partner's use or non-use of the device, and the use of this device may cause unhappiness, discord, or tension in your relationship.

Collection and Use of Data

If you consent, one or more of the interviews will be photographed, or audio or videotaped. These images, audio or video tapes, or digital copies thereof maybe kept by the researchers indefinitely and the information within may be used in publication. It may be possible to conduct these interviews by email or instant message: we are required to inform you by Cornell University that email and Internet transmission is neither private nor secure, and that your answers may be read by a third party.

Confidentiality and Voluntary Participation

We have great respect for your privacy, and will attempt to ensure that your identity remains hidden in any display of this data, including publication and talks. At no point will you be identified by name in any publication. But, as this is a small, qualitative study, with end devices that may be specifically tailored to the couples in question, it is not possible to promise total anonymity in the event of publication.

At any time prior to or during this study you may withdraw from the experiment with no penalty or punishment. Your participation is entirely voluntary.

Intimate Object Study: Pre-Test Questionnaire

2

Participant Name: _____

Date: _____

1) What range does your age fall into?
   - ❑ Under 18
   - ❑ 18- 24
   - ❑ 25- 34
   - ❑ 35- 44
   - ❑ Over 45

2) Gender:
   - ❑ Male
   - ❑ Female

3) Are you currently enrolled in a college or university? Yes ____ No ____
   If yes, what degree are you currently working towards?
   - ❑ Undergraduate degree
   - ❑ Graduate degree
   - ❑ Other: _____

4) Are you currently employed? Yes ____ No ____
   If yes, what is your current occupation? _____

5) What is your current relationship status?
   - ❑ Dating casually
   - ❑ Dating exclusively
   - ❑ Engaged to be married
   - ❑ Married
   - ❑ Other: _____

6) How long have you and your partner been in a relationship? _____ years _____ months

7) Have you seen your partner in the last month? Yes ____ No ____
   If yes, approximately how many days of the month were you together? _____ days

8) In a typical year, approximately what percentage of the year are you geographically *apart* from each other? _____ %
   Please explain your answer:

9) On average, how often do you communicate with your partner?
   - ❑ Once a week
   - ❑ A few days a week
   - ❑ Once a day
   - ❑ 2-5 times a day
   - ❑ 6 or more times a day
   - ❑ Other: _____

10) What medium(s) do you use to communicate with your partner on a regular basis? Please check all that apply.

- ❑ Telephone
- ❑ Instant Messenger (IM)
- ❑ E-mail
- ❑ Pager / Beeper
- ❑ Text Messaging
- ❑ Web Camera (Web Cam)
- ❑ Letters or Postcards
- ❑ Other: _____

11) Which *one* medium of communication do you use most frequently?
_____

12) What time of the day do you most often communicate?

- ❑ Morning
- ❑ Afternoon
- ❑ Evening
- ❑ Late night

Please explain your answer:

13) What is your preferred method of communication? Why?

14) How would you define intimacy in your own words?

15) On average, how would you rate the level of intimacy in your communication? (On a scale from 1 to 7, where 1= not at all intimate, 7= extremely intimate). Please circle one number only.

Not at all Intimate 1 2 3 4 5 6 7 Extremely Intimate

16) How effective do you think the current methods of communication are for maintaining intimacy in a long-distance relationship? (On a scale from 1 to 7, where 1= very ineffective, 7= very effective). Please circle one number only.

Very Ineffective 1 2 3 4 5 6 7 Very Effective

17) Who tends to initiate communication in the relationship?

- ❑ Myself more than my partner
- ❑ My partner more than myself
- ❑ Both my partner and I equally

18) What one thing do you miss *most* about your partner when he/she is at a distance?

3

Intimate Objects Study

Daily
Logbook

Introduction

Now that you have signed and sent in your consent form and filled out the pre-test questionnaire, you're almost ready to begin!

Setup your VIO
You'll first need to set up your intimate object, otherwise referred to as VIO. We've given you instructions in the next few pages; if you experience any problems, the instructions don't seem to help, or things don't seem to be working, call Jofish on the number below and he'll help you out. We expect many of the participants will have to call us for individual instruction, as every computer setup is unique.

Daily Logbook
A big part of the study is this logbook. After every day of use, it is important that you complete a section of the logbook. It should only take 5-10 minutes of your time to complete. Don't worry about getting the right answer: what we're looking for is inspiration and an understanding of how intimacy works in your relationship, and how the device we've given you makes a difference.

As always, if you have any questions about this study, feel free to call Jofish or Mariah or email any one of us at any time – really – and we're happy to help.

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Guidelines: Setting up your VIO

Virtual Intimate Object - VIO v1.0

Step 1. Open up your favorite web browser and go to http://io.jofish.com/vio1.exe

Step 2. Download the file and run it. Follow the instructions! VIO will now run every time you start your computer. After the installation finishes, it'll automatically start VIO.

Step 3. You'll see a configuration box pop up. You ***must*** configure VIO before using it.

Step 4. To configure VIO, put your first and last names in the "Local Client" box. Don't include any spaces or punctuation, and write it in lowercase. So for example, if your name was Jacob O'Mallery, you'd write:

jacobomallery

in this box.

Step 5. Do the same with your partner's name in the "Remote Client" box. So if you were married to Bing Tsao Norbert-Weiner, you'd write:

bingtsaonorbertweiner

in this box.

Note: Make sure you coordinate with your partner so you're using the same names -- although remember that your name will be in the "Local Client" box and your partner's name will be in the "Remote Client" box, and for your partner it'll be the other way around: their name is in the "Local Client" box and yours is in the "Remote Client".

Step 6. Click OK, and you're done! Your VIO is configured and ready to use.

How to use VIO:

You'll see a small grey or red circle show up on your Taskbar. That's your VIO!. To send your partner a message, click on the circle. The VIO on their machine will show up as bright red, and fade over time, eventually returning to grey after twelve hours. If they click on their circle, then yours will show up as bright red and fade over time in the same way. To see what their VIO currently looks like, just move your mouse over the circle: it'll change to a smaller circle, the same color as their current VIO.

If you want to remove your VIO:
Go to the Start Menu→ Programs → VIO, and click on Uninstall VIO.

If you or your system administrator have any problems setting up your VIO, feel free to call Jofish Kaye, 607-232-0649.

Day 1. Date: _____/_____/ 2004

I think I pressed the button about _____ times today.
I think my partner pressed the button about _____ times today.

1) How close do you feel to your partner today?

Extremely Distant 1 2 3 4 5 6 7 Extremely Close

2) How satisfied do you feel by your relationship today?

Extremely Dissatisfied 1 2 3 4 5 6 7 Extremely Satisfied

3) How connected do you feel to your partner today?

Not Connected 1 2 3 4 5 6 7 Extremely Connected

4) What impact do you think your frequency of use of VIO had on your partner's day?

No Impact 1 2 3 4 5 6 7 Significant Impact

5) What is your overall attitude towards VIO today?

Extremely Unfavorable 1 2 3 4 5 6 7 Extremely Favorable

6) What is your overall interest level in VIO today?

Extremely Uninterested 1 2 3 4 5 6 7 Extremely Interested

7) How comfortable did you feel with VIO today?

Extremely Uncomfortable 1 2 3 4 5 6 7 Extremely Comfortable

Explain <u>one</u> of your answers for #1–3.

Explain <u>one</u> of your answers for #4-7.

If my VIO made a sound, I would want that sound to be…

The TV show that best represents my relationship is…

If I were to do a dance about my relationship today, it would be a:

Rumba Samba Tango Waltz Swing

Day 2. Date: _____/_____/ 2004

I think I pressed the button about _____ times today.
I think my partner pressed the button about _____ times today.

1) How close do you feel to your partner today?

Extremely Distant 1 2 3 4 5 6 7 Extremely Close

2) How satisfied do you feel by your relationship today?

Extremely Dissatisfied 1 2 3 4 5 6 7 Extremely Satisfied

3) How connected do you feel to your partner today?

Not Connected 1 2 3 4 5 6 7 Extremely Connected

4) What impact do you think your frequency of use of VIO had on your partner's day?

No Impact 1 2 3 4 5 6 7 Significant Impact

5) What is your overall attitude towards VIO today?

Extremely Unfavorable 1 2 3 4 5 6 7 Extremely Favorable

6) What is your overall interest level in VIO today?

Extremely Uninterested 1 2 3 4 5 6 7 Extremely Interested

7) How comfortable did you feel with VIO today?

Extremely Uncomfortable 1 2 3 4 5 6 7 Extremely Comfortable

Explain <u>one</u> of your answers to questions #1–3.

Explain <u>one</u> of your answers to questions #4-7.

I generally found I used VIO when I was…

If my relationship were a season, it would be…

This is a picture of what I wish my intimate object really was (Please draw):

Day 3. Date: _____/_____/ 2004

I think I pressed the button about _____ times today.
I think my partner pressed the button about _____ times today.

1) How close do you feel to your partner today?

Extremely Distant 1 2 3 4 5 6 7 Extremely Close

2) How satisfied do you feel by your relationship today?

Extremely Dissatisfied 1 2 3 4 5 6 7 Extremely Satisfied

3) How connected do you feel to your partner today?

Not Connected 1 2 3 4 5 6 7 Extremely Connected

4) What impact do you think your frequency of use of VIO had on your partner's day?

No Impact 1 2 3 4 5 6 7 Significant Impact

5) What is your overall attitude towards VIO today?

Extremely Unfavorable 1 2 3 4 5 6 7 Extremely Favorable

6) What is your overall interest level in VIO today?

Extremely Uninterested 1 2 3 4 5 6 7 Extremely Interested

7) How comfortable did you feel with VIO today?

Extremely Uncomfortable 1 2 3 4 5 6 7 Extremely Comfortable

Explain <u>one</u> of your answers to questions #1–3.

Explain <u>one</u> of your answers to questions #4-7.

If I could change one thing about my VIO it would be…

The color that best represents my relationship is…

Of the seven numbers below, my favorite number is…

1 2 3 4 5 6 7

Day 4. Date: _____/_____/ 2004

I think I pressed the button about _____ times today.
I think my partner pressed the button about _____ times today.

1) How close do you feel to your partner today?

Extremely Distant 1 2 3 4 5 6 7 Extremely Close

2) How satisfied do you feel by your relationship today?

Extremely Dissatisfied 1 2 3 4 5 6 7 Extremely Satisfied

3) How connected do you feel to your partner today?

Not Connected 1 2 3 4 5 6 7 Extremely Connected

4) What impact do you think your frequency of use of VIO had on your partner's day?

No Impact 1 2 3 4 5 6 7 Significant Impact

5) What is your overall attitude towards VIO today?

Extremely Unfavorable 1 2 3 4 5 6 7 Extremely Favorable

6) What is your overall interest level in VIO today?

Extremely Uninterested 1 2 3 4 5 6 7 Extremely Interested

7) How comfortable did you feel with VIO today?

Extremely Uncomfortable 1 2 3 4 5 6 7 Extremely Comfortable

Explain <u>one</u> of your answers to questions #1–3.

Explain <u>one</u> of your answers to questions #4-7.

I think that VIO is enchanting.

Absolutely Not 1 2 3 4 5 6 7 Absolutely

I think that VIO is embarrassing.

Absolutely Not 1 2 3 4 5 6 7 Absolutely

I think that VIO is intimate.

Absolutely Not 1 2 3 4 5 6 7 Absolutely

I think that VIO is _____.

Absolutely Not 1 2 3 4 5 6 7 Absolutely

I think that VIO is _____.

Absolutely Not 1 2 3 4 5 6 7 Absolutely

Day 5. Date: _____/_____/ 2004

I think I pressed the button about _____ times today.
I think my partner pressed the button about _____ times today.

1) How close do you feel to your partner today?

Extremely Distant 1 2 3 4 5 6 7 Extremely Close

2) How satisfied do you feel by your relationship today?

Extremely Dissatisfied 1 2 3 4 5 6 7 Extremely Satisfied

3) How connected do you feel to your partner today?

Not Connected 1 2 3 4 5 6 7 Extremely Connected

4) What impact do you think your frequency of use of VIO had on your partner's day?

No Impact 1 2 3 4 5 6 7 Significant Impact

5) What is your overall attitude towards VIO today?

Extremely Unfavorable 1 2 3 4 5 6 7 Extremely Favorable

6) What is your overall interest level in VIO today?

Extremely Uninterested 1 2 3 4 5 6 7 Extremely Interested

7) How comfortable did you feel with VIO today?

Extremely Uncomfortable 1 2 3 4 5 6 7 Extremely Comfortable

Explain <u>one</u> of your answers to questions #1–3.

Explain <u>one</u> of your answers to questions #4-7.

I would name my VIO:

I would name my partner's VIO:

I would name the people conducting this research:

I think this research is really about:

Day 6. Date: _____/_____/ 2004

I think I pressed the button about _____ times today.
I think my partner pressed the button about _____ times today.

1) How close do you feel to your partner today?

Extremely Distant 1 2 3 4 5 6 7 Extremely Close

2) How satisfied do you feel by your relationship today?

Extremely Dissatisfied 1 2 3 4 5 6 7 Extremely Satisfied

3) How connected do you feel to your partner today?

Not Connected 1 2 3 4 5 6 7 Extremely Connected

4) What impact do you think your frequency of use of VIO had on your partner's day?

No Impact 1 2 3 4 5 6 7 Significant Impact

5) What is your overall attitude towards VIO today?

Extremely Unfavorable 1 2 3 4 5 6 7 Extremely Favorable

6) What is your overall interest level in VIO today?

Extremely Uninterested 1 2 3 4 5 6 7 Extremely Interested

7) How comfortable did you feel with VIO today?

Extremely Uncomfortable 1 2 3 4 5 6 7 Extremely Comfortable

Explain <u>one</u> of your answers to questions #1–3.

Explain <u>one</u> of your answers to questions #4-7.

What is the worst intimate object you can think of?

What is the worst relationship you can think of?

I'd say this song currently represents my relationship:

_____

Day 7. Date: _____/_____/ 2004

I think I pressed the button about _____ times today.
I think my partner pressed the button about _____ times today.

1) How close do you feel to your partner today?

Extremely Distant 1 2 3 4 5 6 7 Extremely Close

2) How satisfied do you feel by your relationship today?

Extremely Dissatisfied 1 2 3 4 5 6 7 Extremely Satisfied

3) How connected do you feel to your partner today?

Not Connected 1 2 3 4 5 6 7 Extremely Connected

4) What impact do you think your frequency of use of VIO had on your partner's day?

No Impact 1 2 3 4 5 6 7 Significant Impact

5) What is your overall attitude towards VIO today?

Extremely Unfavorable 1 2 3 4 5 6 7 Extremely Favorable

6) What is your overall interest level in VIO today?

Extremely Uninterested 1 2 3 4 5 6 7 Extremely Interested

7) How comfortable did you feel with VIO today?

Extremely Uncomfortable 1 2 3 4 5 6 7 Extremely Comfortable

Explain <u>one</u> of your answers to questions #1–3.

Explain <u>one</u> of your answers to questions #4-7.

Tell us a better way to do this study.

How many people have you told about this study? Who?

Why?

Thank you for participating in the Intimate Objects study. We hope you enjoyed taking part in the experiment!

One last step!
Please find the document with a "4" on it. This document should be labeled "Intimate Object Study: Post-Test Questionnaire". Please answer all the questions on the document the best you can.

Intimate Object Study: Post-Test Questionnaire

Participant Name: _____
Date: _____

1) Did VIO fall short, fulfill, or exceed your initial expectations? How so?

2) What are 3 things you liked the *most* about VIO?
   1.
   2.
   3.

3) What are 3 things you liked the *least* about VIO?
   1.
   2.
   3.

4) Did VIO make you think of your partner more often? Yes____ No ____

5) Did you feel as though using VIO was an obligation or an optional activity? Please explain.

6) Did VIO make you feel closer to your partner at any point during the study? Yes____ No ____
   If yes, how so?

7) Did you consciously think of VIO during the day? Yes____ No ____

8) Did using VIO become a regular part of your daily routine? Yes____ No ____

9) Did you experience any technical difficulties with VIO during the course of the study?
   Yes ____ No ____ If yes, please explain briefly.

10) Do you have any suggestions for improving VIO?

11) On average, how often did you find you used VIO?
   - ❑ 0-1 time a day
   - ❑ 2-3 times a day
   - ❑ 3-5 times a day
   - ❑ More than 5 times a day

12) What time of the day did you most often use VIO?

- ❑ Morning
- ❑ Afternoon
- ❑ Evening
- ❑ Late night

13) Who tended to initiate communication with VIO?

- ❑ Myself more than my partner
- ❑ My partner more than myself
- ❑ Both my partner and I equally

14) In the past week, how often did you communicate in any way with your partner?

- ❑ Less than once
- ❑ A few days
- ❑ Once a day
- ❑ 2-5 times a day
- ❑ More than 5 times a day

15) On average, how would you rate the level of intimacy in your communication? (On a scale from 1 to 7, where 1= Not at all Intimate, 7= Extremely Intimate). Please circle one number only.

Not at all Intimate	1	2	3	4	5	6	7	Extremely Intimate

16) In the past week, how would you rate the level of intimacy in your communication? (On a scale from 1 to 7, where 1= Not at all Intimate, 7= Extremely Intimate). Please circle one number only.

Not at all Intimate	1	2	3	4	5	6	7	Extremely Intimate

How effective do you think the current methods of communication are for maintaining intimacy in a long-distance relationship? (On a scale from 1 to 7, where 1= Very Ineffective, 7= Very Effective). Please circle one number only.

Very Ineffective	1	2	3	4	5	6	7	Very Effective

17) Do you think you would like to use VIO on a regular basis? Yes____ No ____ Why or why not?

17) Other Comments?

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