Critical Technical Practice as a Methodology for Values in Design

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ABSTRACT

Critical Technical Practice (CTP) is an approach to identifying and altering philosophical assumptions underlying technical practice. In this paper, we propose CTP as a useful method for developing value-sensitive design, complementing existing ethics-based approaches in HCI. CTP, originally proposed by Phil Agre, tightly binds technology development (as practiced in computer science) with critical reflection (as practiced in critical studies and design research), thereby uncovering and altering hidden values and assumptions in technology design. HCI, due to its interdisciplinary constitution and reflective nature, is a particularly fruitful domain for critical technical practice. We demonstrate through four case studies how critical technical practice supports the identification of values underlying design as well as the development of concrete technical alternatives.

INTRODUCTION

The process of designing, building, and deploying innovative technologies and systems requires navigating a complex ocean of technical, economical, social, and political waves. The dangers of failure abound, calling for resoluteness and necessitating constant choice-making that gives preference to certain moral, social and political values over others. As technology literally surrounds us —wireless networks saturating the ether, computers crawling off the desktop and into our living spaces and our bodies, technology shaping the way we communicate, think and reproduce — recognizing the values designed into technology becomes an acute issue.

Values and Choices

As attendees of this workshop will no doubt be aware, the design of technology has always been informed by cultural and historical notions of value, values, and quality. The difference with many of today's HCI systems, however, is that by striving towards engineering objectivity value choices often becomes invisible. This concealment of values is dangerous because it obscures a much needed renegotiation of values in an environment which is in radical socio-technological flux. As we develop the perceptiveness to the stories that unfold everyday in the form of chips, printed-circuits, antennas, compilers, and bits our value choices should be clearly articulated and defined. In the early years of computing and information systems design, most research has revolved around input and output to these systems: how information is extracted, codified and distributed. But as HCI becomes part of every aspect of our environments it is important that we join a growing body of work that recognizes that these new systems need to be conceptualized as an integral component of our everyday value-laden activities, and that our choices of quality and value are not separate processes from our design practices.

Beyond efficiency and productivity

For years the lighthouse of 'productivity' has guided technologists in the rough seas of design, its beam illuminating 'efficiency', 'efficacy', and 'effectiveness' as the promised lands of success. But recently new goals for HCI are being articulated, and new design principles are being formulated. For example, much attention is now given to design that supports more authentic, rich human experiences taking into account the complex meaning-making activities we engage in every day.

One approach toward enhancing design for experience is to identify aspects missing from existing computer models, such as emotion and creativity, add these missing variables to the equation, and otherwise continue with design-practice-as-usual. This approach is often marked by design and research strategies of reduction and representation. Designers following this codification approach seek to understand human activities so that the systems they design are smarter, more appropriate, more effective. They are driven by a worldview that complex phenomena may be understood and predicted by identifying and separating discrete, operational parts. This approach does identify new values to design for, but is less concerned with explicating, or challenging, the values that go into the design practice itself.

An alternate approach for supporting more authentic interaction with and around technology does not attempt to fit complex experiences into computer models but, rather, looks at ways in which technology can stimulate reflection on, enhance awareness of, and create opportunities for meaning making activities. The goal in this approach, which we espouse, is to use systems for enhancing people's own awareness of context, affect and other complex experiences that are being augmented. In this approach, interpretation is not black-boxed inside a system but rather is a process of co-construction between users, systems, and designers. Participation may not always be equal among all three groups but awareness of who is participating is imperative. A final distinction between our approach and that of the codification-of-experience model is in metrics that push beyond utility and efficiency measures. Successful systems are not determined by whether or not a user 'got it right' or 'performed more efficiently'. Instead we look at metrics such as levels of engagement, enjoyment of use, integration with everyday experiences, the variability of use or capacity for re-appropriation.

Value centered practice

In developing systems that approach experience in these ways, it has become essential to our practice to not only identify values our systems ought to express -- critical reflection, emotional experience, interpretive flexibility -- but to bring those values back into technology design and evaluation practices themselves. This approach is akin to that of participatory design, which advocates changing not just systems, but practices of system-design and system-building, in order to more fully support democratic values at all stages of the design process. It is similar in spirit to moral-philosophy-based approaches such as Batya Friedman's value-centered design, but focuses more on a constant critical engagement of the designers with their technical and design practices. This means, for instance, that the values to be espoused in system design are not necessarily easy to articulate before design has begun, but instead may emerge through a process of engagement with users, materials, and fellow researchers.

Our approach departs from these two traditions is in our desire to embody cultural critique in systems; i.e., systems may be designed, not to do what users want, but to introduce users to new, critically-informed ways of looking at the world around them. In this way, it is closer philosophically to critically-informed design practice such as that of Bill Gaver and Tony Dunne (1999). We explore the limits of HCI practice – what is it we may design for, what methods we may use – to question and provide potential alternatives to core assumptions of the field. To do so, one must have methods in hand that let one get at those assumptions, which are often so obvious as to be unquestionable. In doing so, we have found Phil Agre's CTP to be a useful approach.

WHAT IS CRITICAL TECHNICAL PRACTICE?

CTP is outlined by Phil Agre in his 1997 book Computation and Human Experience. He proposes using insights from a field that provides critical reflection to question the core metaphors of a technical field, and thereby overcome recurrent technical impasses in that field. Briefly, CTP consists of the following moves: identifying the core metaphors of the field, noticing what, when working within those metaphors, remains marginalized, inverting the dominant metaphors to bring that margin to the center, and embodying the alternative as a new technology. It is important to note that during this process, the values embodied by the field can be questioned and shifted.

Agre's formulation of CTP was distilled from his collaboration with David Chapman which critiqued the dominant planning approaches in Artificial Intelligence and offered alternatives to them. Agre and Chapman, echoing arguments by Lucy Suchman (1987), showed that planning approaches marginalize the embodied and situated nature of human activity. Instead, taking situated embodiment as central to intelligence, they developed alternative agent technologies for situated, routine, reactive, real-time behavior. By inverting the core metaphor of AI, namely abstract cognition, Agre and Chapman opened a new design space for AI, and their work became an influential part of the new 'situated action' paradigm. In this work, critical technical practice functioned to bring to the fore and make

meaningful in technical discourse aspects of human activity which were previously marginalized from design.

Although the technical work resulting from this shift was generally well received, the criticism of AI's underlying philosophies was less appreciated. Agre himself argues that the conceptual structures of AI as a field make it almost impossible to incorporate serious critical reflection on its methods and assumptions. A different situation exists in HCI, however. Because of HCI's interdisciplinary constitution, ranging from computer science to ethnography and design research and even extending into the arts, there is more openness to possibilities for HCI that lies outside of the purely technical. Indeed, the reflexive nature of HCI has provided fertile ground for the use of CTP, most notably embodied in Paul Dourish's work as formulated in his book Where the Action Is (2001). Key concepts from that work resonate in several projects including The Influencing Machine (Sengers et. al. 2002) which questions our assumptions about what technical practice can consist of, and particularly the role that emotion can possibly play in machine intelligence. In addition, Höök, Sengers & Andersson's (2003) used digital media art practice as a way to rethink HCI evaluation techniques. The CHI 2004 workshop on Reflective HCI explored the role of critical technical practice to help us uncover and question hidden assumptions in HCI.

Case studies - CTP in HCI

In Cornell's Culturally Embedded Computing Group (www.infosci.cornell.edu/cemcom/) we try to incorporate the CTP approach as we analyze, design, build, and evaluate information technology in a cultural context. We integrate technical system-building with cultural, philosophical, and critical reflection on technical practice. We expand Agre's technically focused CTP to allow for building from and contributing to both technical and critical discourse. We seek to elucidate the ways in which technologies reflect and perpetuate unconscious cultural assumptions, and accordingly we design, build, and test new computing devices that reflect alternative possibilities. Three major themes guide our on-going projects: (1) Reflective design. (2) Focus on personal experience (3) Contextualizing technology in culture (and not vis-à-vis other technology).

The following case studies demonstrate how CTP allows us to consider values. In each, we have attempted to explicitly identify theory-constitutive metaphors and what they marginalize, show our inversion of the assumptions as we think of new metaphors, and finally, design and build systems that demonstrate the alternative assumptions.

Museum Imprints

One of the projects informed by the Culturally Embedded Computing Group's approach to CTP in HCI involves designing new applications of technology for museums. Traditionally, technology enters the museum either as an artifact on display or more commonly as a tool mediating interpretation about the objects on display. The prevalence of technology as an information delivery tool is symptomatic of the predominant view of typical visitors as novice information seekers/recipients. Although great care is taken to allow for a personal museum experience, visitors

have little effect on the museum itself other than choosing their own path in it. One of the most recent additions to the museum toolkit is the use of handheld computers as personal tour guides. These guides are championed as devices for optimizing the museum visit, giving visitors footholds for interpreting the objects on view and allowing greater autonomy in navigation. The success of the guides is measured in terms of whether the visitor believes he or she learned more about the objects or whether the visit was more enjoyable. These computerized guides certainly are successful in delivering information, but they do so through maintaining the dominant museum paradigm.

What the guides, and technology in general, tend to marginalize are the visitors' social, creative, and affective experiences. At any given time, a museum holds a collection of not only objects but of people. The experience of the exact same exhibit may be dramatically different from one day to the next depending upon the configuration and mood of people present. Yet, the personal handheld guides remain the same regardless of who is present, and in fact, they tend to foster a much more isolated experience as one spends more time looking down than up or retreats within the isolated soundscape of the headphones. In the spirit of CTP, we have attempted to take these marginalized elements of the museum experience and move them to the center with the design of an application, called *Imprints*, that augments the functionality of a handheld tour guide.

The Imprints program was designed to draw visitor attention to the implicit, and explicit, effects of visitors on the museum space. When a visitor chooses to use a handheld tour guide, he or she is given the opportunity to also create a personal mark with a computer drawing program. This imprint is subsequently associated with every object the individual visits. In addition to questions such as 'who was the artist?' or 'how was this made?' one of the questions visitors can ask about each object on the handheld computer tour is 'who else visited this object?'. This last question brings up the imprints of all previous visitors from which visitors can look for patterns of marks or ponder why one object was more popular than another.

In this very simple manner, we allow visitors the opportunity to change the museum space by leaving something behind for other visitors. In addition, they have the opportunity to participate in a creative act of expression – making a mark reflective of their mood or their sense of identity. (Figure 1)

In line with the reflective philosophy of a critical technical practice, we are measuring the success of the Imprint program not in terms of does it create a 'more' enjoyable experience or does it create 'more' awareness of visitor roles, but instead, we seek to understand how visitors appropriate an application designed for marginalized aspects of the museum experience. How do visitors integrate this simple act of making, leaving, and viewing marks into their visit? Do they see these marks as legitimate forms of expression and participation?

Intimate Objects
We started to look at couples in long distance relationships as one class of extreme users of communication technologies. We saw some assumptions about communication in such cases: today's advanced technology means that people in long distance relationships can talk by cellphone whenever and wherever they want, and they can ostensibly videoconference using webcams at a moments notice. The corollary of this assumption is that the more bandwidth available, the easier it must be to transmit a sensation of intimacy at a distance. Furthermore, standard communication devices capable of communicating a wide variety of information are the best choices for communication. And finally, communication devices should all be able to talk to each other: Metcalf's law suggests that the value of a communication device grows as more similar communication devices there are it can talk to.

We decided to invert these assumptions, working with the minimum amount of bandwidth possible. We knew it was possible to communicate intimacy over low-bandwidth connections: for centuries it was common for couples separated by the demands of career, family, or empire-building, to communicate by handwritten letters, with high
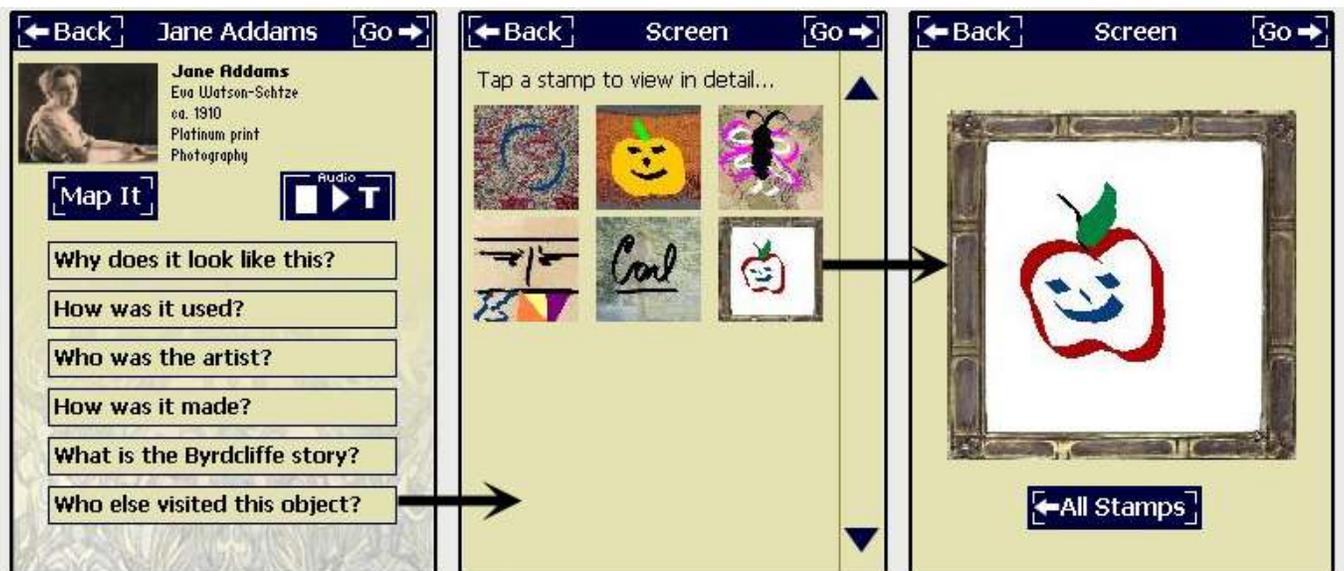

Figure 1: Imprints as traces

latency times due to batched delivery mechanisms, such as ships and horses.

We wanted to find out if intimacy really does scale as bandwidth. We wanted to explore devices that were targeted specifically at communicating intimacy rather than general-purpose communication. And we wanted to design devices that were only for communicating within a couple. To do this, we built two separate systems: a physical minimal intimate object (PIO), and a virtual minimal intimate object (VIO).

Figure 2: Physical Minimal Intimate Objects

The PIO is a small metal box, formerly used to contain Altoids mints, and now used to contain a small computer with an internet connection, a large LED and a button. (See Figure 2) When the button is pressed by one member of a couple, the LED on their partner's PIO glows bright red, and then fades over time. A small LED on the side of the box shows the current state of the partner's PIO.

The VIO implements identical functionality in software: it appears as a circle in the Windows system tray. (Figure 2.) When it is clicked, it sends a signal to the partner's VIO to turn bright red; this also fades over time. Moving the mouse over the circle without clicking shows the current state of the partner's VIO.
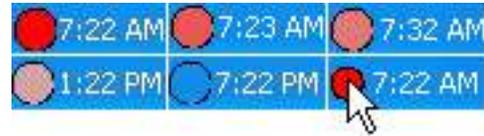

Figure 3: Virtual Intimate Object (VIO) in taskbar, showing color changes over a twelve hour period. Note initial rapid fading in top line. Final image shows display of remote partner's button state on mouseover.

We were pleased to find in user testing that this small amount of bandwidth turned out to be of value to our subjects and found too that the simplicity of the interface made for rich opportunities for dynamic and continuous reinterpretation by the users. Our re-examination of key metaphors inherent in communication resulted in a technological improvement as well as a deeper understanding of the issues being explored.

Appraise

Appraise is a project that investigates the reflexive relationships between documentation and ideation. The project explores the relationship between documents, the technological basis of scholarly communication, and the structure of scholarly communities using that technology. The project investigates how documents provide the basis for social worlds, the context for ideation and scholarly activities. (Figure 4)

The key story we are used to telling about scholarly activity is that of the romantic 'genius author' who does research alone or in a small team and then reports it to the world in a succinct article. Thus, for nearly 350 years, the scholarly journal has been the primary vehicle for communicating the results of scholarly activity, providing the basis for registering new results, establishing the quality of those
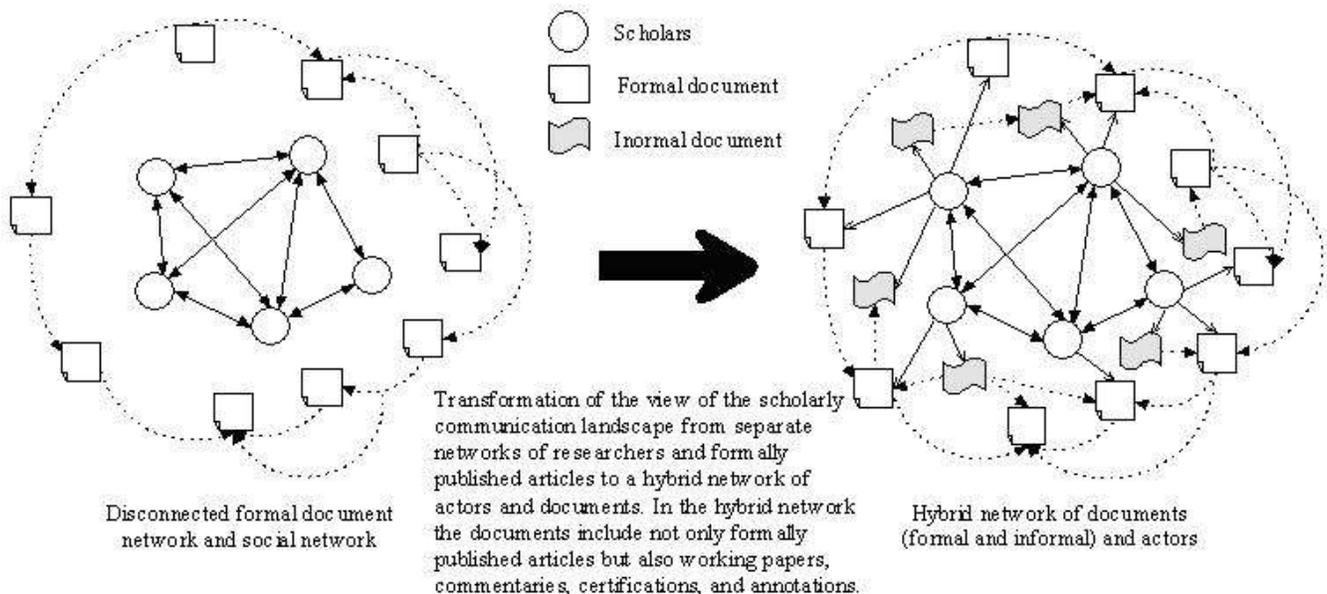

Figure 4: Appraise formally and informally hybridizes networks of documents and actors

results through peer-review, and awarding tenure and promotion. However, with the rise of web based publication alternatives such as email, Wikis and Blogs, the journal system is now under serious pressure.

Challenging the 'genius author' story we can think of a more reflexive and evolutionary relationship between communities of authors and documents which together create hybrid networks. To understand such networks which include both authors and various formal, semi-formal, and informal documents, we utilize and extend state-of-art analysis techniques (e.g. social network analysis methods and document-based link analysis) and build visualization and search tools to further explore the effect of community. Through in-depth analysis on the different levels of communication artifacts and the evolution of this hybrid network, the reflective and evolutionary interaction between researchers, their communication artifacts and the development of intellectual assets could be elucidated. In difference from similar social-networking projects, the analyses tools developed in the project will be available to the community members in real-time, thus opening a space for reflection, and allowing authors to consider, while writing, their own understanding of values like trust and their conception of authority, authorship, agency and expertise.

Affector

Affective computing promises to enhance technology interaction by adding the neglected dimension of emotion. Yet, most attempts to introduce affect into system design still abide by the metaphor of codification and opertionalization. Trying to fit emotion into existing computer models results in de-emotionalization; emotion is instead codified into transmittable and computational information. What is lost in the process is the richness of human experience which is radically limited during interaction with computers.

Figure 2: Sample Affector output showing image distortion by affective inputs

As part of a broader set of projects exploring alternative approaches to affective computing, we are experimenting with Affector. Affector expresses emotions between people without itself understanding or representing them. A video feed between the offices of two friends is systematically distorted to give a sense of background mood (Figure 5). Inspired by Brooks' subsumption architecture, sensors directly select and drive video distortions without an intermediate layer of emotional representation. The system's input/output mappings will be tuned by its users to their own personal relationship and strategies of interpretation.

Our new metaphor suggests that emotion cannot be codified and transmitted, rather, that it is in a state of constant negotiation by which meaning-making is part of our everyday activities. In this approach to affective computing, the emotional connotation of the system is not correlated with an internal, formal emotional model, but with its meaning to its users, who are interpreting the behavior of the system in a rich, situated network of human relationships. Evaluation of the system will not focus on whether the system is 'right' (i.e. makes a correct, but limited model), but on the nature of its evolving impact on relationships between friends. Our goal in developing this approach is to demonstrate technically that it is possible to integrate a richer understanding of emotion into design and to bring forth values other then efficiency and accuracy.

Conclusion

We believe that as emotive, social, and spiritual beings, people continuously sense and respond to technology in complex ways. Designers have an opportunity to embrace this complexity by questioning and highlighting values in their technology design.

In the projects above, we have shown how it is possible to invert the values of productivity and efficiency and yet produce technological systems that continue to be meaningful to users, espousing values of experience, felt life and emotion.

As we outlined, CTP is a powerful set of practices, design principles and approaches that is much needed in HCI today. It allows us to rethink our dominant metaphors, to expose the values that go into design and to surpass impasses that are encountered during standard system building approaches. Moreover, as we depart from 'efficiency' and 'productivity' models, CTP allows us to rethink our choices and renegotiate our values.

We believe that with our strong theoretical background, years of hands-on experience and demonstrated commitment to the subjects at hand, we will significantly contribute to the workshop's success. We hope to learn from and contribute to the projects of our peers.

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