The Disenchantment of Affect

Phoebe Sengers
Information Science, Cornell University
Ithaca, NY 14850 USA
Tel.: 1-607-254-5396
Fax: 1-607-255-5196
Email: sengers@cs.cornell.edu

Kirsten Boehner
Information Science, Cornell University
Ithaca, NY 14850 USA

Michael Mateas
Literature, Communication and Culture and College of Computing, Georgia Institute of Technology
Atlanta, GA 30332 USA

Geri Gay
Information Science, Cornell University
Ithaca, NY 14850 USA

Abstract: In computing design, experience is often broken down, compartmentalized, and engineered: a process that often disenchants the original experience. In this paper, we demonstrate the possibility to design for experience, not by formalizing and rationalizing it, but instead by supporting open-ended engagement and appropriation. We illustrate this approach through Affector, a case study in affective computing, in which we focus on user interpretation and construction of emotional experience over its computational modeling. We derive design and evaluation strategies for enchantment that focus on supporting the ongoing construction and interpretation of experience by human participants over the course of interaction. We suggest that enchanting experiences may be designed only by approaching enchantment obliquely: not by engineering it in, but by providing opportunities where it may emerge.

Keywords: enchantment, affective computing, affective presence, ambient computing, social awareness, interpretation

Introduction

"The fate of our times is characterized by rationalization and intellectualization and, above all, by the 'disenchantment of the world.'" – Max Weber [1, p. 155]

Experience design is the new hallmark of interaction design. Products not only provide functionalities but support experiences and many practitioners now seek ways to optimize user experiences of new technology. One approach to optimization tries to script and control user experience as tightly as possible. This approach draws on our understanding of software engineering – anticipating possibilities, engineering flows of action, constraining alternatives – and positions personal experiences as engineerable.

In contrast, McCarthy, Wright, Wallace, and Dearden [2] argue for considering enchantment in design, i.e. supporting depth of engagement and allowing for surprise that can lead to – as opposed to script or control - rich experiences. This notion of enchantment is drawn from the work of anthropologist Alfred Gell [3], who illustrates the potential of technology to enchant by describing the magnificently decorated Trobriand war canoes carved to awe and overpower their trading partners. An enchanting technology in this sense inspires wonder, amazement, and emotion, and suggests magic and mystery.

In considering enchantment in contemporary technology, we run into a conundrum, since magic and mystery are vanishing commodities in our scientifically-oriented society. Max Weber argues [1, p. 138] that one of the fundamental differences between modern and 'primitive' societies is that mysteries are seen as positive in primitive societies but are a source of discomfort for modern societies. Modern humans, Weber says, view mystery as a problem to be solved and seek to eradicate it through scientific explanation. Weber calls this disenchantment the hallmark of contemporary society. In modern society, we believe "that principally there are no mysterious incalculable forces that come into play, but rather that one can, in principle, master all things by calculation" (138).

Following this argument, most technologies in our scientific society are indeed disenchanting. Things that could be considered mysterious or magical are rendered technically available by delineating and defining them, by developing cause-and-effect narratives for them, by controlling them. Human experience, for example, moves from a personal, subjective, and elusive phenomenon to a commodity that can be technically, reliably, and even mass-produced. While the user of a technology may experience it as enchanting, the designer knows better, for he or she directs how it operates and, barring unintentional mistakes, knows there is no mystery to its function.

In this paper, we argue, in contrast to Weber and to script-focused experience design, that it is both desirable and possible to build modern technologies that recognize and honor the mysteries of human experience. Our approach involves embracing ineffability, as Boehner terms it [4], as a core aspect of technology design. We see human experience as to some degree fundamentally unknowable, necessarily exceeding the categories by which technologies operate. Rather than modeling, delineating, and identifying rules for human experience and reifying those categories and constraints as technologies, we instead use technologies to provide stimuli that support human experiences as open-ended and emergent.

We explore the possibility of addressing enchantment in this way through an analysis of affective computing, a specific aspect of experience design. As we argue below, many current approaches to affective computing inadvertently disenchant affective experience, rendering it explainable and categorical, and, in the process, reducing its richness to the simple kinds of categories available to a computer. We propose instead to support human experience and interpretation of affect. Together with our project partners, we have developed a variety of case studies for open interpretation of affect [e.g. 5,6,7,8,9]. In this paper, we present our theoretical orientation in response to what we see as the disenchantment of affect, and we elucidate this orientation through a case study of a system to support awareness of emotional climate. We end by documenting general design and evaluation strategies for restoring the ineffability, the mystery, and the enchantment of affect.

Disenchanting Affect

Affect is an important case study for the disenchanting effects of contemporary technology since, as Dror has documented [10,11; see also 4], affect was historically considered a mysterious, spiritual outside force acting upon humans in ways analogous to Gell's description of enchantment as a "magical power which may deprive the spectator of his reason" [3, p. 46]. Yet, in Dror's account of laboratory sciences and the development of physiological measurement, emotion moved conceptually from a spiritual, feminine, subjective, uncontrollable force to a measurable, categorizable, reproducible, and objectively trackable entity. In Weber's terms it became disenchanted: technically understood and potentially controllable.

Similar issues arise in contemporary affective computing, which inherits the intellectual legacy of earlier physiological experimentation [4]. This is most obvious in contemporary approaches that use physiological measures to identify human emotions, drawing directly from the intellectual legacy described by Dror. In these approaches, the unexplainable mystery of subjectively experienced emotions is often replaced by a scientific, objective certainty tracked by externally observable physiological measures. This disenchantment of emotion is seen as precisely the virtue of these external approaches. Mandryk et al. [12], for example, cites the ability to externally, continuously, and objectively track user emotions as the prime advantage of physiological measurement over self-report.

The disenchantment of emotion in affective computing is not, however, tied primarily to the physiological mechanisms sometimes used to sense emotion, but instead to its underlying theory of emotion. As we have argued elsewhere with DePaula and Dourish [13], much existing work in affective computing sees emotions as informational units: well-defined, internally constructed states transmitted between people or from people to machines. The goal of affective computing is then for computers to cleanly and accurately identify and respond to pre-existing, well-defined human emotional states. This model relies on a notion of emotions as objectively discoverable, capable of being modeled formally, and computationally tractable.

Weber argues that disenchantment in modern society arises from an emphasis on intellectualization and rationalization to make sense of the world around us. Emotion is a case in point: while on the surface, it is hard to imagine a phenomenon less rational than emotion, in both Artificial Intelligence (AI) and Human-Computer Interaction (HCI), emotion is frequently assimilated into rational procedures. Picard's ground-breaking work [14], for example, made emotion palatable to a computationally focused community by drawing on Damasio's arguments [15] that emotion is a necessary part of rational behavior. Thanks in large part to Picard's work, such arguments are no longer needed to motivate emotion as relevant to interface design. Nevertheless, in order to make emotion computationally available, it is frequently necessary to develop rational decision procedures to address it. AI-based affective applications, for instance, still frequently draw on Ortony, Clore, and Collins's formal model of emotions [16] to provide a computationally tractable calculus for rationally deducing emotional states from an actor's goals and perceptions and events in the world. Affective applications that center on formal identification and processing of emotional states necessarily disenchant emotion in order to be able to address it computationally.

On the surface, it is unclear that such disenchantment is problematic. The power of disenchantment in affective computing is the power of technique, leading to a proliferation of warrantable affective technologies. What makes them disenchanted is precisely what makes them work. But in the process of making emotion amenable to technical calculation, aspects of emotional experience that are not easy to delineate, define, reason about, and control tend to be left out of the picture. For example, Dror notes that experimental subjects who did not appear to reproduce defined emotional states were dropped from 18th-century experiments [10]. Similarly, contemporary affective computing researchers sometimes use actors in experiments because of their ability to portray recognizable emotions better than ordinary people, but risk oversimplifying real human emotions in the process [17]. In terms of applications, this may result in an impoverished view, focusing on simple tokens of emotion rather than the dynamic complexity of felt emotional experience.

Reenchanting Affect

As McCarthy et al. note, "[e]nchantment does not necessarily imply that the object of enchantment must be novel or extraordinary, rather that the person sees how rich and extraordinary the everyday and familiar can be" [2, p. 2]. Affective computing opens an important space for addressing the richness of everyday experience, but the constraints of computing can make it difficult to avoid reducing this richness to simple, numeric categories and explanations. Our goal, in collaboration with our Affective Presence partners Bill Gaver, Kristina Höök, and the Intel People & Practices Group, is to "re-enchant" emotion by focusing users' attention on the fascination of everyday emotional experience. In our model, computing is primarily used, not to acquire and reason about users' emotional states, but rather to provide opportunities for users to experience, interpret, and reflect on their emotions. Affect is understood as co-constructed by people and machines over the course of interaction. Affective presence systems focus on affective *experience*, rather than affective *computing*; they support reflection on rich, enigmatic experiences of affect.

This changed notion of what affect is leads to new epistemological commitments in design and evaluation, and new strategies to support these commitments. For example, consider two systems supporting identification of users' emotional states: Anttonnen and Surakka's EMFi Chair (2005) and Lindström et al's Affective Diary (2006). The EMFi Chair [18], following the standard affective computing model, contains an embedded electromechanical film that measures heart rate. Based on statistical models derived from laboratory experiments where subjects are exposed to affectively valenced images, an algorithm for the chair's sensed data determines whether its user is experiencing positive, negative, or neutral affect. This affective state can then be reported to an application without active awareness of the user.

The Affective Diary [8], based on the affective presence approach, also collects physiological data from users during the course of a day. The design of the system is based, not on a statistically valid laboratory experiment, but on a cultural probe eliciting emotional experiences, with returned data left under-interpreted. Rather than classifying the user's emotion directly, the data is represented to users for interpretation in an open-ended format along with photos, SMS messages, and other 'affective memorabilia' collected from the user.

While the diary automatically proposes shapes, colors, and animations for a particular day based on collected data, users alter these and add notes to better portray their felt experiences.

While the EMFi chair focuses on how emotional data can unobtrusively be extracted, the Affective Diary focuses on how users themselves become aware of the everyday complexities of emotional experience. The differences between these two case studies demonstrate some of the major theoretical shifts that occur in moving from the standard affective computing to the affective presence approach, and resulting changes in design and evaluation strategies:

1. **Affect as Interaction**: The target of design and evaluation shifts from affect as a form of data that can be collected and interpreted by computers to affect as experienced in interaction with other people or with machines. Systems are designed for appropriation, with active engagement required to determine meaning. Although science and technology studies suggest that all systems are appropriable [e.g. 19,20], it is still possible to preclude the license to appropriate or close off the range of appropriation. Evaluation therefore involves accounting for how users engage and make meaning of the system in action and the influence of system attributes on interpretation.
2. **Co-Interpretation of Affect:** Design strategies shift from classifying and responding to affective data to supporting rich co-interpretation of affect between people and machines. Users, designers, and systems share indices for drawing inferences and confirming hypotheses. While system meaning is not predetermined or exclusively controlled by the system (or designer), any meaning will not do; the system must be flexible without degenerating into providing no direction for the interpretation process [see also 21] Evaluation of interpretive flexibility entails phenomenological accounts of how indices for interpretation are shared, taken up, or challenged, and how meaning is co-constructed.
3. **Reflection on Affect and Technology:** The application focus shifts from what computers can know about emotions, to how people can reflect on each others' emotions and the influence of technology on it. In other words, emotion is not just experienced with or through systems; emotion and the system itself become objects of reflection.

Evaluating the evocativeness of reflection throughout the design and use of affective presence systems involves creating accounts of when, how, and why new perspectives on affect and technology emerge.

4. **Affect as Art and Science:** To support richer, 're-enchanted' notions of affect, inspiration shifts from primarily cognitive psychology to include a broader set of perspectives from the arts and humanities that do not require objectification and technical calculation in the sense of the sciences. We draw on rich traditions of affect as subjective experience in the humanities [e.g. 22,23] and situational, experiential approaches in HCI [e.g. 24,25,26]. We aim to design for emotion as a rich, complex, and personally meaningful phenomenon, while our evaluations evoke the production of rich, complex, personal narratives of use.

Our goal in the remainder of this paper is to unpack these 4 principles and their relationship to design and evaluation for enchantment. Next, we describe how these principles were instantiated in one detailed case study, then step back to flesh out a broader set of strategies for the enchantment of affect.

Case Study: Affector

In this section, we describe how the design and evaluation of Affector leveraged these 4 core principles to support a 're-enchanted' sense of emotion. Affector was designed to support, not affective communication of tokens such as 'happy' or 'angry,' but a deep, intuitive, complex, and difficult to capture sensation of affective climate or mood of a space.

Design of Affector

The design of Affector emerged from the personal experiences of author Phoebe Sengers and her colleague Simeon Warner. They noticed that although they sit mere feet away from each other in adjoining offices, the dividing wall limits their awareness of each other. Sengers and Warner wondered if a translucent digital 'window' could communicate some sense of their befriended neighbor's emotional presence through the dividing wall. They did not want a physical window, since they did not want to give up their privacy nor be distracted by each other's movements and activities. They wanted to evoke not presence but affective presence.

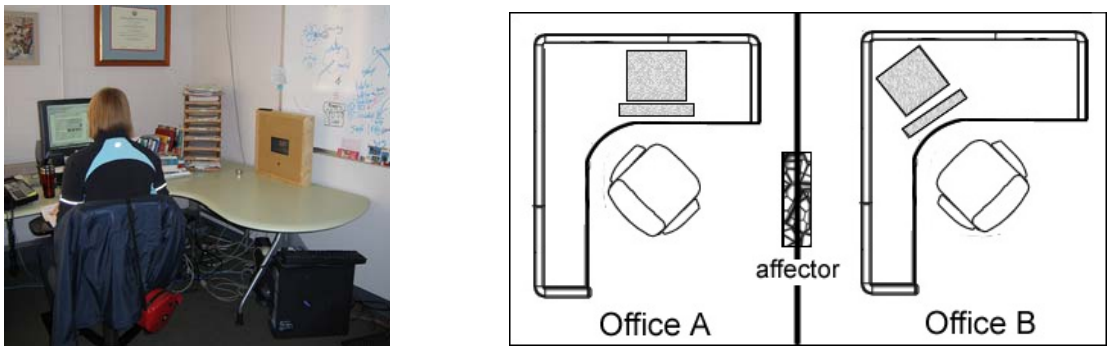

Figure 1: Affector set-up.

Figure 2: Example distortions.

The Affector system consists of two units, each of which contains a small web camera and a display screen (see Figure 1), mounted on both sides of an adjoining wall. Each camera is connected to the opposite units' display, so that Sengers sees a view of Warner's office and vice versa.

Principle 1: Affect as Interaction

In order to force design focus on affect as interaction, not data, the authors removed internal models of emotion from the system. This decision was motivated by Brooks's principle of intelligence without representation [27], which argues that systems can respond intelligently to their environment while replacing internal representations with response-action rules. In

the case of Affector, the system instantiates a set of user-specified rules that control the mapping between sensed data and output. Based on sensed aspects of the input image, such as the number of pixels containing skin color or moving, the system selects a distortion, such as inverting colors, to apply to the display (Figure 2). Users' interpretation of the emotional meaning of the resulting distortion, or of the objects, people, or movement they see in the distorted video, is up to them and is a major focus of evaluation documented below.

Principle 2: Co-Interpretation of Affect

To support the development of a joint language of affect, the mapping between what is sensed and the resulting distortion is configurable through a joint web interface accessible to both users. Whereas in many affective communication systems, mappings between input data and output expression are hard-coded, in Affector, users as designers can change the mappings on the fly. There is not (necessarily) an interim step where the designers say: "if we detect skin tone, then it probably means X, and this distortion best communicates that meaning." Instead, users as designers play with detection and presentation simultaneously. The determination of meaning happens not prior to use but during and subsequent to use.

Principle 3: Reflection on Affect and Technology

In order to support reflection on both emotion and the role technology plays in it, Affector is deliberately designed to communicate emotion obliquely and enigmatically. It does not provide easy answers to how someone feels today; instead, it provides indirect evidence which users must interpret with reference to the data supplied by the system, as well as background knowledge of their friendship and contextual cues.

Principle 4: Affect as Art and Science

One of the central problems in designing for enchantment is the difficulty of accessing the personal, intimate, and inherently subjective nature of experience. Affector addresses this issue through the use of autobiographical design. By designing for rich details of his or her own life, which he or she knows intimately and personally, designers may be able to offer richer experiences to other users as well. Rather than aiming to achieve objective knowledge about personal experience, autobiographical design embeds the designers' personal experiences and subjectivity into the system.

Autobiographical design is not the same as 'I-methodology' [28], where designers substitute their own needs or desires for those of a different target group. Autobiographical designers are not designing for others but for themselves explicitly and reflectively. This type of introspection is a standard modus operandi in the arts and humanities. Cultural theorists, for example, argue that disciplined self-examination leads to kinds of knowledge that escape an objective approach. In literature, authors may draw upon their own experiences and present themselves in ways that – they hope – will be useful and interesting for readers. This cannot be simply self-indulgent; in writing, as in design, authors must think carefully about how their experiences may be similar to their audience's experiences, or, if dissimilar, how they can be presented in ways that are meaningful to the audience. In the case of Affector, Sengers and Warner are testing the system on themselves to develop an experiential sense of what it is like to use such a system and to fold that experience directly into the system design. The known risks of autobiographical design are balanced, in part, by the non-autobiographical evaluation of the system, to be described next.

Evaluation of Affector

Evaluation of Affector was led by co-author Boehner with David Klein, Liz Goulding, and Tom Jenkins. The evaluation took place over two years of designing, implementing, and using Affector. We used many standard HCI evaluation techniques, including observations, diaries and daily logs, interviews, and focus group sessions, but the shift to open-ended support of rich, interpreted experience altered the evaluation questions these methods were intended to answer and the ways in which their results were interpreted. In this section, we describe how the 4 principles shaped our approach to evaluation before highlighting relevant results.

Principle 1: Affect as Interaction

When considering affect as data to be transmitted, a natural evaluation technique would be to measure how accurately one party can detect the other's emotional state. In recognizing that affect is constructed and experienced in interaction, we instead study how the system acts as a resource - among others - for users to develop a sense of their own and their partners'

affect. The process of meaning-making was tracked through third-party observation of how Sengers and Warner oriented to and incorporated the system into their respective offices and daily work practices, as well as through intermittent workday interviews where evaluators asked the users to narrate their system use.

Principle 2: Co-Interpretation of Affect

Co-interpretation stresses the joint roles of designers, users, and other participants in making sense of how a system works. In terms of evaluation, this means identifying and drawing out multiple, sometimes conflicting interpretations of Affector over time. Interpretations were identified during interviews and focus groups where Sengers and Warner discussed their different interpretations of how Affector worked (or didn't work) and planned design changes. Sengers and Warner also maintained diaries of their day-to-day experiences with the system. Throughout the evaluation, Sengers and Warner were asked about their respective points of view regarding the goals of the system, their measures of success, their design strategies, and whether or not these changed through design and use.

Principle 3: Reflection on Affect and Technology

Because one of the dominant design strategies used for Affector is autobiographical design, evaluation interventions were designed in part to stimulate reflective autobiographical accounts. Although we maintained a degree of separation between designer and evaluator by having a separate team execute evaluation, the role of the evaluators was not only to form their own impressions of what was going on but also to provoke Sengers and Warner into articulation, deeper reflection and analysis of their experiences. In the process, user (and, in this case, designer) interpretations were not merely reported by evaluators but actively challenged, as we will describe below.

Principle 4: Affect as Art and Science

The focus on interpretation and reflection led to a shift in our use of objective data during the course of evaluation. The tracking of objective data about user behavior is an essential component of many evaluations, and the same is true of our evaluation of Affector. The shift from a standard scientific approach occurred in our use of such data; rather than focusing on

what the numbers might mean objectively, we used raw data as a resource for narratives and interpretations by stimulating participants to articulate and reflect on their experiences.

Results

Our shifts in principles also shift the central evaluation question from "does it work?" to "how is the system made to work?" and "what does 'working' mean in the shifting context of this particular system for this particular dyad?" [29]. A full account of the Affector evaluation can be found in [4]. Here, we focus on 3 results from reflective probes that articulate how Affector does or does not support enchantment.

1. **Success of the system is not tied to a countable effect on face-to-face interaction but to a subjective experience of camaraderie.** Sengers and Warner kept a constant log of how many times they consulted or engaged with Affector, manipulated Affector's sensor/distortion rules, and interacted with each other face-to-face. This information was always available to Sengers and Warner, but the evaluators would also periodically present the usage data to them during interviews and focus groups for their interpretation. It was through this constant awareness of counting 'looks' and 'face-to-face' interactions that Sengers and Warner began to modify their goals of the system and metrics of success. For instance, in one of the original design sessions, Warner articulated the goal of the project as "to produce something that affects our awareness of each other and perhaps changes our interactions as a result." However, although they initially anticipated that Affector would increase their face-to-face interactions and that their usage of Affector would be high, they later described the importance of Affector in less utility-based and codifiable terms. For example, Sengers enthusiastically described one encounter with Affector as recognizing that "I'm in my office with the door shut. And Simeon is in HIS office with the door shut. And he's still keeping me company. That's cool!" Sengers' sense of the system's success in this instance was not about detecting an accurate mood of Warner or that it clearly indicated his presence and therefore availability for social interaction. Instead, the system was operating successfully through providing a more ephemeral sense of the other from the vantage point of their respective private spaces.

2. **Affector ideally would support richer meaning-making than simply giving a sense of presence or absence, in part by challenging easy interpretation.** In one focus group, Sengers and Warner worked with a 'data table,' a physical table stacked with all the existing information collected arranged in chronological order, including usage logs, screen shots from various stages of development, important emails and sketches about system design, papers written about the project, and quotations from interviews. Akin to browsing through a family photo album or scrapbook, this reflective time-out prompted affirmations of previous discussions as well as new articulations.

One set of new reflections, for example, surrounded the difference between Affector and instant messenging buddy icons. The latter they described as providing 'information tokens' – something that did not require or invite much interpretation – indicating directly a state of being on or off-line, while the former should support and encourage situated meaning-making. For instance, Warner indicated that one difference between a buddy icon and Affector is that "it's part of me being **there**" where the 'there' is a rich context of a shared space and shared relationship. Interactions that occur in the common space outside their offices, for example, become a source for reflection not only by each individually but jointly as they would often consult Affector to see how their partner responded to a common stimulus. In other words, the richness of the information is not contained completely in the information token of "online" or "offline". The meaning of Affector depends upon its embeddedness in a larger multi-faceted environment. The richness of the Affector window was also advanced through distorting what would otherwise be considered easily 'readable' emotion cues such as facial expressions. For instance, Sengers commented on one distortion that "I feel like I'm looking at a picture of him as opposed to looking at him. It feels very unreal in some sense and unobtrusive." At another point she commented: "It's poetic, even if you can't read s*** in it". Even when Affector failed to support meaningful interpretation, it still gave off an evocative sense of presence.

Although Sengers and Warner felt Affector in its current incarnation often defaulted to binary presence indication, they were striving for something more open to interpretation. They wanted meaning opportunities, not information tokens, to build up a sense of affective

presence over time and not in an instant. These reflections led to specific design goals for Affector v2.0 to support new meaning opportunities: more complex sensors, distortions that visualize sensed data such as movement, and integration of memory into sensing and distortion.

3. **The ephemeral nature of Affector is critical to success; a 'good' experience of Affector does not involve reading affect on demand but a complex development of interpretation.** In another focus group, the evaluators asked provocative, devil's-advocate-type questions meant to challenge Sengers's and Warner's thinking. To formulate these questions, we suggested reversing defining characteristics of the system set-up. For instance, although Affector was designed to run continuously in the background, the evaluators suggested requiring the user to push a button on Affector in order to display all the changes in the neighboring office since its previous invocation. Sengers and Warner immediately, and aggressively, rejected and deconstructed this suggestion. They argued that the ambience of Affector was important not only because it was less distracting but because it was ephemeral. They liked that Affector changes fleetingly and might pass by unnoticed, as Sengers stated "it's supposed to be like the everyday and the everyday is ephemeral". Warner agreed and suggested that you can't tell how someone feels just by staring at them for a long period of time. Instead, one would occasionally be rewarded by catching something worth pondering. For instance, during one interview with Sengers, she was commenting on how Affector in its current incarnation worked as a low resolution video window and wasn't conveying affect. At that very moment, the evaluator and Sengers witnessed a low-resolution, cartoony Warner reclining in his chair and lazily putting his arms behind his head, apparently in a pinnacle of relaxation. Sengers immediately exclaimed, "Wait a minute! There's emotion, right there!" Whether or not Warner intended to communicate emotion or whether emotion could be 'read' accurately through this movement, Sengers interpreted the movement as significant and part of her enthusiasm came from the serendipity of observing it.

In sum, both Sengers and Warner felt it was important that Affector could rarely be read in an instant or in a single look, but that one's impression of the neighboring emotional climate built up slowly over time and was integrated with other interactions with each other

throughout the day. The devil's advocate suggestions helped the designers better understand and articulate how they experienced Affector by specifically responding against what they did not want it to be, a state that is sometimes easier to articulate.

Did Affector support enchantment? In a narrow sense, our evaluation highlighted some factors that were key to the aspects of Affector that were successful – supporting a sense of camaraderie and an ephemeral, ongoing process of interpretation integrated with everyday life. It also highlighted aspects that were not yet successful, in particular the need for supporting more complex interpretation.

More broadly, a deeper understanding of enchantment emerged over the course of design and evaluation. With Affector, Sengers and Warner began with a desire to get away from productivity-type presence tools, but the participants were all still to some degree designing or evaluating with the focus on 'reading affect,' though in novel ways. But when Affector was working, it did so in unplanned-for moments when context, content, and interpretation combined to give a pleasurable sense of the other.

In the end, if the guide for our work had been accuracy of communication, we would have emphasized face-to-face interaction accounts and Affector's readability, and tried to demonstrate the value of the system through its utility. But its shape and the value of its use is more nuanced. In some ways it is enchanting because you cannot easily articulate what it is doing and how it is used. It is enchanting as a playful object that seemingly has nothing to do with work nor with typical social activities. It is new and magical, but, because it is something that can be easily ignored, it is also unassuming and humble. Our experiences with Affector suggest that enchantment must be approached obliquely: that a space for enchantment can be created but not forced. In the next section, we will indicate, more generally, how it may be possible to do so.

Designing and Evaluating for the Enchantment of Affect

Affector is one of many affective presence systems [e.g., 5, 6, 7, 8, 9]. Here, we step back from the specifics of Affector to identify general design and evaluation strategies for

enchantment emerging from our and our collaborators' work. Our methods aim to support enchantment through open-ended reflection and co-interpretation of users' everyday experiences. To this end, we draw from disciplines with a focus on meaning making, interpretation, and the dynamic between designer/artist, user/audience, and the artifact, such as participatory design, critical design, cultural studies and media theory, the arts, and hermeneutics [see also 21].

Strategies for Design

Varying System Control

To encourage open-ended reflection on user experience, we play with and expose the amount of authority and influence the system has on the meaning-making process. One technique for this strategy is to *remove explicit internal models* of meaning such as described previously. Another technique, also employed by Affector, is to allow *end-user configurability*, so that users literally recode what the system does. A third technique, which Mateas terms *alien presence*, uses Artificial Intelligence not to create an intelligent system with authority over interaction, but to portray the system as having a specific, idiosyncratic point of view [30]. For example, Office Plant #1 [5] is a robotic sculpture which modifies its physical structure in response to its perception of the tone of its users' email. The metallic plant assumes different positions throughout the day, presenting its interpretation of the office climate in a foreign language of fronds and petals. The alien-ness of this display production suggests to users that it is but one interpretation of the office climate.

Defamiliarization

Defamiliarization, or making the familiar strange, opens space for appropriation, interpretation and reflection by short-circuiting expected meanings and leaving room for ambiguity [31,32,33]. Alien presence, described previously, is one technique for defamiliarization. Gaver et al. suggest *juxtaposing incongruities*, placing something in an *unexpected context,* or *exaggerating information* that usually fades into the background [33]. Another technique we have found useful is *minimal representation;* in this case, the system is unfamiliar because of its apparent silence about what its representation should mean. For example, Kaye et al. have developed the Virtual Intimate Object, a communication device for

couples in long-distance relationships [7]. The VIO is a small button in the taskbar, which lights up in red when the user's partner has recently clicked on their own VIO. VIO is explicitly built to be unconstrained about what this click means, allowing its meaning to emerge over the course of a couple's interactions. It is in the open-ended interpretation of such systems that the 'magic' of enchantment can happen, leaving open a space for individual reinterpretation and reflection.

Digital Scaffolding

The strategy of defamiliarization, however, can easily dissolve into a lack of meaning or incomprehensibility. Designing for appropriation, interpretation and reflection requires more than generating apparently random displays disconnected to user activity or context. Therefore, we are also careful to provide a level of digital scaffolding, or bridges for moving from the familiar to the strange and back again. One useful approach is to *leverage familiar cues and contexts*. Although the system's ambiguity signals an openness to interpretation, the familiarity of the context provides a common ground to manageably navigate the interpretation space. Affector and VIO, for example are designed for people with some degree of shared context, whether a pre-existing relationship or a shared physical space. Another technique for scaffolding is the *framing* of a system – how the system is explained or situated. The name of the VIO (Virtual Intimate Object), for instance, alerts users that these little red dots on their task bar are about intimacy. They are given a gentle guide in that direction, though how they use it for this end is up to them. Finally, we use the technique of *dynamic feedback* where any information collected about the users for the system's use, or for the evaluator's use, is simultaneously available to the users as well. This promotes users' awareness of how the system works but also provides opportunities for forging interpretations of the data that may differ from the system's.

Idiosyncrasies and Personalization

Designing for enchantment entails designing for very personal and idiosyncratic experiences. The *autobiographical design* approach was explored in detail in the Affector case study. As the experts on their own unique situations, autobiographical designers cannot help but address their idiosyncrasies that could be lost in a generic user needs analysis. A related technique is to design for *extreme users* [34,35], such as fictional versions of the Pope [34],

existing users with unusual interests [35], or well-known complicated literary figures like Romeo Montague [36,37]. These real or fictional users provide a rich background for the designer to explore. Although designed for very specific users, the strategy of designing for the particular and idiosyncratic does not necessarily limit its general appeal. It is the very specificity of the design and resulting richness that affords opportunities for others to appropriate the design in new and interesting ways.

Strategies for Evaluation

The evaluation objectives and methods for affective presence systems follow from the design goals of designing for appropriation, co-interpretation, reflection, and richness. Our evaluation methods, informed by phenomenological approaches and interpretive inquiry [e.g. 38], orient around the question of how (and why) users attribute meaning to a system.

Reflection Probes

Since the key thrust of evaluating affective presence systems is elucidating how users make sense of the system, our strategies involve creating points of reflection for users to articulate this process. The evaluation methods we use become part of the system design blurring the boundary between where the system ends and the evaluation instruments begin. For example, the *dynamic feedback* methods described previously provide usage information to both users and evaluators, offering users an opportunity to share their perspectives on system usage. The user's interpretations of use, not simply the user's use of the system, become data for evaluation. Other reflection probes include *open-ended interviews* and *guided journals*. For example, in the VIO project, users wrote in a journal containing provocative, open-ended questions about the system as well as about their relationship. The journal became a point of reflection for users as well as for evaluators interpreting user reflections. As such, the journal became as much a part of system design as the little red dot on the task bar.

Rich Personal Accounts

To develop a better sense of user experience, we aim to help users create rich, personal accounts from users. The *diaries,* described above, and *open-ended interviews* are designed

to provoke users to think and express themselves critically and evocatively. These methods draw from the design approach of *cultural probes* [39] where responses are meaningful and personal to particular users at a particular time. The questions and prompts are not designed for standard responses that can be correlated and categorized easily into themes, but seek to surface user particularities for inspiration. In both traditional HCI and affective computing, self-report methods are viewed with a degree of suspicion: users could misrepresent the truth either because they forgot certain details, because the experience became transformed in memory, or because they wants to present a more idealized view of themselves. Certainly, this can be the case, but we are interested in what the system comes to mean to the users, whether this be based on some pre-existing truth or whether the truth is called into being during report. In other words, the very reasons why self-report methods are problematic in traditional HCI evaluation are reasons why they interest affective presence evaluators.

Outsider Perspectives

As our interest in interpretation is not in matching interpretations but in allowing them to emerge, our evaluation goal is not to find a definitive interpretation but to stimulate and put into conversation multiple possible interpretations of the system. As such, we invoke multiple interpretations of users, and also those of a range of evaluators using several techniques including *trading systems* for evaluation among collaborators, using *professional storytellers*, and using *participants as evaluators*. For example, Gaver [6], has used professional documentary filmmakers and ethnographers to create accounts of users in action with various affective presence systems. Sundström, Ståhl, and Höök [9] trained users to not only use their eMoto affective messenging system, but also to document and evaluate their friend's or companion's use of the system.

Internal and External Comparisons

To develop a systematic account of the design space for enchantment of affect, we perform internal and external comparisons with our systems. For internal comparisons on a single system, we *vary its design attributes* such as how familiar or strange its representations are or how the system is framed. For example, Sengers and Warner compared their use of Affector

with their use of a straight-forward video conferencing window. For the external comparisons, we explore the interaction of various system attributes with context dimensions. For instance, Affector is designed for a co-located environment for friends in a pre-existing relationship. The strategies for this environment will likely be different than for a system designed for co-located strangers with no shared relationship or for separated intimates with no shared physical space. Evaluating a specific affective presence system means evaluating it in a particular context, but to evaluate affective presence systems in general, we look more broadly at how people engage with or make meaning in a variety of settings with a range of different system attributes.

In sum, the design and evaluation strategies presented here are not all completely new. They are, however, refocused in order to support the open space in which users can experience enchantment. For instance, using feedback in system design is a well-known principle for an effective user interface, however our use of feedback is not geared toward matching one interpretation between user, designer, and system but in opening up points for multiple or at least unanticipated interpretations. Likewise, having comparative conditions, such as a baseline condition and an experimental condition, is a common method in HCI evaluation. However in this study, the comparative conditions were positioned as a resource for Sengers and Warner (i.e. the users) to provoke their development and understanding of Affector. In other words, the use of conditions supported the enhancement of the users' interpretations as opposed to being primarily a tool for the evaluators to judge significant differences. Disenchantment as practiced in technology design focuses on defining, categorizing, and controlling experience; our focus is instead on opening a space in which new interpretations and experiences can emerge.

Conclusion: Implications for Enchantment

The enchantment of technology can be understood in a variety of ways. As unpacked by McCarthy, Wright, Wallace, and Dearden [2], enchantment is a way of thinking about and designing for depth in an interactive experience. Our approach to affect has similarly been focused on using interactive experiences to increase awareness and reflection on the richness

of everyday emotional experiences. We have cautioned against disenchanting approaches to addressing affect with computer technology, in which affect is coded as a set of data to be extracted from users, classified, sorted, and reported to others – irrespective of a users' sense of their own experience. In contrast, we have presented an approach for re-enchanting affect, applying technology to augment rather than reduce the complexity of felt experience. This alternate approach also requires caution, however, so we will end with three important caveats.

First, it is important to recognize that enchantment is not necessarily a positive attribute of technology. In Gell's original formulation [3], enchantment includes a sense of being overwhelmed by technology's grandeur, potentially to the extent of subjugating one's sense of self. In this sense, enchantment is a means by which the technology builders assert domination over those who come into contact with it. In this respect, the enchantment of technology is not the aim of our work. Rather than making technology enchanting, our goal is to re-enchant affect. That is to say, we aim to help people understand how rich and interesting affect is – not the systems that help them to think about affect. This requires a shift in design and evaluation towards engaging users' personal re-interpretations.

Second, in arguing for the re-enchantment of affect, we are not advocating re-mystifying affect, in the sense of black-boxing emotions or blocking attempts to examine components of complex phenomena. We are not suggesting that, since we can never understand emotions completely, we should simply stop trying and celebrate the mystery of life. Instead, we argue against abstracting away the particularities of an experienced emotion and then forgetting that abstraction always loses something in translation. Because we see affect as dynamic, we advocate that what we understand to be true at one point in time for one individual is open to change. This malleability and openness can be short-circuited by hard-coded models of how affect works across time and across individuals. We draw attention to the meaning-making process in affective experiences, and in particular to the question of who has authority over this process – whether users, designers, system code, or some combination.

Finally, we emphasize that although we seek to move beyond the science of affect and objective physiological measures of emotion, we are not against the scientific method or the use of physiological data as indices of emotion. The scientific study of emotions, in part through physiological data, has made great advances in recognizing the integral role of emotions in our everyday experiences. Looking beyond scientific methods is motivated by the belief that this is one way of knowing the ineffable, but that, despite everything we will learn about affect, there will still be mysteries to explore. Science measures what it can control for and operationalize, but we are interested in experiences that often escape the necessary controls and codification of scientific experiments. Furthermore, in positioning affect as interaction as an alternative to affect as information, we recognize that information is still represented in our systems. We build on many similar methods and techniques, such as using physiological data as input. The difference is in whether the meaning and value of this information is allowed to emerge through interaction or whether it is controlled and prescribed.

In the end, affect can be 'designed *in*' or it can be 'designed *for'*. We can either build affect into the system's formal representations or set up situations where users are likely to have new experiences of and reflections on affect. Similarly, enchantment can also be 'designed in' – by focusing on the complexity and interest of the technology itself – or it can be 'designed for', by using technology to spur rich and engaging experiences and reflections. We believe the principles, design, and evaluation strategies presented here provide a valuable resource for stemming disenchantment and designing *for* the enchantment of experiences in our modern world.

Acknowledgements

This work is supported by NSF awards IIS-0238132 and IIS-0534445. We are indebted to our Affector collaborators: Simeon Warner, Eunyoung "Elie" Shin, David Klein, Rev Guron, Tom Jenkins, Yevgeniy "Eugene" Medynskiy, and Liz Goulding; our Affective Presence partners: Ken Anderson, Bill Gaver and Kristina Höök; and to Paul Dourish, Shay David, Brooke Foucault, Rogerio DePaula, Michael Golembewski, Joseph "Jofish" Kaye, Lucy

Suchman, Petra Sundström, Elizabeth Wilson, and the Cornell Culturally Embedded Computing and HCI Groups. Thanks to this issue's editors and reviewers for helpful suggestions.

References Cited

1. Weber M (1946) Science as a vocation. In Gerth, H. H., Mills, C.W., trans. and ed., *From Max Weber*. NY: Oxford University Press, 129-156.
2. McCarthy J, Wright P, Wallace J and Dearden A (In Press) The experience of enchantment in human-computer interaction. Personal and Ubiquitous Computing. Available at Online First: http://www.springerlink.com/(2eed2yilfjxksvyf3v2wjv55)/app/home/issue.asp?referrer=parent&backto=journal,1,31;browsepublicationsresults,1224,1581;
3. Gell A (1992) The enchantment of technology and the technology of enchantment. In Coote, J., Shelton, A., eds., *Anthropology, art, and aesthetics*. Oxford: Clarendon Press, 40-63.
4. Boehner K (2006) *Interfaces with the ineffable*. PhD Dissertation, Cornell University Department of Communication.
5. Böhlen M and Mateas M (1998) Office Plant #1., *Leonardo*, 31 (5), 345-348.
6. Gaver W, Boucher A, Pennington S and Walker B (2005) Evaluating technologies for ludic engagement. *CHI 2005 Workshop on Innovative Approaches to Evaluating Affective Systems*.
7. Kaye J, Levitt M, Nevins J, Golden J and Schmitt V (2005) Communicating intimacy one bit at a time. *CHI 2005*. ACM Press, 1529-1532.
8. Lindström M, Ståhl A, Höök K, Sundström P, Laaksolathi J, Combetto M, Taylor A and Bresin R (2006) Affective diary. *CHI 2006*. ACM Press, 1037-1042.
9. Sundström P, Ståhl A, and Höök K (2006) A wild evaluation of users' emotional engagement. *HUMAINE Workshop on Innovative Approaches for Evaluating Affective Systems*.
10. Dror O (1999) The Scientific Image of Emotion. *Configurations*, 7(3): 355-401.
11. Dror O (2001) Counting the affects. *Social research*, 68(2): 357-378.
12. Mandryk R, Atkins MS, and Inkpen K (2006) A continuous and objective evaluation of emotional experience with interactive play environments. *CHI 2006*. ACM Press, 1027-1036.
13. Boehner K, DePaula R, Dourish P and Sengers P (2005) Affect: From information to interaction. *Proc. Critical Computing*, 59-68.
14. Picard R (1997) *Affective computing*. Cambridge, MA: MIT Press.

15.Damasio A (1995) *Descartes' error*. New York: GP Putnam.

16.Ortony A, Clore GL, and Collins A (1988) *The cognitive structure of emotions*. Cambridge: Cambridge University Press.

17.Batliner A, Fischer K, Huber R, Spilker J and Noth E (2003) How to find trouble in communication. *Speech communication,* 40 (1-2): 117-143

18.Anttonen J and Surakka V (2005) Emotions and heart rate while sitting on a chair. *CHI 2005*, ACM Press, 491-499.

19.Bijker WE (1995) *Of bicycles, bakelites and bulbs*. Cambridge, MA: MIT Press.

20.Oudshoorn N and Pinch T (2003) *How users matter*. Cambridge, MA: MIT Press.

21.Sengers P and Gaver B (2006) Staying Open to Interpretation. *DIS 2006.*

22.Campbell S (1998) *Interpreting the personal*. Ithaca, NY: Cornell University Press.

23.Hansen M (2004) *New philosophy for new media*. Cambridge, Massachussetts: MIT Press.

24.Dourish P (2001) *Where the action is.* Cambridge, MA: MIT Press, (2001).

25.McCarthy J and Wright P (2004) *Technology as Experience*. Cambridge: MIT Press.

26.Wright P and McCarthy J (2003) Making sense of experience. In Blythe, M., Monk, A., Overbeeke, C. & Wright, P. (Eds.), *Funology*. Dordrecht: Kluwer.

27.Brooks RA (1991) Intelligence without representation. *Artificial Intelligence, 47(1-3)*: 139-159.

28.Akrich M (1995) User representations. In Rip, A., Misa, T.J., Schot, J. (eds.), *Managing technology in society*. New York: Pinter Publishers, 167-184.

29.Sengers P, Boehner K, Warner S and Jenkins T (2005) Evaluating Affector. *CHI 2005 Workshop on Innovative Approaches to Evaluating Affective Systems*.

30.Mateas M (2001) Expressive AI. *Leonardo*, 34 (2): 147-153.

31.Aoki P and Woodruff A (2005) Making space for stories. *CHI 2005,* ACM Press, 181-190.

32.Bell G, Blythe M and Sengers P (2005) Making by making strange: Defamiliarization and the design of domestic technology. *ToCHI,* 12 (2):149-173.

33.Gaver W, Beaver J and Benford S (2003) Ambiguity as a resource for design. *CHI 2003* ACM Press, 233-240.

34.Djajadiningrat JP, Gaver WW and Frens JW (2000) Interaction relabeling and extreme characters: Methods for Exploring Aesthetic Interactions. *DIS 2000*. ACM Press, 66-71.

35.Holmquist LE (2004) User-driven innovation in the future applications lab. *CHI 2004*. ACM Press.

36.Blythe M (2004) Pastiche scenarios. *interactions* 11 (5), 51-53.

37.Blythe M and Monk AF (2005) Net Neighbours: adapting HCI methods to cross the digital divide. Interacting with Computers, 17, 35-56.

38.Denzin N and Lincoln Y (2000). *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications.

39.Gaver W, Boucher A, Pennington S and Walker B (2004) Cultural probes and the value of uncertainty. *Interactions*, 11(5), 53-56.