FROM MEASURE TO LEISURE:
EXTENDING THEORY ON TECHNOLOGY IN THE WORKPLACE

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ABSTRACT

The values present both in modern organizations and in research on these organizations reflect the organizational culture that has developed gradually over time. For example, research on organizations regularly focuses on the aspects of work that can be most easily quantified, such as the hierarchy within the organization or the physical arrangement of the office. Less defined aspects of organizations, such as the support for visibility and reflection, are more difficult to study and potentially less valued by the organizational culture.

Similarly, the scientific management movement that spurred the Industrial Revolution is a very visible example of the high value that has been assigned to quantifiable efficiency within the workplace itself. Though the scientific management movement was soon contradicted by findings that showed the importance of psychological factors such as individual recognition, the ultimate response within organizations was to quantify additional aspects of the work environment, to varying degrees of success.

The values that give efficiency and quantification this prominence in the workplace and in organizational research also impact the design and use of computing technology in the workplace. Computing has become a significant element in the modern organization, but the accepted role for computing technologies is often restricted to the automation of analytic tasks formerly accomplished by workers. In this way, computing technology becomes a surrogate for a human brain, attempting to model the way a specific type of work has traditionally been done.

The mental processes involved in work, however, are not simply analytical. David Levy (2005) contends that the excess of information available for analysis in contemporary work environments cannot be meaningfully processed without allowing

workers time for reflection and contemplation. This time may help workers draw connections that are still difficult for computers, or it may provide workers with opportunities for collaboration and diversification. The elevation of the importance of visibility and reflection within the workplace may have more success if undertaken in conjunction with the installation of technology designed for this purpose.

Because current organizational studies typically omit activities with complex motivations, initial studies on the subject must gather data for the purpose of grounded (inductive) theory generation. The study described herein addresses traditional organizational research topics as well as the presence and use of non-task-based activities in the workplace. The study takes a broad look at a university department encompassing approximately 60 individuals, utilizing surveys and interviews to collect a variety of background information. As an additional intervention, a prototype technology devise with ludic intentions was introduced to the department, and its use provided further insight into the role of technology in the workplace. Ultimately, a series of testable hypotheses are proposed to guide further research into visibility and reflection in the workplace.

BIOGRAPHICAL SKETCH

Angela Marie Zoss (Bachelor of Arts, Cognitive Science, Communication and Culture, Indiana University, 2003) has been exploring the intersection of media and technology, particularly as it relates to creative or artistic expression within primarily institutional settings. Following completion of her master's degree, she will continue her work as an administrator for arXiv, a digital repository for scholarly communication in scientific fields, where she sees much evidence of the influence of the structure of technology on the creation of cultural norms and standards of use. She will soon return to graduate school to continue research on the intersection between complex social phenomena and technology as a doctoral student the field of Information Science at Indiana University.

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LITERATURE REVIEW

Introduction to Visibility and Reflection in the Workplace

The current uses of computational technology have dramatically evolved beyond a time when only a handful of specialists could use the few computers in existence in the world. In "A Brief History of Interaction," Dourish (2001) describes the gradual shift that has happened in HCI over the past several decades. Early interaction with computers involved only the manipulation of circuitry and electrical configurations. Over time, however, the burden of training has been handed over to the computer, and now a series of layers of programming transform the computer into a device with which most people can interact much more quickly and comfortably.

Until technology had evolved to the point where a large number of people could communicate with devices on a regular basis, computing was restricted to a relatively small group of highly trained individuals and a correspondingly small set of potential uses for the computers. Computing cycles, however, are no longer a scarce resource to be harnessed in the most efficient way possible for only the most complicated of scientific work. Now we can productively discuss the infiltration of computing throughout society and the ways HCI research can influence its further development. As the number of users of computing technology increase and the computing power similarly increases, the original expectations for the purposes of computers in society must also expand. The immeasurable potential of modern-day technology has spurred researchers to design technology that breaks past the view of computing as a mere tool to increase productivity and efficiency.

The restrictions that are placed on the use of technology, particular in the modern workplace, may have their roots in a culture that excluded any non-utilitarian activity from the workplace and focused exclusively on quantifiable productivity.

This culture, however, fails to acknowledge the importance of very complex motivators that influence human behavior. Two such constructs, visibility and reflection, may play a significant role in the performance of workplace activities. In order to incorporate an understanding of visibility and reflection into current research and into the structure of the modern workplace, it is necessary to examine these constructs both from a historical perspective on their development and from a conceptual perspective on how they relate to existing organizational research. By taking a closer look at how these concepts are currently addressed and how this impacts the workplace and the use of technology, we can explore further opportunities for design and intervention into the workplace.

Visibility

Our current Western industrialized society has emerged only recently from the Middle Ages, a period of time during which Europe looked very little like the Pyramid Age of Egypt or any other early state. Feudalism guided agriculture and kept populations largely decentralized. Craftsmen of varying skills and specialties were able to sell their products and form guilds, and women were often able to supplement the household income with sewing or weaving work from home (Backer, 2001, Luhmann, 2000, Strasser, 1982). The Catholic Church was the last bastion of the fallen empires and an incubator of education until the Renaissance, when universities gained independence. The Benedictine monasteries of the last centuries of the Middle Ages were governed by a strict internal structure that coordinated the activities of the monks and necessitated the demarcation of regular intervals throughout the day.

The invention of the clock to signal the canonical hours at regular intervals regardless of season was one of the first and most influential scientific contributions to begin to apply arbitrary measurements to continuous natural phenomena (e.g. time,

distance, direction, etc.) (Mumford, 1986).

> "The clock, moreover, is a piece of power-machinery whose 'product' is seconds and minutes: by its essential nature it dissociated time from human events and helped create the belief in an independent world of mathematically measurable sequences: the special world of science" (ibid, p. 326).

This emphasis on abstraction and standardization inspired many other inventions into and through the Renaissance. In this way, scientists looked for ways to control nature, and with help from the Protestant Reformation, cultivated a work ethic that asserted man's ability to master his environment instead of one that deferred the ultimate course of his existence to the will of God. "Secure in his newly acquired knowledge, the European traveled outward in space, and, losing that sense of the immediate present which went with his old belief in eternity, he traveled backward and forward in time" (Mumford, 1986, p. 251). As a result, the invisible continuity of natural phenomena like time and space became visible, definable, controllable quantities.

As Backer (2001) argues, however, these technological advances and even the change of mindset of the relevant inventors were not sufficient to spawn an entire revolution. Cultural values played a large role in the adoption of technology and procedural advancements, resulting in variations in the development of even highly connected Western nations. A series of interrelated events, such as an increase in the demand of certain products, the development of technology that allowed managers in certain industries to require workers to leave their homes and begin to work in factories, and the establishment of standardized processes for the increase of productivity and efficiency were all necessary for the new, Industrial ideology that mechanized the workforce and cultivated values still influential in today's society. Coincidentally, the Protestant Ethic that was spreading through Western nations during this period prepared people for exactly the kind of hard, sustained effort they

would find in the new industrialized factory (Weber, 2001).

Taylorism

New machinery during the Industrial Revolution made it necessary to centralize previously distributed work (such as weaving and other textile production). Workers who previously directed their own work without being watched by a supervisor became one of the many interchangeable parts that comprised the factory (Backer, 2001). Frederick Taylor, in describing the burgeoning principles of scientific management, wanted to forestall the problem of the "struggle for control of production between management and labor" (Backer, 2001, Scientific Management section, para. 2). Taylor thus began his famous time studies in order to ensure that workers would not be able to engage in "the practice of purposely stalling or slowing down," or "worker soldiering" (ibid, Scientific Management section, para. 3).

Such time studies and the production quotas they produced required management to observe and scrutinize their workers at all times. In scientific management (or Taylorism) work was seen as a sequential process that could be improved by maximizing the efficiency of sub-processes using the division of labor and other timesaving techniques. Taylorism arose in conjunction with the growth of cities, the localization of the workforce in factories, and the design of technologies both to preside over the quantity and duration of work and to act as another partner in the work activities. The watchful eye of those in management analyzed the work activities to maximize productivity and prevent any unnecessary diversions. Just as science had begun the regulation of natural phenomena like time, scientific management attempted to break down complex work processes into exact, prescribed motions that could be endlessly repeated and coordinated to optimize output (Backer, 2001). Opportunities for recreation or leisure activities no longer occurred throughout the workday as they had for the medieval craftsman but were instead relegated to

specifically non-work hours (Sherman, 1986).

The visibility of workers that allowed managerial control in Taylorist factories is still a charged issue in modern workplaces. Recent findings in social science research, however, indicate that (most[1]) organizations are less successful when they retain the principles of scientific management than when they expand the benefits available to their workers (Klauss & Bass, 1982). Instead of using visibility to control the actions of workers, additional research suggests that visibility can improve many aspects of the work environment, including physical arrangements, hierarchy, and informal communication.

Physical Environment

Organization studies from the 1960s and 1970s begin to proclaim the importance of co-location, and to a surprising degree. Allen (1977) found that interaction was drastically reduced even at a distance of 30 feet, and that this effect is almost as pronounced with intra-department relations as with inter-department relations. Shorter distances can help promote informal internal communication, the benefits of which will be discussed in a later subsection but can additionally include project idea generation and technical problem solving (ibid). In Allen's studies of engineers and scientists in an R&D environment, consultation with members outside a worker's project group and functional group was correlated with higher evaluations of the solutions developed.

Allen's studies (1977) included the restructuring of two office environments. In the first, three R&D groups that had previously been separated across different buildings or floors were collocated onto a single floor in a building. Shared spaces were placed in the center of the facility to gather the separate groups together. While

[1] An exception to this might be a prison, where coercive sanctions and high control have different effects on subordinates than they would in a hospital (Klauss & Bass, 1982).

communication among the R&D groups improved, communication with other departments that used to intervene between the groups lessened. The second restructuring modified a fixed seating office environment into a nonterritorial office. After the reorganization, the workers were significantly more satisfied by the nonterritorial office than the fixed work environment in terms of amount of space, ease of communication, and feeling about nonterritorial offices. Intra-group communication increased and diversified. Communication with other departments (other than an initial increase), employee productivity, and satisfaction with privacy, noise level, and distraction all experienced no significant change. The studies offer concrete examples of the influence environmental concerns can have on the success of groups within an organization.

Hierarchy

Organizations with a defined vertical hierarchy encounter additional complications that can affect the success of the organization. The principles of scientific management prescribe a rigid role for supervisors, for example, to ensure that workers are as efficient as possible (Weissenberg, 1971). More recent research, however, indicates that there are a variety of leadership styles and structural factors that can improve the relationship between a supervisor and his/her subordinates and that lead to higher job satisfaction and lower turnover.

The results of many separate research programs indicate that managers on a variety of hierarchic levels spend between 70% and 80% of their time talking with others (Klauss & Bass, 1982). An appropriate communication style and the establishment of credibility are thus essential for a positive response from the manager's subordinates. Trust in a relationship can promote upward communication, and openness in or frequency of communication between levels of the organization can increase job satisfaction for subordinates (ibid). More specifically, job satisfaction

and retention are typically the highest when managers exhibit high levels of consideration for subordinates and low levels of "structuring" or prescriptive tendencies (Fleishman & Harris, 1971). In addition, findings show that workers who use managers as an information source show improvement in decision-making (Klauss & Bass, 1982).

The relationship between the employee and the organization itself is also important for the success of the organization. For most organizations, or ones that use "normative" control instead of "coercive" or "utilitarian" control, it is desirous that employees develop *moral involvement* with the organization (Klauss & Bass, 1982, Weissenberg, 1971). With this type of involvement, the worker accepts the authority of the organization as more than a simple precondition of economic exchange but also as a personal value system that guides behavior (Weissenberg, 1971). The interaction between involvement in the organization and trust in authority figures can either enhance or inhibit the employee's job satisfaction and loyalty.

Informal Communication

Psychology and organizational studies have championed trust-building exercises and informal communication in group work, as the development of a shared language and set of goals is an integral part of task achievement and overall satisfaction. For example, Alge, Wiethoff, and Klein (2003) found that teams working without prior interaction experienced lower levels of openness and trust and were subsequently less effective on decision-making tasks that required information sharing, conflict resolution, and negotiation (as opposed to simple brainstorming tasks). Most studies agree that socioemotional cues can have a positive effect on group satisfaction, conflict management, trust, openness, and – in cases where these qualities are essential to the outcome of the task – group performance (Huang & Wei, 2000, Powell, Piccoli, & Ives, 2004). Similarly, whereas unacquainted groups may

feel pressures of conformity and consensus (Whyte, 1956), one study found that groups with high levels of trust "exchanged relevant ideas and feelings more openly, developing greater clarity in goals and problems, searched for more alternative courses of action, and were more committed to implement solutions" (Klauss & Bass, 1982, p. 23).

Visibility consequently has the ability to improve trust and overall job satisfaction, and it can even increase the quality of work output. The opportunity to manipulate visibility in order to exact control over a subordinate, however, is also still available in the modern workplace. As a complex social construct, visibility must be explored in more depth to determine how it relates to specific work practices. Another related construct, reflection, has a similarly complex history in the workplace and may be studied in conjunction with visibility to form a more complete understand of the workplace.

Reflection

The first major movement to criticize Taylorism and the principles of scientific management actually grew from a Taylorist productivity study (Whyte, 1956). The Hawthorne experiment, initially conducted to determine the optimal level of lighting for increased productivity, found that the experiment itself (i.e. separating a group of workers from the rest of the factory, conducting interviews, etc.) increased productivity even in the almost total absence of light (Weissenberg, 1971). These findings inspired the human relations movement and acknowledged for the first time that workers may be motivated by factors that are not entirely "visible".

With the human relations movement came a focus on what was assumed to be man's innate need to belong (Whyte, 1956). In their opposition to Taylorism, however, the social scientists that championed human relations employed the same

scientific techniques to determine other motivators and methods for improving efficiency. "Through the scientific application of human relations, these neutralist technicians will guide [the worker] into satisfying solidarity with the group so skillfully and unobtrusively that he will scarcely realize how the benefaction has been accomplished" (Whyte, 1956, p. 41).

Whyte further describes this pervasive trust in the scientific method in terms of "scientism." Especially questionable for social science researchers, scientism contends that, given enough time and resources, even extremely complicated social phenomena can be predicted scientifically by reducing them to component parts and subjecting them to "direct and simple treatment" (Whyte, 1956, p. 27). Voegelin has identified more specific tenets of scientism, including a component that states "that all reality which is not accessible to sciences of phenomena is either irrelevant or, in the more radical form of the dogma, illusionary" (as cited in Whyte, 1956, p. 26).

The danger of dismissing everything that cannot be easily seen, reduced and codified threatens fields like technology study and design, where recent research attempts have found the injunctions of reductionism and generalizability no small challenge. At least as early as 1974 (Layton Jr.), researchers in the history of science and technology identified an inequity between science and technology, wherein the latter is systematically divorced from thought and knowledge production in industrial and post-industrial culture. Science, in many circles, is still considered the sole producer of true, sustainable knowledge (ibid).

The Protestant Ethic that spurred the Industrial Revolution admonished both rich and poor to glorify God with "hard, continuous…labour" (Weber, 2001, p. 105) in whatever "calling" God had provided for him. Furthermore, the acquisition of wealth, while problematic as an enticement to idleness or fruitless leisure, was itself a sign of

blessing from God. To use one's time for leisure or for work not related to the "calling" was scorned and considered disrespectful to God (ibid).

Whereas the Protestant Ethic required work for work's sake alone and even equates continuous hard work with morality and truth (Whyte, 1956), the scholars of antiquity and of the medieval times took it as rote that the primary purpose of "work" was to support leisure. This modern preoccupation with toil is more drastic even than the Christian conception of sacrifice, which has salvation as its motivation (Pieper, 1952, p. 42). In antiquity, however, work (or providing for the common need) was seen to be necessary primarily to support contemplation (or contributing to the common good).

Likewise, Russell (1935) supposes that it is only our preoccupation with work for work's sake that mandates eight hours of work each day for a fraction of the population and relegates the rest to unemployment because of the efficiency of production. He calls the devotion to long workdays a "foolish asceticism" (ibid, p. 23) and proposes instead a system where all individuals actively cultivate leisure time, whatever their economic status or educational background.

The effects of the Taylorist ideal of efficiency in order to maximize production manifested themselves not only in factory work but also in the production of information, particularly during the scientific boom associated with World War II. Vannevar Bush, in his seminal article "As We May Think" (1945), was already expressing concern about the amount of information being produced and the problems of storing and reviewing inherent to that production. In the article he describes an elaborate system for the cataloguing and interconnection of documents that, while cumbersome by today's standards, must have sounded idyllic to his contemporaries. The similarities between the functions he predicted and those currently available to us via the internet are impossible to ignore and have been the subject of countless follow-

up articles.

Bush's speculations about the potential of technology to connect information across time and space, however, envisioned a world that was finally able to control the wealth of information it produced. David Levy (2005) argues that, instead, recent technological advances have only aggravated the problem of information overload. "Yet it is hard to deny that the specific problems [Bush] wanted to address, information overload and specialization, have not been solved. The specialization of disciplines has, if anything, increased, and along with it the difficulty of bridging across disciplines" (Levy, 2005, p. 283).

Levy's recommendation is that we structure our work so that we devote time to reflection upon the information that is acquired. He draws on the work of Josef Pieper, a contemporary of Vannevar Bush, for a model of reflection that can restore balance to our organizational culture. "Coming out of the war, Pieper anticipated a world of too much work, and of a kind of work that would distance us from our deepest sources of wisdom and inspiration" (Levy, 2005, p. 284).

In our current climate, where flexibility within the organization is increasing, it is crucial to understand the relationship between analytical thought and reflective thought. Pieper says the following of the relationship between leisure and productivity:

> "And therefore leisure does not exist for the sake of work—however much strength it may give a man to work; the point of leisure is not to be a restorative or a pick-me-up, whether mental or physical; and though it gives new strength, mentally and physically, and spiritually too, that is not the point" (ibid, p. 56).

Thus, reflection is not necessary simply because analytical work is difficult and workers must have a break from the activity. Reflection is also an end in itself and

serves a separate function than restoration. In fact, Pieper elsewhere (1998) says that man pursues actualization and fulfillment through contemplation with a sort of violence.

> "In so far as he exists spiritually, man desires satiation by reality; he wants to 'have' reality; he hungers for 'the whole,' longs to be filled to repletion…To sum up once more: Happiness is attained in an act of cognition because there is no other perfect way in which we can truly obtain 'the whole good,' and all reality in general." (pp. 64-66).

Pieper's formulation of leisure is reminiscent of Maslow's need for self-actualization, a motivation that is widely accepted by mainstream organization researchers. This "act of cognition," however, is actively *not* one of analysis, of scientific discovery. Analytical thought as defined in antiquity (*ratio*) is a characteristically human quality and is also necessary for the individual and common good, but attainment of "the whole good" is pursued through *intellectus*, or receptivity to the true nature of existence.

> "Moreover, just as the highest form of virtue knows nothing of 'difficulty', so too the highest form of knowledge comes to man like a gift—the sudden illumination, a stroke of genius, true contemplation; it comes effortlessly and without trouble" (Pieper, 1952, p. 41).

Allusions to this need for reflection can be seen in modern research as well. Recently, emotion researchers from the field of psychology have attacked a long-standing contention that experiences of emotion lead to distracted and irrational thoughts and decisions. In fact, many studies support the hypothesis that mild positive affect improves creativity (James, Brodersen, & Eisenberg, 2004), problem solving (Isen, 2004), and cooperative negotiation (Carnevale & Isen, 1986), among other activities important for many work environments.

For example, one recent attempt to generate empirical support for a consistent experience of inspiration has resulted in a replicable and robust description of an intuitively recognizable "inspiration" construct. "Inspiration" as it has been formulated is highly desirable for office environments in that creativity and the ability to develop truly novel ideas are considered essential for an adaptable and profitable organization. This construct, however, has demonstrable ties to two separate, established modes of cognitive processing: experiential and rational (the components of Cognitive-Experiential Self-Theory (Epstein, 1994)).

This dichotomy between rationality and experience (or thought and emotion) is extremely common in psychology literature and suggests a lingering conceptual division between analytic, work-relevant thought and emotional, irrational processes. The reduction of emotional experiences to experiential cognition, however, is problematic in a number of ways, not the least of which is that it is contradicted by evidence from emotion researchers such as those discussed above, who have identified extraordinarily analytical components to experiences of emotions. Moreover, as the inspiration concept relates significantly to both modes of processing, the strict division of cognitive processing into these two categories may be overly simplistic. Indeed, natural phenomena may instead describe a spectrum of processing that resists strict boundaries between, for example, analysis and creative wisdom. The ideological barriers excluding emotion and experiential cognition from the workplace have little foundation in current research findings.

Other research about general personality characteristics reinforces the need to understand more than simply the economic motivations that drive workers. In his oft-cited hierarchy of needs, Maslow identifies multiple levels of needs that influence goals and behavior in all human action (Maslow, 1971). The utilitarian incentives devised by early scientific management organizations are less effective than those that

also acknowledge other, potentially conflicting motivations, such as the need for esteem, love, or self-actualization.

Indeed, when more basic needs are fulfilled, people actively pursue novel experiences that will expand their understanding of the world and resolve conflicts in their own worldview (Kreitler & Kreitler, 1972). The factors that consistently have a positive influence on job satisfaction include achievement, responsibility, and advancement (Herzberg, 1971). Organizations that ignore higher categories of need, either by failing to provide opportunities for exploration or by offering little job mobility, may find that workers are unsatisfied and/or unable to adapt to changing environmental conditions.

> "People, deprived of opportunities to satisfy at work the needs which are now important to them, behave exactly as we night predict – with indolence, passivity, resistance to change, lack of responsibility, willingness to follow the demagogue, unreasonable demands for economic benefits" (McGregor, 1971, p. 314).

The opportunity to reflect and be visible in the workplace is an opportunity that can help many workers be much more successful in their activities. Of course, each of these constructs can also be problematic for the workplace and as such must be managed carefully both by workers and by the structure of the organization itself. One component within an organization's structure that is frequently overlooked in literature on these constructs is the computing technology that is designed to operate in the workplace. A closer look at this technology may expose additional possibilities for design that better address the complexity of certain aspects of the workplace culture.

Complexity in HCI Design

Speculations like those of Levy (2005) into the future of Human-Computer Interaction suggest that the field might be poised to continue the dialogue about the roles of visibility and reflection in the workplace. Just as the "scientist" method of reducing and quantifying complex social phenomena has proven problematic, however, the ability to incorporate an understanding of visibility and reflection into the design of workplace technology requires a method that appropriately responds to complexity in order to preserve that which makes these constructs conflicted and powerful.

For example, early work on machine intelligence consisted in attempts to create computational brains that made reasoned decisions by following a logic system like that of conscious human thought. Early attempts met with serious obstacles, not the least of which were the limits of machine vision techniques and the time delays required to convert perceptual information into symbols that could be computationally manipulated.

Pioneers like Rodney Brooks have since established, however, that sometimes simpler solutions are much more successful in complex situation and present much more promising avenues for future development (Pesce, 2000). Brooks has created a series of robots designed with very simple instructions. Unlike robots that require complicated machine vision algorithms and logic-based movement decisions, Brooks' robots can quickly ambulate and react to unexpected stimuli by following precepts like, "If you encounter an obstacle, turn and try again." Brooks' robots do not require a mental map of their surroundings, and many have begun to learn and develop over time to behave in very human-like ways (ibid). This type of "bottom-up" design often surpasses the achievements of "top-down" attempts to exploit the computational capacity of modern processors. Brooks' strategy for Artificial Intelligence, which

finds independent but meaningful abstractions and allows technology to design itself around them, yields devices that are more organic and more compatible with the complex social environment of humans.

Likewise, a seemingly logical response to recent findings in psychology literature about the importance of emotion for various work activities might be a device to measure and analyze emotion. Even with current processing power, the complexity of the human mind (or even a restricted set of recognizable emotional responses) is almost impossible to replicate quickly enough with technology to make devices that are useful. The compulsion to reduce these complex phenomena to component parts and build them back up into a working whole is another example of the constraints of scientism.

In collocated situations, social cues develop meaning over time. Coworkers with a close relationship may be able to distinguish an angry door slam from a hurried door slam, or a calm quiet from a worried quiet. One of the strengths of complex social environments is the ability to convey such a wide variety of experiences with peripheral information that aggregates over time. Even in face-to-face environments, conclusions are not delivered unambiguously from specific cues. Instead, social actors all engage in a system of meaning-making that takes into account a great deal of information.

Systems currently exist that have made strides toward the development of interpretable social presence interfaces, even given this complexity. The *Affector* system (Boehner, DePaula, Dourish, & Sengers, 2005), which establishes a type of virtual window between the adjoining offices of two coworkers, holds promise as a useful display for larger group use. Instead of transmitting a faithful, high-fidelity signal between the two spaces, *Affector* incorporates information about the environment into the video feed, creating distortions and effects that carry some

memory of the activity of distanced worker. The visual distortions act as a surrogate for proximity, while providing the users with an opportunity to engage in the active interpretation of the video.

Affector maintains a level of ambiguity that is unusual even for social presence interfaces. Many social presence systems attempt to quantify the "essential" social cues and hand-deliver their meaning to the users (Tollmar, Sandor, & Schömer, 1996). Even with the incredible processing power of modern computers, this task is doomed from the start. With the wide variety of social situations and social actors intrinsic to human society, the likelihood of finding a manageable set of cues that are consistently reducible to unequivocal bits of information is infinitesimal. Designers will always be forced to make concessions, to ask themselves, "How much information is enough, without being too much? How do I know my interpretation is the correct or most useful interpretation?"

Other systems have explored varying levels of abstraction in similar manners. Studies show that adding distortion reduces a user's concerns about privacy without necessarily inhibiting interpretation (Boyle, Edwards, & Greenberg, 2000). Other researchers, however, have posited that a more "radical abstraction" method may allow users to personalize the output to a greater extent, and thus optimize the ability of the user to interpret the output of the system (Pedersen & Sokoler, 1997). While it is unclear whether or not extreme levels of ambiguity are genuinely more successful, it has nonetheless been shown that highly ambiguous systems can, in fact, carry powerful indicators of social presence and, thus, have the potential to promote group relationship development.

Use of ambiguous and interpretable systems, however, is still uncommon. Instead of implementing systems that support abstract reflection on group collaboration, the standard practice seems to be to layer social information on top of

computer-mediated communication (CMC) systems, such as an instant messaging platform or a bulletin board-style system (Tollmar, Sandor, & Schömer, 1996, Erickson & Kellogg, 2000). The difficulty of trying to squeeze hundreds of cues into a relatively small interaction space, however, may simply complicate interaction without producing the anticipated benefit of the additional information. While many important social cues are passed during formal communication, research shows that these cues can be transmitted verbally without additional technical support, given enough time (Walther, 1996). Also, the crucial relationship-building encounters that occur in face-to-face communication occur continuously and repeatedly. In modern work environments where the amount of face-to-face or synchronous communication is reduced because of an increasing ability to work outside of traditional working spaces and times, it seems logical to implement a system that has the ability to function outside of direct verbal communication endeavors.

Systems that can support social interaction have obvious utility, given the importance of group work and informal communication to the success of an organization. Socialization, however, can also be seen as fulfilling individual psychological needs, like Maslow's need for love or belonging (Maslow, 1971). The "highest" need – the need for self-actualization – is another need designers might support. This need for self-actualization encompasses both the desire to explore and expand (Kreitler & Kreitler, 1972) and Pieper's concept of contemplation. Can technology help open a space for reflection within the workplace?

The need to explore and expand is often fulfilled by ludic activities, or "play" activities. *Homo ludens*, or Huizinga's (1970) conception of man at play, has inspired a growing body of technology designs, both commercially in industries like video gaming and locally as points of intervention into familiar social environments. Indeed, "play" occurs across ages, social settings, cultures, and time periods. The

reconceptualization of technology to appeal to this instinct for leisure, exploration, and reflection has helped researchers like Gaver and his colleagues develop guidelines for the design of ludic technologies (Gaver, Bowers, Boucher, Gellerson, Pennington, Schmidt, Steed, Villars & Walker, 2004).

> "We will be surrounded by technology devoted to taking care of our everyday chores, giving us the leisure to pursue whatever activities we really value. But what if technologies helped us pursue those activities now, directly, rather than merely helping us get the chores done? What if computing helped us pursue our lives, not just our work?" (Gaver, 2002, p. 2).

Gaver et al. (2004) describe three stages of the design of the Drift Table, a household object that offered a maneuverable view of aerial photographs of the countryside surrounding the participants. The stages were marked by: "our opening assumptions, the tactics that developed in and through detailed design decisions, and the changes in our understandings prompted by observing people live with the Drift Table over relatively extended periods" (ibid, p. 887).

Every design, regardless of its ludic intentions, begins with a period of assumptions and goals that guide the designers. Where ludic design diverges from traditional technology design is the second stage. The tactics for ludic design are very different from the usability-based tactics of typical HCI design. One such tactic is to "de-emphasize the pursuit of external goals." Technology carries with it enough connotations of task and utility that the slightest indication of external goals may stifle more creative uses of the system, and the creative uses of the system are the primary source of ludic engagement. A companion tactic is to "maintain openness and ambiguity," which gives users license to develop their own "narratives of use" (Gaver et al, 2004, p. 888).

Finally, additional lessons emerged from observation of the table's users.

Though some lessons may apply to any design project, such as the warning that designs are not used in isolation and may have an impact on everyday activities, ludic designs need to be especially concerned about the pressure to conform to the wishes and expectations of the users. "Don't seek to meet users' immediate desires," Gaver et al. urge (2004, p. 898). The evidence from the Drift Table confirmed that initial design intuitions helped create a meaningful experience that might have been compromised by a more familiar or conventional design. User expectations are subject to the same social pressures for efficiency that create tension around leisure in the workplace. If ludic designers added features that conform to conventional expectations, the designs would have less opportunity to encourage users to explore, reflect, play, or create.

The design guidelines developed for ludic technology can be meaningfully applied to the design of technology for the workplace. Visibility and reflection are both important aspects of the modern workplace, but the need to address the complexity of the constructs makes it difficult to create task-based technology designs. The ludic design principles create an open space for exploration, and when combined with a more thorough understanding of how visibility and reflection operate within the culture of a particular workplace, it may be possible to use technology to offer spaces for reflection and visibility even in an environment where these constructs are charged with tension from a more Taylorist value system.

The result of this literature review is a set of research questions regarding the roles of visibility and reflection in a postindustrial work environment and the opportunities they offer to technology designers and researchers. The next section describes a research study that explores these constructs in a modern work environment. Primary questions of interest include:

- How does previous social science research extend to research on visibility and reflection in the workplace?
- What insights on visibility and reflection in the contemporary workplace can the historical development of work ideals offer? Are the principles of scientific management or scientism relevant for studies of these constructs?
- How can technological interventions be designed and installed to support complex, non-task-based activities in the workplace, without mandating that they occur or that they follow a specific script?

RESEARCH DESIGN

Before a new field (or a program of research on a new set of constructs) can cultivate a canon of methodologies and theories, it must endure a period of substantive theory generation (Glaser & Strauss, 1967). Rather than making assumptions about the applicability of theories generated within other fields and other research spaces, each field must start afresh and collect a wide variety of data across its own domain. "Grounded theory" (ibid) can then emerge from the evidence collected, and over time these substantive theories will connect themselves into a coherent whole that can also be compared to the literature generated in similar fields. A study designed to use a variety of overlapping methods is best for the generation of substantive theory, as the accuracy and consistency required for the verification of existing theory can often suppress the exposure of interesting concepts and boundary conditions that are meaningful in new environments (Glaser & Strauss, 1967).

To best expose relevant concepts for the generation of grounded theory, this research study incorporated a mixture of scientific methods that were expected to allow the greatest variety of participation. Because the goal was not the verification of an existing theory, concerns about sample size and validity of results are much less restrictive for the design of the study.

> "Naturally, we wish to be as sure of our evidence as possible, and will therefore check on it as often as we can. However, even if some of our evidence is not entirely accurate this will not be too troublesome; for in generating theory it is not the fact upon which we stand, but the *conceptual category* (or a *conceptual property* of the category) that was generated from it. A concept may be generated from one fact, which then becomes merely one of

a universe of many possible diverse indicators for, and data on, the concept" (Glaser & Strauss, 1967, p. 23).

The point of generating theory is thus not necessarily to generate a "correct" theory with the initial attempt. The goal of theory generation is to build a theory directly from collected evidence, however isolated the evidence maybe, and to allow future research to verify the theory or establish more explicit boundary conditions or directionality. Once a theory has been generated, the methodologies that have been developed for theory verification can make up for any deficits of generalizability in the initial study, but these same methods are much too restrictive for theory generation. In addition, because it was important not to be reductive about complex concepts like visibility and reflection, the study was designed to use qualitative and exploratory methods (like cultural probes) to elicit rich, descriptive responses on a variety of topics.

To study visibility and reflection in the work place and the opportunities for technology intervention within this space, the researcher obtained permission to study a single department in a large university. At the time of the study, the department included roughly 30 faculty and staff members of varying ages and career stages, as well as roughly 30 M.S. and Ph.D. graduate students (both active and inactive). The undergraduate population associated with this department was excluded from analysis because of their tenuous connection with the physical spaces allocated to the department proper.

The study included the installation of a technology device, designed in response to initial research findings about the structure of the community and the style of interactions in which the members of the community engage. Participants contributed a variety of data, including survey responses, interview responses, journal responses, and automated logs and screenshots of system use. (While some video

recording took place, no instances of system use were recorded, and thus the analysis of these recordings has been omitted.) Across all components of the study, a total of 22 members of the department participated, including eight M.S. students, five Ph.D. students, five professors, one senior researcher, and three administrative personnel. The number of years participants had spent in the department ranged from less than one year to almost 30 years.

An open-ended survey and a preliminary round of interviews included questions about the nature of interaction in the department. The responses were then used to aid design of a technology system that would be installed within a public space in the department and would help explore the research questions presented above. The remaining interviews, journals, and log data provided additional insight into the relationship between the community and technology devices and identified future areas of development for technology systems that are designed with this purpose in mind.

Surveys

The study began with a survey containing open-ended questions about the types of work done and interactions existing throughout the department (Appendix A). In addition to basic demographic questions, the survey asked respondents to discuss the relationships they cultivated within the department, how technology played a role in both their work and their social interactions, and how their experiences of the department changed throughout the day, year, and course of a career. Out of approximately 60 faculty, staff, and graduate students (including some students on leave or in absentia who nonetheless maintain a mailbox within the department), 13 surveys were returned.

Wherever possible, questions were phrased in an open-ended fashion to allow

flexibility in responses. Although the survey method is frequently used for large-scale quantitative research, the emphasis for this study was on gathering rich data. For this purpose interviews are preferable, but it was anticipated that surveys would enable more people to participate. Indeed, faculty members seemed to prefer the survey format to other components of the study.

In addition to more traditional open-ended questions, the surveys contained three questions of a more experimental nature. These questions, which addressed the participant's average day, previous year, and network of interactions, were designed in the style of *cultural probes* (Gaver, 1999). Though true probes are considerably less utilitarian than these questions were, there is an added element of freedom and flexibility that was designed to evoke less conscious values and associations than may be available to the participants when asked directly. True probes, however, may have appeared too vague or unrelated, and it was expected that many participants would not feel comfortable answering questions so different from their expectations.

First-Round Interviews

The round of interviews undertaken initially (that is, before the technology was developed and installed) focused on topics similar to those addressed in the survey (template available in Appendix B). Participants discussed in more detail their particular work environments and how their days and years were structured. The interview format allowed participants more flexibility in their responses, and thus certain topics received more focus or occurred uniquely in the responses of individuals. There were ten such interviews conducted.

Journal

A group of 4 users volunteered to complete a 5-day journal recording their

interactions with the SandBox (Appendix E). Only 2 were completed and returned. The questions addressed the use of both the tablet and website versions of the SandBox, as well as both personal and observed interactions.

Second-Round Interviews

Participants in the final round of interviews responded both to many of the questions from the first round and to a new series of questions designed to elicit feedback about the SandBox (Appendix F). Though the SandBox was designed to respond to specific observations about the interactions within the department, there was no single quantifiable "metric of success," such as enjoyment of the system or increase in interaction. The intent was never to coerce a certain type of interaction, and including directed questions about the users' pleasure or the perceived utility of the device would have forestalled more interesting and complex reflections about the inclusion of this different sort of technological device within their workplace. Thus, again, questions were very open-ended, and participants were encouraged to be critical or creative and to draw connections as they wished. Five participants completed these final interviews.

RESULTS

The data were collected in two main phases: before the technology installation and after. The conclusions from the first phase are relevant for the design and reception of the system, so they will be explained in detail before the description of the system and the discussion of the second phase.

The first phase of the study yielded data that helped describe the department in relationship to theories and concepts that have previously been outlined by social scientific research. In addition to the results that relate to the physical environment, hierarchy, and information communication, the data also included an independent formulation of the visibility construct, as well as possible connections for studies of reflection in the workplace.

Phase One: Surveys, First Round Interviews

The data collected in the first phase of the study include 13 surveys and ten first-round interviews. (Because some of the same questions were asked in the second-round interviews, this section may also include information from the second-round interview participants, even though it was collected during the later phase.)

Visibility and Physical Environment

Because of the arrangement of the department, offices are either on the same floor of the building as the primary public spaces assigned to the department (including reception areas, a kitchen, a mail/copy room, and several meeting rooms) or on the floor below, which also contains some additional classroom and laboratory space. Hereafter, we will simply refer to the former floor as *upstairs* and the latter as *downstairs*.

The survey participants explicitly declared the number of years they had been affiliated with the department. Upstairs, the participants reported having been in the department for an average of about 10 years, whereas the average amount of time in the department for participants downstairs was 2 years. The downstairs participants were all students (4 M.S., 2 Ph.D.), but the upstairs participants included only three students (2 M.S., 1 Ph.D.) and 4 professors. Similarly, all study participants from downstairs listed the same primary office except for two students, one who nonetheless also had a desk in the office the others shared. Only 2 of the upstairs participants worked in a shared office space.

The shared downstairs office space has by far the most occupants of any office in the department. There are typically 16 available desks, and the students reported that they often share the room with five or six graduate students at one time. There is a hierarchy of desirability within the space, in that the room has a section that is partially enclosed as a separate room, and only the rows of desks furthest from the entrance have direct access to the windows. Two public computer terminals and a printer are also positioned near the entrance, creating a high traffic area that also houses smaller meetings with students.

It is a noisy office. Most students assigned to this space acknowledged that they could not do "serious" work (such as writing or often even reading or grading) in the office. Some complain that the desks are positioned too closely to one another and that the arrangement does not offer enough privacy or personal space. Others mention that the nature of the work also renders the research of other students somewhat mysterious, as opposed to other disciplines where lab work may be much more prominent. Also, there is naturally the problem of feeling disconnected from the faculty and from other department events.

Despite all this, there are many students who enjoy the atmosphere of the large office. Students who want a little distance from the department proper enjoy that they are less "on display" than the graduate students upstairs. Others suggest that the graduate student offices upstairs are also relatively noisy, either because of the graduate students inside working or because of the passersby who stop in the reception area for long periods of time. Finally, some feel that the downstairs environment is comfortable and are happy to have the supportive social climate available.

Because of the hierarchy implicit in the space assignments and the difficulties in finding the optimal work space, students occasionally step outside standard protocol to overtake available space and, in doing so, may change the dynamic of the office environments. Though it is not clear how representative the following anecdotes are, they provide another insight into the complex division between the floors.

Although there is one primary office downstairs for graduate students, there are at least two other habitable spaces downstairs that study participants were using as offices with permission from their advisors. In addition, while there was one official graduate student office upstairs at the time of the study, there were at least two additional research areas that had been converted to offices for graduate students also by their advisors, who controlled the spaces.

It appears that in one of the cases, at least, a student actively inquired about the space to the advisor and was allowed access for the semester. In other cases, desks have become occupied without any formal invitation or sanction, and many of the more desirable positions in the downstairs office seem to be "inherited" by students from their friends.

Ironically, it appears that going through official channels to request a reassignment is much less effective. One participant, a Ph.D. student with a desk downstairs, tells a story of an aborted attempt to move upstairs. The students in the

upstairs office had apparently decided to ask the student to take over the empty desk, but when she asked the administrative coordinator in charge of assignments, she was told that it was too early to be assigned the desk. After waiting a short time, she was then told that the desk had already been assigned. The upstairs students jokingly accused her of snubbing them when she did not move in.

> "It was weird, because I felt like the inhabitants of the office were, like, trying to decide who should get the desk, and they kept on saying 'Go talk to [the Graduate Field Assistant] about it,' and then [the Graduate Field Assistant] didn't know anything about it…I didn't really care too much about moving to the [upstairs] office, I just thought it was really funny that they had obviously talked about [who they could get to fill the empty desk]…so I just thought that was kind of funny, that it was like a club or something."

This particular breakdown is an excellent example of a conflict between social conventions and official procedures. Graduate students obviously have a vested interest in ensuring that they are seated with people who share interests or a compatible work ethic. In this case, the Ph.D. student also felt she would benefit from exposure to other students in her degree program, instead of the largely M.S. population downstairs. The department may have other opposing preferences, or the timing might simply have worked out to the benefit of another student.

The successes of the other students who have been able to secure desks on their own, outside of department procedures, brings one problem into sharp relief. The system of desk assignment is likely increasing the difficulty of interaction for precisely those students who are likely to have difficulties initiating encounters. Students who enjoy the support and camaraderie of the student office downstairs and who prefer to be less visible to the department upstairs or are less likely to challenge protocol may be precisely the students who will find it difficult to seek out faculty

members unless it is absolutely necessary. One such student commented that he was uncomfortable with the recently instituted faculty/student lunchtime discussions because he felt very shy around the faculty members he did not know. While it is understandable for Ph.D. students to be located upstairs where they will be able to research most effectively, it is certainly worth noting that the spatial arrangements are likely to increase the isolation of the M.S. and younger Ph.D. students.

These younger Ph.D. students seem to feel the most tension about their position in the department. A considerable number of Ph.D. students regularly continue on from the M.S. program in the department, but they experience no less stress than those who enter from another department. One internal Ph.D. student expressed the feeling that the accomplishment of the M.S. degree is dismissed, and that they are "second-hand" Ph.D. students without a smooth transition to the new status. External Ph.D. students, however, are likely to spend their first year in the required courses with a larger group of M.S. students, and they thus get much less exposure to the expectations for Ph.D. students. The first-year M.S. students did not express similar concerns, and it is possible that being a part of the larger portion of the cohort makes the transition somewhat easier.

Just as physical location can affect the interaction between members of the department, the understood hierarchy within the department can also influence department members and the work they do. The more subtle hierarchies within the students and even within the faculty may be reflected in the spatial assignments, but other byproducts of the greater hierarchy also emerge with study.

Visibility and Hierarchy[2]

The student participants, though generally widely networked among their fellow graduate students, had a very small set of faculty with whom they regularly interacted. In most cases, this group was restricted to the chair of the student's committee and the advisor of the course for which the student was a Teaching Assistant. In some cases the students also maintained some connection with the professors who taught their graduate classes, but few listed any regular connections with more than one or two faculty members.

Faculty members, on the other hand, listed primarily student connections or connections outside their home department. It seems that faculty may have even more difficulty than graduate students with establishing connections to those outside their specific area of research interest. Students are frequently exposed to different areas of the department because of the required courses they take or because they may be assigned as a teaching assistant to a course that is not directly within their field of interest. On the contrary, faculty members seem to have some difficulty finding time to socialize with their colleagues, and they are often quite positive about opportunities to do so (such as colloquia or the events thrown for job candidates or prospective students).

One large factor within these interactions is, of course, the arrangement of the office spaces within the department. Faculty members and students upstairs will often selectively socialize by selecting to walk down one of the two hallways on the way to the mailroom, the kitchen, the bathroom, or on the way in or out of the department.

[2] The social science literature on hierarchy in the workplace deals primarily with the hierarchy between subordinates and their supervisors. The hierarchy amongst graduate students discussed above may be another area to extend theory on office environments, but the current discussion is restricted to the broader student-staff-faculty hierarchy.

Students on the second floor engage in very little of this type of parading, coming upstairs mostly for meetings or the occasional water or lunch break.

Of course, hierarchy may also vary over time. A teaching assistant may report to one professor in the fall semester and another in the spring. Students who move from a teaching assistantship to a research assistantship may also find themselves within a different hierarchical structure, possibly reporting to a more senior graduate student or having new subordinates themselves.

For students, changes revolve around the classes they take and teach. In the first year of the M.S. or Ph.D. program, students typically complete the required classes as a cohort. Students are less likely to have independent study classes at this time, so they are often required to remain on campus for longer amounts of time and find ways to work productively between class times. In addition, first- and second-year students seem to have a higher likelihood of being assigned as a Teaching Assistant to a large course that is required for undergraduate majors in the department. The teaching load for these courses may differ slightly from higher-level courses. For example, large courses may have somewhat easier grading requirements to streamline the process, but they may instead require TAs to hold more office hours or perform more administrative tasks, both of which typically require TAs to be on campus.

Later in the program, students begin to complete their course requirements and have more flexibility in the classes they take and even in the courses they teach, if they are not reassigned to a Research Assistantship. These changes have wide reaching effects on the interactions within the department. Student cohorts that are quite strong during the first year gradually weaken as the students become more independent. Without activities that require coming to campus, students often prefer to work from home, either because research materials are stored there or because the environment is more conducive to focused study. While students will still often make a concerted

effort to stop by the office to chat with other students or to print out documents on the department printers, the shared offices of the students both upstairs and downstairs are a source of distraction and severely inhibit individual work. The students have developed a variety of strategies for coping with the distractions that will be described in a later section.

Faculty members have a career cycle that is more difficult to identify, given that faculty members typically remain in the department much longer than the graduate students. Two of the professors noted on the survey that a significant change in the department occurred when email was introduced. Some professors also commented the development of a "research culture" in the department, related to the creation of the Ph.D. program and the resultant trappings of research visible throughout the department space.

On the other hand, some of the faculty seem to be mourning a time when professors had a stronger connection or were more physically available. One participant referred to the conversations between current faculty members as rare but "superficially more congenial," and another felt that there is more absenteeism from faculty members and that this is straining relationships with students.

In addition to the evolution of the department as a whole, there appear to be certain differences between junior and senior faculty, both in terms of social interaction and professional commitments. Senior faculty reported extensive travel throughout the year, in addition to the conference, journal, and grant proposal deadlines that seem common to both groups. Junior faculty members seem more focused on cultivating intra-department relationships, at least with other junior faculty members.

Non-faculty staff members, on the other hand, have a much more consistent schedule throughout the year. The most salient changes for them seem to involve

changes to the physical spaces within the department as well as personnel changes amongst the staff. The net loss of an administrative assistant around the time of the study required some restructuring of responsibilities and created a hole in a stable, long-term social network. One of the major effects seemed to be the need to be aware of the schedules of additional groups of people within the department, as these groups had previously been divided amongst the administrative staff and supported separately.

The administrative personnel serve important roles in the interactions between all members of the department. While most members of the department maintain close connections to the administrative personnel, the interactions between students and faculty are less stable and invite further analysis.

Visibility and Informal Communication

Because of the problems with distraction in the work place, both students and staff may choose to remove themselves from the department when their work requires a greater amount of focus. Most faculty, researchers, and students claim to spend time working at home. The ability to work from distributed locations, however, greatly reduces the ability for both students and faculty to engage in informal communication. On the other hand, those who work primarily in the office (even in the downstairs office) have very regular schedules and often work long hours – upwards of 40 or 50 each week. For those students in particular who spend shorter time periods on campus and try to use the time productively, there are a few strategies that seem to help reduce distraction without completely eliminating informal communication.

Many students will try to make it clear that they would prefer not to be bothered, even by friends. These students may first stop by to say "hello" to their friends in the office but quickly announce their intent to do some work. One student would "sometimes strategically leave my wireless card at home" so she would be

better able to immerse herself in her work. More drastically, some students avoid having friendships within the department or simply find an isolated room to use instead. Surprisingly, however, many students downstairs prefer their arrangement to those upstairs. Neither space is without problems, of course, and both have interesting implications for continued interaction.

Though there are a great deal of concerns and many ways in which the interactions in the department are not ideal, many participants still wished actively for opportunities to improve the situation. The aforementioned faculty/student lunches came up frequently as a positive step forward, and it is clear that the participants overall value formal and informal opportunities to become better acquainted with the other members of the department. Some responses from faculty and the research associate respondent, such as the one below, especially seem to relate informal communication directly to the development of new collaborations and, thus, value chance meetings or group events very highly.

> "There haven't really been all the venues that I would think could be fully developed…for collaboration or intellectual discourse of various kinds. I think that's actually a weakness in this department, I don't see – and I don't think it's just me, but the times when people come together, as far as I'm aware, are just faculty meetings and usually those are pretty administrative, as opposed to coffees, something like that where people might just sort of talk about projects, just informal chit-chat…That is not tremendously developed."

Visibility as an Independent Construct

Though the data collected can easily inform research on previously established concepts like physical environment, hierarchy, and informal communication, the study suggests that visibility may operate as an independent construct that simply interacts with these other aspects of the workplace environment.

Take, for example, the following comment by a faculty member: "If I don't want to be seen, I'm usually at home." This sort of comment indicates a coping strategy for distractions and is thus relevant when studying the ways participants manage social interactions. When viewed as a boundary condition for visibility, however, the comment takes on new meaning. In context, the faculty member is discussing a personal desire to remain conspicuously available (i.e. to have an "open door" policy) while in the office environment. This participant, however, also talks about the importance of a visible "research culture" in the department for everyone's mutual benefit.

> "There seems to be a lot of activity around the conference deadlines and grant deadlines, and we could probably be a little bit, even more aware of each other's activities. I think some of that is healthy in terms of spurring additional enthusiasm, as opposed to an unhealthy competition."

When asked to explain the term, "research culture," the participant used explicitly visual cues, like "manuscripts that are being print[ed] out of the office printers, that are clogging it up… so you see that people are doing things." The visibility of the byproducts of research has a noticeable value, distinct from simply being available or unavailable for social interactions.

The concept of visibility, of course, innately begs for an audience. To whom are the members of the department visible? A survey response from another faculty member stated: "Dept culture permits absentee faculty. Those who stick around deal with many more student crises and issues. Basic inequity in this." A third comments, "There is less involvement and participation in faculty governance issues. Reason: faculty are not invited/presented with issues, and are afraid to ask." Coupled with what social networking information participants provided, these comments suggest

that faculty members feel somewhat isolated from their colleagues and would be in support of ways to increase the visibility of both themselves and their colleagues.

Visibility is not so regularly prized among graduate students and staff members, however. Though one Ph.D. student indicates that advanced students "come in specifically to see other people" (after classes no longer force them to be on campus regularly), the same student acknowledges that there are benefits in having an office downstairs. "Upstairs is nice…but then everybody knows what you're doing." Many graduate students struggle between the "need to keep up a social presence" and a desire to "hide out." Visibility and informal interactions like those that are beneficial for faculty do not necessarily provide the same benefits for graduate students, who are not often in search of additional collaborations or evidence of a research culture. Instead, as one student referred to the upstairs office as "sterile," the ready presence of supervisors may compel students to "purify" their activities and behave in a way that is less comfortable or congenial.

Similarly, one of the administrative assistant participants discussed a concern about certain leisure activities that were considered inappropriate during work hours in the past. "As a group we were told not to play games on our computers…You really couldn't because if you were just looking for five minutes the wrong person might see it and you'd get in trouble." The administrative assistants are often engaging in highly visible work, and their preference seems to be to reduce that visibility, or the opportunity for surveillance. At least in the past, even a department such as this one where students and faculty maintain variable schedules and regularly engage in leisure activities during the workday, the administrative staff may still be subject to more Taylorist expectations of efficiency, possible as a result of their more regular work hours.

Though we know that employees do engage in visible activities in the workplace, it is possible to discuss the difference values that are placed on visibility, depending on the situation and the worker. For faculty, it seems the many workplace activities (e.g. walk around, chat, attend meetings, etc.) have the potential to increase visibility. Though this may not act as the primary motivation for engaging in these activities, it may inform future technology design by suggesting that faculty will be more motivated to use the device if it has the potential to increase visibility in compatible ways.

Alternately, though graduate students often walk around and chat, none suggested that an increase in visibility would be a positive outcome of these activities. Indeed, only the students with upstairs offices mentioned having informal contact with faculty, and visibility (as distinct from pure socializing) amongst other graduate students did not emerge as a suggested motivator. Thus, workplace activities and technologies may not increase in value for graduate students if they also increase visibility, either among fellow students or with faculty members.

Reflection

Visibility emerged often within the data. The concept of reflection, while anticipated to be important to a variety of work activities, was not directly addressed. A logical connection between reflection and other activities that were discussed may help direct future research in this area. For example, all respondents appreciated opportunities to get away from their desks. Thus, one motivator during the workday may be to relieve the monotony of a particular task or location. As has been suggested previously, a balance between analytical and contemplative work is necessary for a variety of work tasks and may be an end in itself. This may present an opportunity for technology design to open a space for reflection among more traditional work activities. Similarly, when participants discussed the need to restrict socializing or

visibility to concentrate on their work, they may have been creating an environment more conducive to reflective work. The interaction between reflection and visibility should be address in more detail in future research.

This background study of the department in question highlighted many of the ways that (especially) visibility influences workplace activities. On a more general level, however, it also provided information that guided the design and implementation of a technological installation that was intended to intervene within the work environment and draw out additional information about the role of technology in the workplace.

Design of the SandBox

In order for a technological system to offer insights into the workings of a community, it has to engage the community in some way. That is, if the technology is meant to intervene into a community and produce some sort of response that can be studied[3], it must either appeal to the community and produce a positive response or upset the community and produce a negative response. In this case, a positive response was expected to reveal more information about the value systems present in the department because, in a department that is not frequently exposed to sanctioned non-task-based technologies, a negative response may have reduced trust in the researcher and prevented data from being collected.

The design of the technology itself therefore depended greatly on the preferences of the department involved in the study. Motivated by evidence that workplaces in general and this department in particular have become increasingly

[3] While a lack of response is also something that can be analyzed, in this case a lack of response would likely not have exposed additional information about the roles of visibility and reflection in the workplace and was thus not preferable.

dynamic and distributed, the study sought a design that would first engage even a distributed community in a collective activity and leave traces of that activity to serve as a surrogate for face-to-face informal communication. The public visibility of individual efforts was therefore an immediate necessity. Similarly, active engagement with technology requires that the system project its ease of use and provide users with a sense of agency.

In addition, however, the intent of the system was also to provide a space that encouraged calm reflection within the work environment. This more personal focus could not have easily been met by all systems that also increase social presence (when public). In fact, because reflection is potentially a very private experience, laden with vulnerability, the need to allow the traces of this reflection to be as abstract as possible was also very high.

These concerns found an easy resolution in the template of the personal Zen Rock Garden. This item is recognizable by sight, particularly in the participating department, where one of the prominent faculty members has one available for others to use. The practice of rock gardening connotes relaxation, reflection, and inspiration, but it is also frequently associated with community use and enjoyment. Moreover, sand is a medium often used for experimentation and creation, from a child's sand box to sand sculpting on a beach.

The SandBox, thus, was designed to resemble as faithfully as possible the physical desktop Zen Rock garden (see Figures 1 and 2).

The physical Zen Rock Garden includes sand, stones, a box with a raised edge, and a rake that can be rotated to use different surfaces for different effects. In the design of the SandBox, raking was simulated by three separate "brush" types. The traditional rake with finger-like projections was simulated by a brush that painted parallel lines. The long flat edge of the rake painted a wide stripe, and the side of the

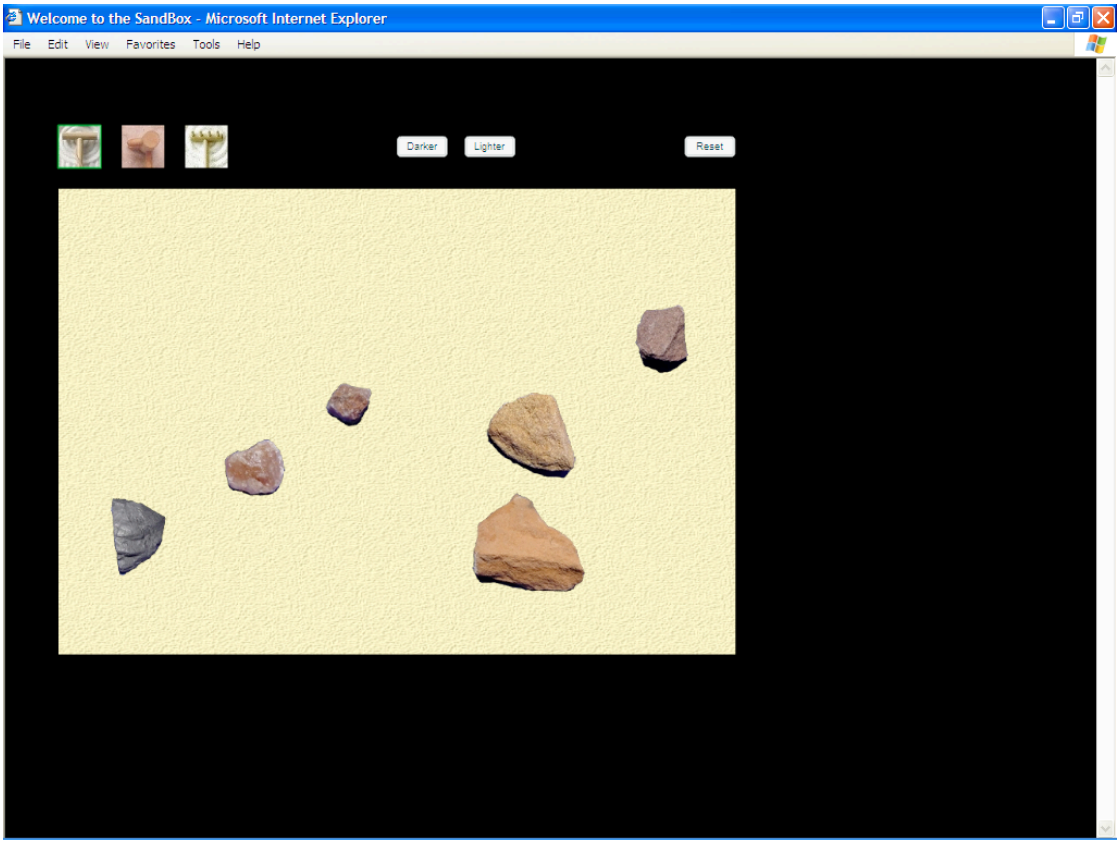


Figure 1: A screenshot of the SandBox.

Figure 2: A personal Zen Rock Garden.

rake painted a thinner, round line. The SandBox itself constrained the movement of the stones within the box, though lines could be drawn outside the box. The "Darker" and "Lighter" buttons changed the colors of the lines in a general simulation of the amount of pressure one can apply to the rake. The available colors ranged from white to black in a series of earth tones, including one sand-like color that could allow users to "erase" part of a previous line. The "Reset" button returned the SandBox to the sand graphic background and randomized the position of the stones.

The SandBox was designed with the intention of allowing both public and private use. Thus, the SandBox is itself simply a Macromedia Flash movie with program-like functions developed through ActionScript™. The public version was run locally on a Gateway Tablet PC that was connected to a projector. The private version was posted on the department website and function in much the same way as the public version. The primary difference in functionality between the two versions of the SandBox involved the inclusion of logging measures that was possible on the public version. Because of security reasons, web scripting protocols do not easily allow the collection of logging information from public sites. For the public, any action taken by a user was logged to a text document that was later copied into a spreadsheet.

The public and private site were specifically advertised to members of the department through a series of email announcements (Appendix C). Usage data for the tablet spans six weeks and details over 9700 system commands (sample available in Appendix D). Fourteen screenshots of the public system were collected as well throughout the study period. More general access statistics for the website version of the SandBox show platform and duration information for the 16 accesses (over approximately 2 weeks).

The final version of the SandBox was intended to resemble not only a Zen

Rock Garden but also another common community activity – a drawing board. Public spaces often have some sort of message board or drawing surface that can be used for announcements or playful displays. One might even think of this form of self-expression and place-marking as a precursor to blogging. By using a tablet (with a stylus) and projecting the image of the SandBox on the wall, the design unconsciously taps into the invitation to "imprint" these sorts of spaces with a record of presence.

Because of the diversity of the department, especially as regards technology usage, the design of the SandBox was a bit conservative. A great deal of ambiguity might have increased the appeal of the system for some users, but it might simply have alienated others and deepened rifts it would have liked to bridge. Thus, as previously described, the system was designed with a familiar and easy-to-use interface in the guise of a Zen Rock Garden. The public display was placed in the department mailroom, projecting just over the copy machine. The first phase of the research suggested that students, staff, and faculty all use the mailroom for various purposes, and that students from downstairs often come upstairs specifically to get water in the mailroom or to make copies for a course. A sign placed in front of the tablet invited everyone to "Play with me!"

Data collection for the second phase of the study continued over six weeks, from the last week and a half of classes for the Spring semester through the beginning of June. Logging data provides a brief, quantitative snapshot of the use of the system, and screenshots help supplement user journals and interviews to suggest the types of conventions that developed around the system.

Phase Two: Logging Data, Follow-up Interviews

The logging information for the public version of the SandBox yielded some descriptions of the types of actions taken by users. Logs were analyzed in conjunction with the screenshots taken of the system state (Table 1).

Sessions of use were determined by significant delays between logs, or a difference of at least two minutes between time stamps. Over six weeks (30 business days), the logs collected information about 31 separate sessions (with an average duration of 35 seconds). When combined with the 14 screenshots, the data comprise a punctuated narrative of the use of the system.

The logs show that usage varied a lot over the six weeks of the installation. The maximum number of sessions in one day was four. Almost exactly half of the weekdays during the installation saw at least one session. Usage was more concentrated during the first half of the installation (21 sessions) than the second half (10 sessions). Evidence from the second phase of data collection helps to expand these findings with anecdotes of use and general impressions of the system.

The screenshots also help illuminate exactly what sorts of interactions users were having with the system. On the whole, the screenshots show rather abstract drawings and rock arrangements (Figure 3). Certain arrangements, however, are clearly recognizable as faces or scenes or even words (Figures 4 and 5). In one case, the screenshots even capture a drawing at one point during the day and an addition to the drawing at a later point (Figure 6).

The information from the journals and the final round of interviews involve many heavy users or viewers of the system, including the administrative staff of the department. This final group of participants helps uncover some of the successes and failures of the system, as well as provide additional information about social conventions not previously apparent.

Table 1: Sample processed log data.

Day	*Mo.*	#	*Time*	*Action*	*Object*	*Duration*	*Reps*	*Speed*	*Session*
Mon	May	1	12:31:40	Dragging	rock4.	0.0000115741	1	86400	
Mon	May	1	12:31:41	Selecting	Smudge.	0.0000115741	1	86400	
Mon	May	1	12:31:43	Dragging	rock1.	0.0000578704	1	17280	
Mon	May	1	12:31:48	Dragging	rock4.	0.0000115741	1	86400	
Mon	May	1	12:31:49	Dragging	rock4.	0.0000231481	1	43200	
Mon	May	1	12:31:51	Dragging	rock5.	0.0000462963	1	21600	
Mon	May	1	12:31:55	Dragging	rock5.	0.0000231481	1	43200	
Mon	May	1	12:31:57	Dragging	rock3.	0.0000347222	1	28800	
Mon	May	1	12:32:00	Dragging	rock2.	0.0000462963	1	21600	
Mon	May	1	12:32:04	Dragging	rock6.	0.0000578704	1	17280	
Mon	May	1	12:32:09	Selecting	Erase.	0.0000115741	1	86400	
Mon	May	1	12:32:10	Painting.		0.0000000000	0	0	
Mon	May	1	12:32:10	Erasing		0.0000115741	4	345600	
Mon	May	1	12:32:11	Erasing		0.0000115741	2	172800	
Mon	May	1	12:32:12	Painting.		0.0000000000	0	0	
Mon	May	1	12:32:12	Erasing		0.0000115741	1	86400	
Mon	May	1	12:32:13	Erasing		0.0000115741	12	1036800	
Mon	May	1	12:32:20	Selecting	Erase.	0.0000115741	1	86400	0:00:40
Mon	May	1	12:45:00	../screen shots/5-1 12-45.png					

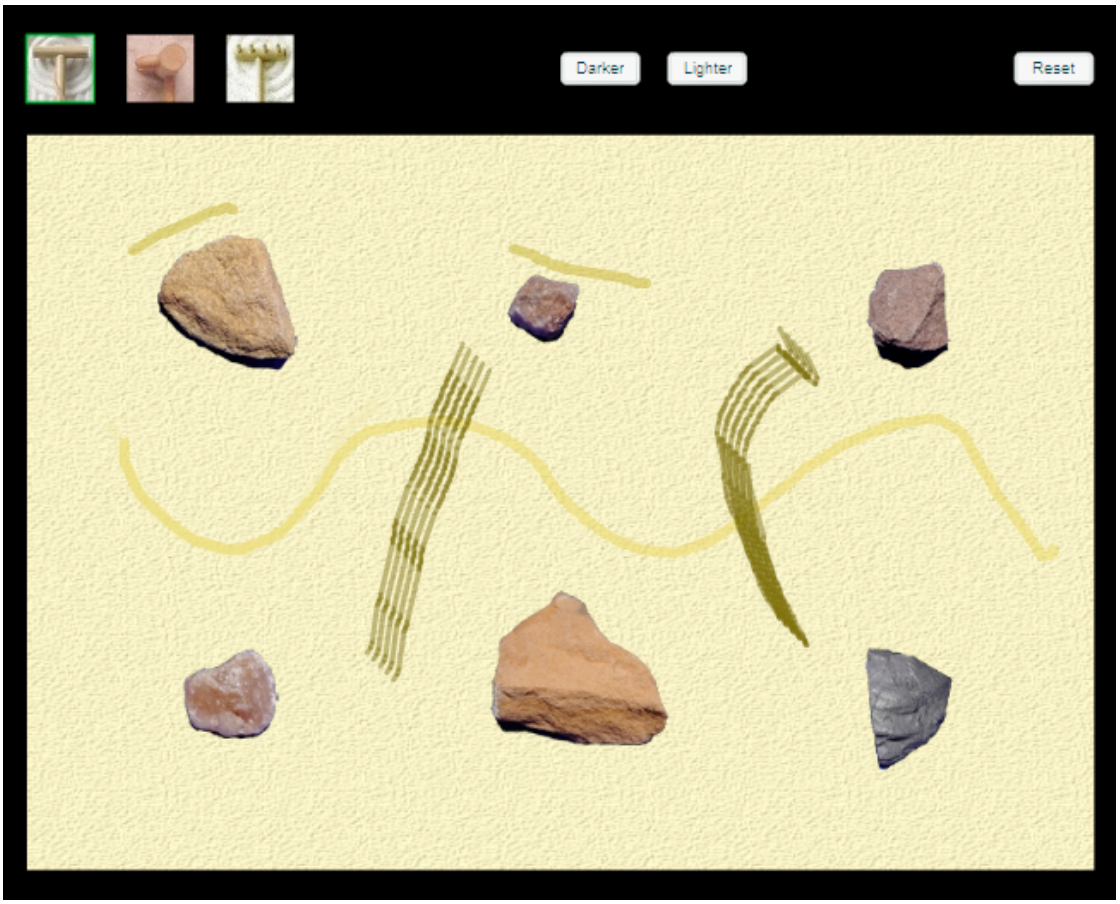


Figure 3: An example of an abstract drawing and rock arrangement.

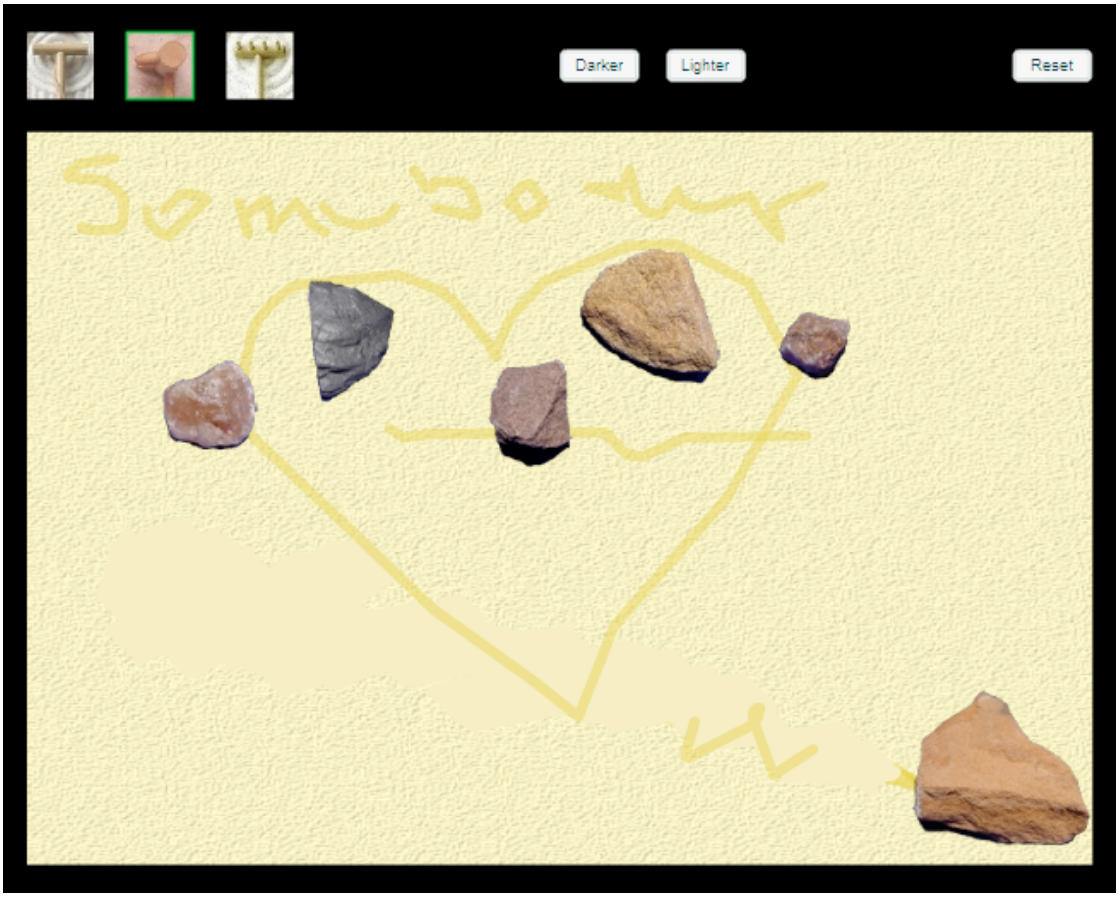


Figure 4: An example of a drawing with words and recognizable shapes.

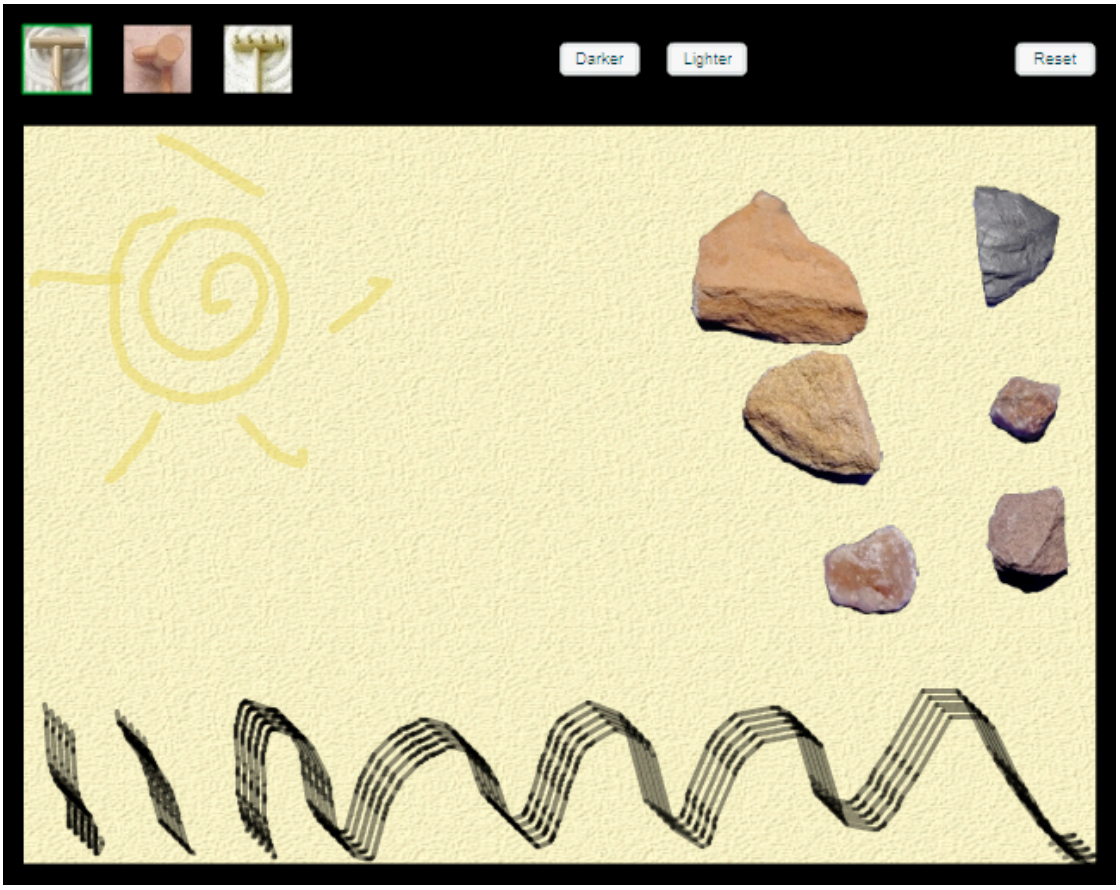


Figure 5: An example of a recognizable scene.

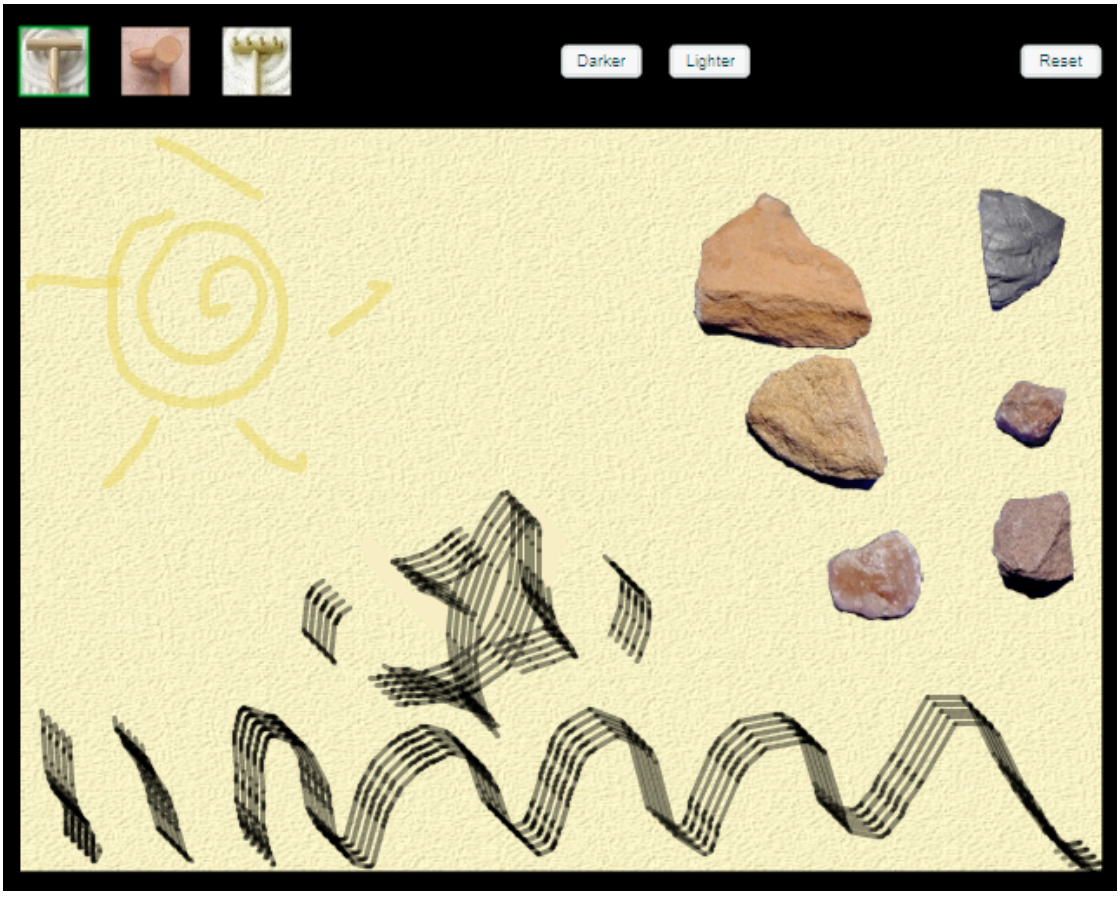


Figure 6: An example of additions made to a previous drawing.

Usage of the Public Display

The primary users of the public display seem to have been the graduate students and administrative personnel. Faculty members were occasionally willing to test it out, but it does not seem that they were regularly engaged with the device. It is possible that faculty do not spend much free time in the mailroom because their graduate student TAs or the administrative personnel take care of copying course materials instead.

Even so, participants generally agreed that the placement of the SandBox was appropriate. Many participants enjoy taking a break from their work by leaving their desk and moving around the department. In this way, SandBox may act as a sort of target and, over time, might have regularly drawn even faculty from around the department. It became clear, however, that the placement of the tablet on top of a file cabinet made it difficult for some to comfortably draw. The file cabinet was restrictively high, and the office mail cart often ended up in front of it, in the way of the SandBox users.

Another arguably problematic aspect of the space, however, is that it is seldom used by multiple people at once. Fewer social encounters around the technology make it difficult for users to engage in conversation about it and negotiate understanding and convention. Instead, users seemed to have a primarily individual experience with the system. In addition, the projection of the display would not stay active if users had left the system idle for a certain amount of time, so the enticement of the large projection was frequently absent. There were also some reports of problems with the system. At times it appears that the system was unresponsive. One of the screen captures involves a great deal of erasing and very violent pen strokes, so it is possible that the user was encountering serious problems at the time (Figure 7).

Figure 7: An example of possible problems with the system.

One drastically underestimated result of the study, however, may have had a large impact on the reception of this technology system in the department. A video camera was placed in the mailroom periodically during the first few days of the installation. Some members of the department who used the mailroom regularly expressed extreme nervousness and distrust. One participant admitted, "When [the camera] was in I avoided that area…kinda scaled the mail boxes, hoping that it wouldn't get me. I don't like cameras."

The SandBox project unwittingly violated the trust of the users with the installation of the video camera. To improve reception of the camera in the department, it might have been helpful to provide more thorough declaration of the intention of the video camera or select a public space that was less task-oriented. Members of the department who were forced to enter the mailroom for some work purpose when the video camera was installed may well have felt some coercion to participate in the study, even though they were given the opportunity to have their presence removed from the analysis. Though footage of the system in use may have increased understanding of its place in the daily social interactions of participants, its removal was essential for restoring the comfort of participants and their willingness to stretch their own boundaries.

The videotaping portion of the study ended shortly thereafter, as the intention had obviously not been to inhibit free and easy use of the mailroom or the SandBox activity. Regardless, the initial phases of a technology installation are crucial for adoption and for developing conventions, so it is quite possible that the use of the system was damaged by the intrusion upon an unknown privacy constraint. This is supported by the data collected in the first phase of the study, which showed that visibility has the potential to be problematic for certain groups of people; when

coupled with an inability to manage anonymity, the visibility enforced by the video camera was understandably upsetting to participants.

Usage of the Private Site

While much of the tracking information from the website version is inconclusive, it appears that a number of access were made and that, on the whole, users played for longer on the website than they did on the public display. Sessions on the website were occasionally longer than 3 minutes, whereas sessions on the public version averaged only 35 seconds.

Only three participants acknowledged using the website. One journal participant used it in addition to the public display, while the other used the website exclusively as a break from work. An interview participant seemed to use the website as a way of exploring and understanding what activities were going on in the mailroom. Many of the responses about the website were positive, and others who had not tried the website expressed that they would be interested in doing so. One user suggested that an interesting feature would be the inclusion of a history of changes made by users.

For at least one participant, the tactile experience of the physical rock garden was much more compelling than the web version. She also indicated that, though she ran the risk of spilling sand all over an already cluttered desk, she could envision using the physical rock garden in ways she wouldn't use the virtual version.

> "I find myself sometimes spending a lot of time on conference calls, so now that I'm no longer the secretary during those conference calls, I always need something else to do… if you try to sort emails, you can be too distracted…it's the kind of thing I think I like a lot, or if you're waiting in a doctor's office, that kind of thing."

This comment sets up an opposition between the physical rock garden, whose sensory stimulation is both pleasurable and somewhat mindless, and the SandBox. The SandBox is described more regularly as if it were a sort of game or task to be completed. These limited responses indicate that the intended reflection connotations did not come across very strongly. Particularly on a personal computer, where a mouse or a track pad gives a very different feel from a tablet stylus, the SandBox may seem much closer to a simple drawing program or game than a way to explore reflection at work (or home). As was suggested as a ludic design principle, (Gaver, Bowers, Boucher, Gellerson, Pennington, Schmidt, Steed, Villars & Walker, 2004), the resemblance to an application designed for a more specific, task-based purpose may preclude an interpretation of the site as more ambiguous.

DISCUSSION

The challenge for the design of new experience-based technologies is to avoid reductionist and determinist traps, while also realizing that successful design must have some structure and, thus, restrict activity in some ways. Orlikowski (1992) reviews two major trends in research and proposes that both the deterministic view (which presumes that the design of technology determines decisively how the technology will be used) and the agency view (which contends that users are decisive agents and will typically use technology to their own purposes) are only partially correct. The design of the technology imposes constraints on its use, as do the structure of the organization and the patterns of interaction already established within the culture. At the same time, however, the agency of the users and the decisions they make when incorporating technology into their workplace also feedback on social interactions and even on the institutional structure.

Thus, although visibility and reflection may have a positive impact on productivity (and on quality of life) in certain circumstances, designers must resist the temptation to try to force visibility and reflection on users, or to analyze precisely how these states are achieved. It is important that these constructs are achieved when and how the users determine they should be because this is the easiest way to protect the complexity of the constructs and allow users to avoid their negative potential.

There is an opportunity to design technology such that it reflects a changing expectation about the type of experiences that are appropriate for work environments. Ultimately, the value of ludic designs comes at least in part from the ability of these designs to create a safe environment for users to encounter the unfamiliar and make sense of it and/or find a way to appropriate it. "Playing involves pursuing one's inner narratives in safe situations" (Gaver, 2002, p. 5). If a workplace technology clearly

provides a space for reflection or leisure, activities in the pursuit of these states may be more readily accepted during traditional work hours.

The role of the organization in this initiative is, of course, crucial. Organizations have already begun accepting and sponsoring research into physical environment, hierarchy, informal communication, and individual psychological differences. Indeed, the human resources movement is an outgrowth of the desire to study how various motivations influence performance and satisfaction at work. This study, though not designed to verify established theories in these areas, uncovered consistent support for past findings. The SandBox, however, was designed with an alternate agenda than these previous studies: to provide workers with a space for informal communication, leisure, and reflection in a diverse workplace. Many of the problems faced in this study could easily be encountered in other office environments and with other technology designs. A commitment to the importance of reflective thought during the workday on the part of administration is essential during trial installations and early development periods. Such a commitment can mobilize resources for repairs and redesigns, or it can assure employees that the environment is safe and that their agency to pursue unconventional activities is sacrosanct.

Based on the previous analysis, a series of grounded theories can now be proposed, subjected to verification testing, and (if supported) incorporated into future designs for the workplace. The concepts and properties identified suggest the following theories that can be tested by future research:

1. Visibility and reflection can productively complement efficiency-oriented analytical work in contemporary organizations.
2. Visibility can act as a motivator or inhibitor for different subcultures.
3. As hierarchical status increases, the motivating influence of visibility increases.

4. Technologies that are designed to reflect visibility concerns will be more widely adopted than those that do not.

Future studies, however, may also benefit from further conceptual work on visibility and reflection. The literature review, historical discussion and research study described here have outlined potential properties and boundaries for these constructs. An additional property that may be studied is the publicity/privacy of both visibility and reflection. Visibility may seem inherently public, but the ability to manage anonymity, the content being made visible, and even the intended audience may significantly impact how a person values visibility. A more "private" form of visibility like an anonymous contribution to a system like the SandBox was clearly very different from the "public" form of visibility required by videotaping. Similarly, reflection in the workplace may seem less acceptable or appropriate in a public space in an office environment than it would in a private office. On the other hand, public reflection is accepted in other public places such as a museum, and it may be possible push the boundaries of convention and create a technology device that helped establish a safe environment for public reflection in the workplace.

Just as this study has revealed potential problems for the design of technology that aim to support visibility and reflection, such designs may find that even the ludic design guidelines must be extend. While the guidelines warn against creating designs that can easily be converted to a task-based activity, the very nature of public visibility may imbue activity with a sense of purpose. The clearer it is that the organization supports the activity, the more likely it is that participants will liken it to a work activity with a desired objective or outcome. Additional care may need to be taken to prevent this sort of interpretation, which would reduce the technology's ability to create a free space for complex interactions.

The final tension that must be addressed by any future studies is the tension between theory generation and reductionism. Theory generation is by nature reductive. Concepts are given boundaries and are incorporated into predictions about participant behavior. Without the generation of theory, however, the results of research may be difficult to apply to future studies. Alternative methods of data collection, like cultural probes, provide researches with complex data that does not undergo an immediate translation into a codification scheme or rating scale. The qualitative researcher may later translate the responses after a thorough analysis of the entire body of data, with the intention of codifying the data in a way that is organic to the culture being studied. Further translation of that analysis into theories, however, invariably runs the risk of excessive abstraction and an inability to maintain that complexity in future studies.

"Grounded theory" is an attempt to at least make sure that the theories are based on substantive data and not extrapolated from largely unrelated research, but when studying constructs like visibility and reflection it may be necessary to continue to include qualitative methods even in theory verification studies to ensure that the constructs are stable across cultures. The pitfalls of scientism are easy to forget during the theory verification phase, but an attention to the collection of complex data and a close understanding of the community being studied can help safeguard the conclusions that are drawn.

The result of this study is a deeper understanding of the tension that surrounds visibility and reflection in the postindustrial workplace. The value system built up by Taylorism may still influence activities in modern work environments, but there are also competing values that complicate these constructs and introduce variability into motivation and behavior. While it would be possible to operationalize these constructs and quantitatively determine their impact on job satisfaction, quality of work, or

frequency of communication, this study grounds the constructs in a larger body of work that suggests that they have value beyond these quantifiable metrics. A challenge to future researchers may be to find a way to *increase* the complexity of these constructs by finding evidence of their ineffable benefits. These fundamental needs for contemplation, exploration, inspiration, connection, and even identification are often the needs that drive researchers themselves to pursue a course of study. The complexity is essential to an understanding of what compels people to engage in certain behavior, and continued research on these topics may uncover new ways of managing that complexity.

APPENDIX A

SURVEY QUESTIONS

If any of the following questions do not apply to you, please explain why in the space provided.

Section A: Introduction

To get a basic idea about your work environment, we would like to know a little bit more about you and your position.

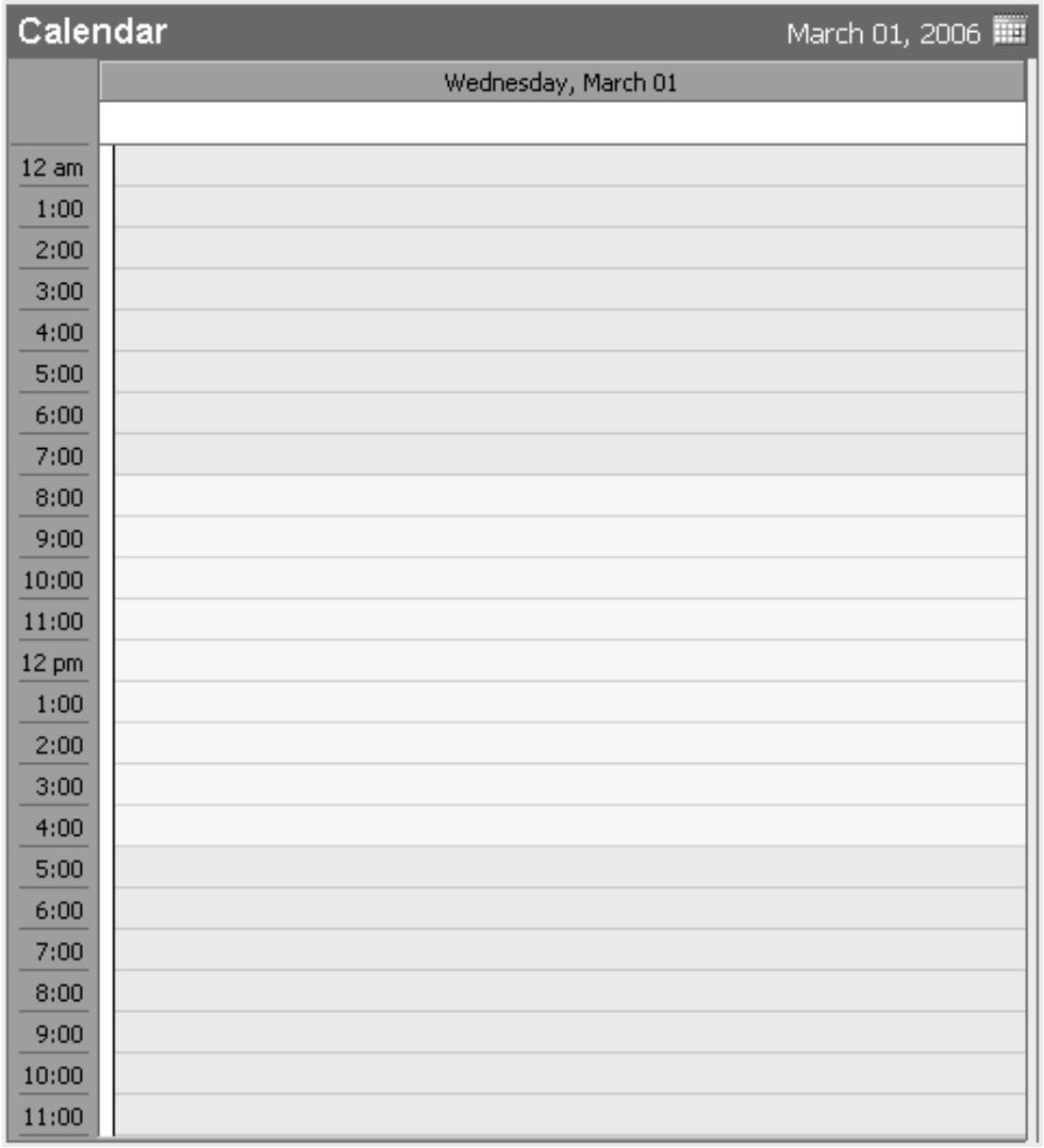
1. What is your name?
2. How long have you been at Cornell (as either an employee or a student)?
3. How long have you worked or studied in this department?
4. Where is your office or primary workspace in this department?
5. How many hours each week do you spend in this department
6. If you have other offices, how many hours each week do you spend in each of them? Where are they?
7. What is your current job title?

Section B: Personal Work Habits

Please tell us a bit about your normal work habits. Try to think generally.

8. How regular is your work schedule? Does it vary daily? Weekly?
9. Do you take any breaks from your work while you are in the office environment? If so, what sort of breaks do you take?
10. Approximately what percentage of your work involves using the computer or other technical devices?
11. Do you work in a solitary environment? If not, how many people share your space?
12. On the next two pages, you will file a blank daily schedule and monthly timeline. Using whatever representation is most comfortable for you, please:
    i. Describe a typical day for you in this department, and
    ii. Give an overview of your year last year.

Describe a typical day for you in this department.



Give an overview of your year last year.

January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

Section C: Workplace Interactions

Consider your interactions with other people while you are at work.

13. Do you have any coworkers in this department whom you would also consider friends? If so, how do you interact with them while you are at the office?
14. What percentage of your time is spent interacting with people from departments other than your primary department?
15. Do you prefer one method of communication over another for interacting with people within your department? Why or why not?
16. Have the ways people interact in your department changed at all since you began working there? If so, please explain how and speculate about what you think might have influenced these changes.
17. Finally, please take a moment to describe your work connections. Use any representation that is comfortable for you, including generalizations that may help represent groups of people or particular types of interactions.

APPENDIX B

FIRST-ROUND INTERVIEW TEMPLATE

- Tell me about an average day at work for you.
- What sort of activities do you engage in while you are working?
- Tell me about your office/workspace.
- In what ways have you personalized your office/workspace?
- Who do you interact with most while you are at work?
- Do you have any friends in your department? Tell me about your interactions with them.
- What do you do to "catch up" after you are absent from work for a little while?

APPENDIX C

E-MAIL ANNOUNCEMENTS

"Hello everyone,

First, I would like to thank you all for your patience this week. We have been testing out a new system that has been installed in the copy room [in your department]. I would like to invite you to head over and check it out over the next few weeks.

In addition to the system, however, there will be a few intermittent periods of time when there will be a video camera set up to record interactions. This is not meant to inconvenience anyone or invade anyone's privacy. The tapes will be studied only to examine how people interact with the system, and if anyone is uncomfortable with the idea of being videotaped, I will remove that person's footage from the analysis. Please contact me if you have any questions or concerns about this or any other component of the study.

Again, I want to thank you all very much for your participation and patience so far. "

"Hello everyone,

Many of you have probably had the chance to play with the SandBox system that has been installed in the copy room on the 3rd floor since last week. I just wanted to let you know that if you enjoy using the system, we have just uploaded a version to the [department] website that you can use from any computer. The link is:
[omitted]
I hope you are all enjoying the final week of classes!"

"Hello again,

Hopefully everyone has gotten a chance to test out the SandBox in the copy room at this point. If you still haven't, feel free to stop by [upstairs] or visit the website:
[omitted]
For those of you who didn't get a chance to participate in the first round of interviews and surveys, I'll be starting the second round soon. I would love to hear from you, especially from the faculty members, so I'll be sending out more emails soon about possible meeting times.

Thanks again for your patience! I look forward to talking with you about your impressions."

APPENDIX D

SAMPLE LOG DATA

Log Message
level - undefined
time - Tue May 16 13:31:38 GMT-0400 2006
name - sandbox
message - Dragging rock3.
Log Message
level - undefined
time - Tue May 16 13:31:40 GMT-0400 2006
name - sandbox
message - Dragging rock5.
Log Message
level - undefined
time - Tue May 16 13:31:41 GMT-0400 2006
name - sandbox
message - Dragging rock3.
Log Message
level - undefined
time - Tue May 16 13:31:42 GMT-0400 2006
name - sandbox
message - Dragging rock1.
Log Message
level - undefined
time - Tue May 16 13:31:42 GMT-0400 2006
name - sandbox
message - Painting.
Log Message
level - undefined
time - Tue May 16 13:31:42 GMT-0400 2006
name - sandbox
message - Raking - 0xE4D045
Log Message
level - undefined
time - Tue May 16 13:31:42 GMT-0400 2006
name - sandbox
message - Raking - 0xE4D045
Log Message
level - undefined
time - Tue May 16 13:31:42 GMT-0400 2006
name - sandbox
message - Raking - 0xE4D045

APPENDIX E

JOURNAL QUESTIONS

Day One

1. Describe your typical interactions with the SandBox at this point.
2. Have you seen anyone else interacting with the system? Describe what you have seen.

Day Two

1. What do you think of the location of the public display of the SandBox? Would you change it?
2. What did you see in the SandBox today?
3. Draw a picture of your favorite design in the SandBox so far. (This can be something you created or something you saw on the public display.)

Day Three

1. Have you had any conversations about the SandBox? Describe what was said.
2. Who would you most like to see using the SandBox?

Day Four

1. Would you use the SandBox if it was in your home? Would you do anything differently?
2. What stone is your favorite? Why?
3. How often have you been interacting with the SandBox in some way?

Day Five

1. Do you ever use the SandBox on a private computer? Explain.
2. If this were a real rock garden, do you think you would use it more or less frequently? Why?
3. Has your understanding of the SandBox changed over the week? If so, how?

APPENDIX F

SECOND-ROUND INTERVIEW TEMPLATE

- We'll be talking about the SandBox system that was installed in your department. Can you describe the system to me in your own words?
- How did you typically interact with the system? What drew you to the system initially?
- How did others typically interact with the system? How did they talk about it?
- Did your friends in the department interact with the system? How?
- Did the system ever have a significant emotional impact on you?
- What role do you think the system played in the department while it was installed?
- Do you work in other departments? How do you think people in other departments would interact with the system?
- Do you think you would continue to interact with the system if it were still available publicly? Privately?

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