Part 1

Proximity and Experience: New Rules for User Interface

INTRODUCTION

The stranger was in my direct path as I walked down the sidewalk. He had positioned himself into the flow of pedestrian traffic for maximum effect. As if by his design, I began thinking about my own personal space immediately. My discomfort grew with each step I took.

As the distance between us compressed to a few feet, he extended his cup and kindly asked me for money. I managed an awkward "sorry" with my eyes locked to the ground. My preoccupation was with the uncomfortably small distance between us. I was able to consider many aspects of our encounter, yet a thoughtful response to his question was beyond reach. A simple conversation never crossed my mind.

I realize now that he was in complete control of the situation—truly the architect and intervening force. He transformed an unremarkable location into an interactive space, modifying and exploiting the conditions of physical proximity to encourage interaction.

INQUIRY

This study explores the progressive roles that computational logic and physically integrated interface can play in interactive experience design. This investigation is based on the premise that physical proximity is a basic unit of social communication.

Research is focused on expressive works and experimental systems. In contrast to utilitarian and commercially based systems, these experimental applications thrive on the experiential benefits that ambiguity and self-directed exploration can offer. Still, this research is conducted with the expectation that these benefits will be recognized by commercial design practice. Users deserve a greater stake in the exchange and more freedom to shape the experience.

overview of theoretical work

Focus is placed on interactive experiences where artistic intent and opportunity for self-directed exploration coexist. Priority is given to the concept of shared control and approaches that allow users to re-interpret and re-appropriate system interfaces. Research and inquiry covers three main areas—the critical components for the construction of such interactive experiences.

physical and social setting

The physical and social setting of the experience is of great consequence. The differences between public and private interaction determine the level of control system architects and participants have over the experience. Public and social settings can establish opportunities for chance occurrences. The same can be said for allowing users to see how others interact with systems and with each other and to be influenced by these observations.

This area also relates to the user's physical orientation with systems. Traditional personal computing experiences deal with users sitting at desks in fixed positions. Interaction with that system is confined to mouse and keyboard. Visual experience is confined to a small display. This is not the setting for immersive nor opportunistic nor dramatic experience[1]. Consider the new setting with open spaces where the computational logic, interface and content is integrated into the physical architecture.

humanistic interface

Opportunities emerge when interface is allowed to breathe and flex in physical space. Direct contact between users and content become possible. A user is given the freedom to interact with objects and with others in not one but many ways. Some of these methods may be predicted while others may be constructed by the user. Such possibilities for usage and re-appropriation are rare with the conventional interfaces that define desktop computing.

Conventional keyboard and mouse interfaces represent a binary condition where a single user is either interacting or not interacting with the system. Physically integrated interfaces that use human movement and spatial orientation eliminate this oversimplified condition. Room is created for ambiguity, nuance and the unexpected.

system logic and disclosure

Computational logic is the fabric of interactive experience design. It defines the rules that govern the mediated experience. It simultaneously creates and withholds opportunities for interaction. The extent to which these rules are disclosed to users is an area that can be exploited to great effect. Unpredictable interaction and re-appropriation by users become plausible, even likely.

At a situational level, they reveal the potential for self-directed exploration and creative manipulation of the system. In the broader contexts of participatory art and structural interface design, the study can provide important insights into the communicative and experiential possibilities that exist when computational logic, ambiguity and physical interface converge.

Like other art forms and media such as sculpture and site transformation, the content cannot be separated from the actions and methods of the artist. However, the material and structural choices can be evaluated independently for their ability to allow observers to interact with the subject and enter into an intellectual and emotional conversation with the artist.

PROXIMITY AND EXPERIENCE

on physicality & personal experience

Physical touch provides immediacy, an instant connection between people, spaces

and objects. Memories are often imprinted with sensory details that provide nuance. One morning, more than twenty years ago, my father drove me to school. I recall the strong smell of coffee, the texture of his car seats, the baritone voice on the radio. My father allowed me to share in his morning routine and the moment became momentous. For me the experience remains tangible through the sensory details forged in my memory. For him, I'm sure the moment was unspectacular, the sensory details unrecorded in his memory.

Renee Spitz and John Bowlby studied the role of physical contact and intimacy in the 1930s and concluded that "we need strokes [denotes human contact] as much as we need the air we breathe, the water we drink, and the food we eat."[2] Intimacy without physicality is a difficult proposition. Yet as 'new media' designers we readily accept the non-physical conventions that define the mass media standards of the day.

Emotional responses result when we form personal and physical connections. We draw on our experience, consciously or subconsciously, to evaluate and understand. Direct multi-sensory interaction in three-dimensional space provides unique opportunities to form these connections. And physical touch is an important component to learning. According to researchers Price and Rogers, "Physical engagement with something creates an involvement and activeness in learning that passive listening or watching does not."[3]

the downside of efficiency

Email and instant messaging have become ubiquitous with personal computing. They have left the confines of our offices to join us in our living rooms. They're with us when we take a walk. They ride shotgun in our cars. They infiltrate nearly every aspect of our lives, yet they lack the intimacies and subtleties of physical closeness. Rather than keeping us in touch, do these tools encourage us to avoid physical interaction?

In his study of how the existence of online communities affects interpersonal relationships, Brad Hunter echoes these questions. "Face-to-face communication is difficult to maintain, and as such, we are continually becoming more reliant on other, easier forms of communication to maintain these relationships."[4]

why proximity matters

You enter a conversation-filled room and feel the pressure of fitting in quickly to avoid looking like you're alone. Where we position ourselves and how we navigate the space indicates our comfort level and ability to relate to others.

We use physical space to communicate nearly every moment of every day.[5] Our proximity to others can embody feelings not expressed in words. We set the distance that separates us from others, displaying important clues about who we are and what we think.

We readily make physical contact with the closest people in our lives. We stand close to those we judge are our friends. People we consider friends, that are open to our ideas, are allowed to enter our personal spaces. And we go out of our way to distance ourselves from those we believe don't share our ideals.

But our ability to control these encounters is limited. Public spaces are unpredictable. Sometimes they're uncomfortable. And this discomfort can create memorable experiences, personal growth and learning. Predictability and control can limit these opportunities.

mass media experience

Mass media conventions are about convenience and economy. Economy for the author, publisher and consumer. But convenience rarely leads to learning. Innovation and discovery require work. For content developers and artists, mass media can be about compromise.

Gain wide distribution and enjoy economies of scale but forgo a handcrafted aesthetic and the individuality and nuance of a one-on-one exchange. Theater slash film slash broadcast is a perfect example.

Theater provides individuality and nuance. Every performance is unique. Opportunities for artists and viewers to interact abound—either directly or indirectly. The viewer decides where to direct her attention.

Film retains a great deal of these core values of artistic expression and experience but makes concessions to reach a wider audience. Film must adhere to common presentation standards. Scale is fixed. More important, presentation is linear and non-interactive. A screen actor's performance is unaffected by the audience. And the performance will be the same today as it is fifty years from now. Like theater though, film preserves the unpredictability that comes with public viewing.

Home theater and broadcast video dilute the experience in profound ways. The technological promise of home theater attempts to preserve the immersive qualities of cinema experience. Larger displays, higher resolution and high fidelity surround sound provide impressive selling points.

But what we gain through our complete control of the experience is also our loss. We decide with whom we share the experience. The unpredictable aspects of public encounter are reduced or eliminated. We can observe only the observations and reactions of our handpicked companions and our experience is no richer as a result.

Interactive design is no exception. Our mass media channel is the Internet—easily the most far-reaching and cost-effective mass media outlet in existence. If our content is desirable and well publicized and promoted, we can literally deliver our material replete with interactivity and intelligence to millions. And we can place it on their laps at practically no cost.

experiential disadvantage

But there is a cost. Unlike the performing arts, our discipline was conceived in a commercial setting. Our concession is one of experiential quality. When we accept this mass media channel, our work is placed in the same context and setting as the business applications that occupy the personal

computers we reach. The experience occurs on a small display—the viewer seated uncomfortably at a desk. The devices that broker the exchange are the tools of utility and commerce. The environment is completely without ambience and works against any dramatic objectives. This is no place for immersive experience.

Where are the opportunities for chance occurrence? The web-based experiences we facilitate are singular. Viewers of our work do not enjoy the benefits of seeing another react to a poetic or unexpected moment. The expression of another person's pleasure or dissatisfaction with the content or performance is absent. Your experience is solitary—without the richness of unpredictability and of shared experience.

CHANCE OCCURRENCE AND COLLECTIVE EXPERIENCE

Chance is by definition that which cannot be predicted or controlled. Chance can be a source of anxiety. Aboard a plane, we may think obsessively about the chance of crashing. About our complete inability to control the situation.

Chance can also be a source of inspiration. The possibilities of chance encounters, of crossing paths with anyone at any time, is intriguing. Being at the right place at the right time–we've all thought about it. Such possibilities give color to life and inoculate us from the repetitive.

How can this potent force be leveraged in communication design? Is it a contradiction in terms to think the opportunity for chance can be engineered? Not at all. Its a legitimate and important technique practiced by artists from Calder to Ben Rubin however varied their tools and methods may be.

Are the material choices of traditional sculpture (the concrete and rigid versus the variable and flexible) comparable to the structural aspects of dynamic media and interaction design? There are notable differences. The sculptor who chooses stone with the expectation that her expression will remain unmutated does so by selecting the material best suited for that objective. The new media artist who fails to leverage the dynamic properties of the medium fails to advance the discourse or intellectual potential inherent in the medium.

the power of observation

We rely heavily on the shared nature of our experiences. Our own reactions to events and experiences are often influenced by the reactions of others. This ability of observe others and incorporate what we perceive into our own decision-making process could be described as the very essence of human experience.

We use total strangers and their visible, if nuanced, expressions as tools for our own purpose. A loud noise heard in a public space may instantly instill a sense of fear for those who are unaware of its source. Unable to identify the source, we look immediately to the reactions of those around us–people we don't know–for clues about how to respond and act. If they appear unaffected, we will likely conclude that our initial alarm is unfounded.

This human condition has been manipulated by many filmmakers who reveal limited clues about a situation or craft a scene with sufficient ambiguity as to mislead an audience to false conclusion. Although I can't verify this, I suspect that this is often done with an understanding of the nuanced, non-verbal interpersonal communication that occurs among audience members.

Dynamic media experience confined to the desktop will generally miss such opportunities to expand the conversation among viewers. Collaborative systems (i.e. chat rooms) are the obvious exception, though the extent to which human experience can be shared through text-based exchange is unclear[6]. Conversely, new media systems which encompass public spaces with interfaces not restricted to private and individual experience will no doubt see the influence of human observation and collective experience.

Artists and architects may choose to exploit and manipulate this occurrence to broaden the discourse among and between participants. People from diverse backgrounds and experience. People we don't know.

Researcher Adrian Chan asks several important questions pertaining to individual response and experience in technology-infused interaction design[7]:

- Is there digital touch? If so, how long does it last, who can it be obtained from?
- Do we really feel acknowledged in and through mediated exchanges?
- Does mediated acknowledgement substitute for the kind gained by successfully sharing physical interaction with others?
- How much acknowledgement is gained from the act of expression itself–regardless of the recognition that comes back?

NEW RULES

conventional interfaces

Conventional cursor-based interfaces have great value in utilitarian applications. Such systems would suffer from ambiguous or interpretive interfaces. But designers often move beyond utility without moving beyond these conventions. And because the creative process begins with the assumption of mouse, keyboard and desktop display, great distance often exists between author, content and user experience. In many cases, the adoption of mainstream interface methods inherently reduces the opportunities for intimacy, nuance and unpredictability.

A number of graphical user interface (GUI) conventions have been created to address the limitations of cursor-based systems. These conventions represent additional layers that separate the user from the content. Scroll bars are one example. While simple, their mechanics must be learned if a user is to access the content. Moreover, they are not borne from how we move or interact as humans. Browser environments comprise scores of such devices that exist to resolve the inherent input and display limitations of personal computers. As these layers

accumulate, more proficiency is required of the user and the focus on content and experience is compromised. The experience is interrupted. Distance is created.

users and systems as interface

Opportunities emerge when interface is allowed to breathe and flex in physical space. Direct connections between users and content become possible. A user is given the freedom to interact with objects, with other users, in not one but many ways. The system architect may have predicted these methods. Or the user herself may construct the method at the moment of use. Such possibilities for usage and re-appropriation are scarcely possible with conventional interfaces. Interaction in the web browser is relegated to rollover, click and drag. The mere existence of such limited methods constrains the possibilities of usage. The potential for engagement and real discovery is stifled despite the best intentions of the architect.

Yet great opportunity exists for those willing to dig deeper. Producing great content and developing strong narratives are not enough. A designer who does not thoughtfully consider the method of interaction will generally fail to engage her audience. Immersion is a rare achievement in communication—rarer still when interaction is squeezed from computer screen and mouse. Interface is the point of contact between the author and participant, between user and content. Its conventions and possibilities shape the manner in which users are allowed to interact.

ambiguity and pluralistic interaction

Conventional user interface, whether as desktop application or web browser, generally involves a single user in a singular location. That location, whether set in public or private domain, is pressed through the filter of a personal computer. In most cases the interaction has already been constrained to a singular experience.

Chat rooms and other social systems notwithstanding, the user will have an experience shaped and confined by her own intentions and limitations. Another user may be involved, as is the case with email or instant messaging, but the opportunity for chance happenings, and unforeseen influence and observation is nil.

Now remove the desktop computer. Imagine the room itself is the interface. The mere act of approaching another person or touching an object elicits a response from the system. An image is projected. A sound is heard.

Imagine now the many ways that interaction can occur. There is no singular approach, no correct sequence of steps. There are no clickable buttons, no scroll bars separating the user from content or experience. The system may account for subtle movements and nuanced physical proximities and relationships. Ambiguity may be exploited. Users can influence the system with intent or without. They can know their influence on the system or be unaware of how their actions affect it. The binary condition where a person is either using or not using the computer is eliminated. Level of interaction now comes in many flavors, creating opportunities for discovery for both architect and participant that before were unavailable.

Users are influenced by the actions of others. We watch as others discover the mechanics of the system, the rules that govern the space. It changes how we perceive the system and space and alters our own course of action as we interact. We interact not only with the system, but also with each other. This is where the promise of discovery and shared experience lies.

re-appropriation

While individual designers, architects and artists may share common goals, their work is shaped by their personal experiences and intentions. This intent can lead to diverse experiences when the public encounters the work. The conversation between artist and consumer can be subtle and unassuming, provocative and confrontational. The artist's intention guides the many structural and aesthetic decisions. When successful, the setting is created for the particular type of exchange envisioned by the artist.

Re-appropriation is among the countless formal possibilities for this dialogue. It is defined here as the ability for viewers and participants to interpret their role and relationship with the artist's work in ways perhaps not predicted by the artist. While this quality could be loosely attributed to all subjective artwork, it can be observed–even measured in quantifiable form.

This can be done in simplified form by documenting the artists articulation of the possibilities envisioned for user interaction. This assessment can then be compared to documentation by a third part of specific public encounters with the work, conducted with as diverse and numerous a sampling group as possible. The result is an objective analysis of the capacity for participants to identify and create new relationships with the work (and indirectly with the artist).

It is undeniable that this quality exists at a purely cognitive level when we view art, communicate and interact. We are creative beings and we naturally explore our relationships with the people and ideas we encounter. And because much of this cognition is internalized and not outwardly unexpressed, this evaluation requires the work to be realized in a form where these dynamic relationships are observable. That is, the participation and interaction must take physical or verbal forms for these constructions are to be quantifiable.

For these reasons, I have given disproportionate weight to the physical relationships between the participants and the system in the development of the experimental platform and programs in this study. This interpretation of re-appropriation is, in my judgement, a logical extension of the long history of creative and dynamic relationships formed by those who encounter expressive works. The evolution of these artistic expressions into computational domain allows these relationships to be facilitated, even exploited, in ways that were not previously possible.

It introduces possibilities for elevating the conversation–for creating new opportunities

for learning. At its best, it challengers the viewer to rethink her relationship with the material and to actively engage the work.

At its worst, the opportunities are inaccessible. The ambiguous nature of the experience means that some will fail to find a point of entry or moment of discovery with the system. This is the greatest risk with such experiments and the balance between ambiguity and approachability (usability) requires continual evaluation.

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The task of the designer is not to create a better button, but to determine if buttons are required in the first place.
– Florian Brody, *The Medium is the Memory*

Part 2
Proximity Lab

OVERVIEW

Proximity Lab is a participatory installation and experimental interface platform designed to visualize relationships between users and mediated spaces. The system directs attention to the intersections of physical and computational interaction.

The platform is an 8-foot by 16-foot walkable surface fitted with radio frequency ID (RFID) technology. Participants wear shoes fitted with RFID tags, enabling the system to track and record their positions in real-time. Images projected directly onto the floor are accompanied by stereo sound as a continuous response to the actions and interactions of participants.

Proximity Lab has the unique ability to discern the individual identities of participants regardless of how or where they move. Conceived as an experimental physical interface system, it allows architects with diverse intentions and aesthetic goals to create repeatable experiments in physical interaction.

INVESTIGATION

The study seeks to stimulate inquiry about physical proximity, social interaction and computational mediation. Semi-facilitated experiences involving algorithmic logic, system observation of behavior, and dynamic role assignment are offered to participants for contemplation and discussion.

The central case study involves participatory installation where physical location brokers interaction between users and system. The study focuses on the following issues:

- *natural interface* – utilize natural abilities of user as foundation for core user-system interface favored over introduction of additional interface layers
- *visibility of interface* – minimized to reduce experience to essential content
- *disclosure of system rules* – minimized to exploit widest range of user responses
- *pluralistic interaction* – exploit ability for users to observe and respond to other participants (interacting with system and each other) to create new opportunities for discovery and re-appropriation
- *human scale* – exploit to elevate immersive qualities of experience both in terms of interaction and perception

PROGRAM MODULES

Two program modules were developed for Proximity Lab—Social Circles and Loop Holes. The programs are accessed through an iconic menu representing the visual and kinetic forms of each program. Users step on one of the forms to begin the program, which runs for three minutes.

social circles

Social Circles deals with the visualization of social activity and physical proximity. Small shapes bustling with movement surround users and follow them as they navigate the platform. The molecules orbit around participants and react kinetically when users approach one another. Molecules are color-coded to distinguish individual users. Molecules can be exchanged. As the session progresses, molecules mix and the distribution of colors reveals the unique interactions of the group.

loop holes

Loop Holes is a sound instrument that reconfigures itself based on user interaction. Sound spots are represented as simple shapes that reveal kinetic and sound properties when activated. Chance sound performance and contrived composition coexist.

Each of the eight spots represents a note in a fixed scale. Each time the spots reconfigure the timbre and distortion of the sound set changes. At first, the notes are undistorted with short attack and sustain. As the loops progress, sustain gets longer, creating overlap and chordal opportunities. Frequency modulation also adds to the variation.

First configured in a simple and organized manner, the sound spots gradually separate into scattered arrangements. Are these configurations random or based on the behaviors of participant? The progression and location of sound spots is based on interaction with the system. The user who interact with the system the least are targeted by the system. Sound spots reposition themselves around this user, perhaps encouraging more active users to approach less active users.

SPECIFICATIONS

An 8-foot by 16-foot by 7-inch walkable platform sits at the center of the Proximity Lab system. Combined with a set of five RFID-tagged slippers, the platform represents the sole input for the system. System outputs consist of a ceiling-mounted video projector pointed down onto the platform and amplified speakers positioned at opposite ends of the platform.

The platform is fitted with a collection of 1-foot square antenna loops which sit directly below the floor surface. These antenna loops are wired into a set of four RFID readers connected to a PC by way of USB connection. A continuous data stream delivered from the readers is parsed by the PC to:

- qualify the presence of tags based on signal strength at preset frequency ranges
- convert the serial locations of qualifying signal values into the x and y coordinates needed to locate the tag on the platform

The program logic involves the specific rules that govern the mediated experience. It quantifies interaction between users and the system. It defines what visual and auditory events occur as well as the conditions that trigger them.

electronics

The electronics for Proximity Lab consists of four RFID readers developed by TagSense Inc. Each reader is designed to accommodate four platform units or 32 individual antenna loops. The antenna loops attach to the reader via mini connectors. The male connector is soldered directly to the wire leads on the platform unit, the female connector is soldered directly to the reader board. Each reader has its own power supply and sends data to the host computer independently via serial USB adapters which attach directly to the reader board.

Firmware residing on the reader handles all RFID functions. This code allows the reader to calibrate baseline signal strength by polling the connected antennas and comparing it to a reference signal generated by the board. It also handles the signal processing functions that allow the reader to discern between noise and the presence of a tag A Visual Basic executable handles all communication with the readers and includes a setup function that sends commands to initialize the readers and control data polling functions.

software / data processing

The system relies on two layers of software to complete the experience. The first layer, handled by Visual Basic, manages the continuous stream of data delivered by the RFID readers. Visual Basic simultaneously writes the data to disk for future recall and processes positive tag hits, converting them into Cartesian coordinates. A lookup table drives this conversion by assigning unique x and y coordinates for each data position on each line of data sent by the reader.

These coordinates are passed to Flash, which handles the specific program logic. Here, user movements are observed as actionable behaviors and expressed as discrete visual and auditory expressions.

platform construction

The building block of the platform is a 2-foot by 4-foot unit containing 8 independent antennas. Each antenna covers 1 square foot using a cloverleaf configuration. The 8 sets of antenna leads terminate at a common point on the platform. Termination points are designed to efficiently reach the center point of a cluster of four units. RFID circuitry and antenna multiplexers also reside at this location. Four sets of readers drive the platform to produce:

- *128 separate RFID read zones*
  The platform is comprised of 16 individual units to produce a 16-foot x 8-foot area at 7 inches high. The platform houses four RFID readers driving 128 independent antennas (read zones). RFID tags placed in both shoes of each participant.
- *265 unique tag positions*
  When a foot is placed between two individual read zones, both readers detect the tag and provide the means to interpret 265 tag locations, roughly double the number of read zones.
- *1953 interpreted user center points*
  The number of recordable user locations is further increased because a tag exists in both shoes of a user. This provides two separate tracking points, allowing the system to calculate user center point between the right and left tags.

system logic

The following definitions were developed as the underlying rules for the evaluation of socialization based on discernible user behaviors and movements. These rules, combined with the specific program logic, determine how the system responds.

- *Personal space* - A half-circle with a two-foot radius exists at the user's center point. The shape is rotated based on user direction to remain in front of the user.
- *Intimate encounter* - Occurs when a user's personal space intersects with that of another user with the intersection occurring for at least three seconds.
- *Intimate departure* - Occurs when the intersecting areas of two user's personal spaces no longer intersect with a tolerance of three seconds to reconnect without ending the encounter.

While initial experiments deal with personal space as a fixed and uniformly sized area, the potential to dynamically define and adjust personal space on an individual basis based on the actions or inactions of the individual is compelling. This logic will be explored in future revisions of the experiment and may take a variety of forms including the reduction of personal space for relatively non-social users, requiring even closer proximities to trigger encounters.

These events have various effects on the user socialization ratings, which are calculated continuously as users interact with the system. Socialization value is calculated with the following expression:
$socVal(K) = (encInit^2 \times encUn \times depSoc^4 \times encDur^{1/2}) / depNon^2$

The resulting socialization values are used as the primary vehicle to determine the behavior of the floor-projected visualizations. It should be noted that this system was simplified for the initial release of Proximity Lab, which uses total accumulated interpersonal interaction time to assess individual socialization value.

KINESTHETICS AND BEHAVIOR

If the changing positions of participants are the primary input for the system, then the visual material projected onto the platform floor is the primary output. This dynamic visual layer exists to reveal the nature of social activity on both individual and collective levels. To leave room for subjective interpretation and a more expressive experience, imagery should be more abstract than literal.

rendering socialization

The key component to visualization is the direct relationship between the socialization value (socVal) of users and the formation and kinetic activity of visuals at user locations. This relationship exists to provide users with a direct, if subjective, window into the general operational rules and behavior-derived data that is collected and used by the system.

This window is a two-way conduit connecting users with the system. It focuses the user's attention on the cause and effect nature of proximity in social interaction - within the walls of this installation and hopefully beyond.

sound exploration as conceptual tool

I found great clarity can occur when the structural and conceptual possibilities of sound are considered early in the creative process. Moreover, it had a profound influence on the conceptual and visual development of my work.

I had struggled with the visual language throughout the development of the program logic. I had fleshed out the general system rules and was unable to find meaningful solutions that would connect image and kinetics to the overall concept. An advisor suggested shifting to the exploration of sound and the solution materialized in a matter of days.

I began by recording violin notes and phrases. I was immediately drawn to the faster, higher-pitched plucked sounds over the low bowed notes I had originally envisioned. This lead to varied sound experiments including rice spilling into glass bowls and colliding marbles. Certain sounds seemed to connect with the concept of socialization.

While making these recordings, I noticed the sound of ice cubes rattling in a glass. I heard the sound of computation and randomness. It focused my sound experiments and suggested the first clear visual forms for the program. Subsequent recordings included tapping metal measuring cups and experimenting with digital samplers.

A molecular aesthetic emerged. I envisioned participants surrounded by small circles as they navigated the platform. The molecules are in motion, orbiting around participants, reacting as if excited when users converge. By recording and analyzing a wide range of sounds including variations in timbre, tempo and composition, I was able to consider how specific events and variables could be expressed. Manipulating tempo and reversing certain recordings revealed structural possibilities that would not have been otherwise apparent. A rapid succession of Kalimba notes played forward and backward created respective acoustic equivalents of users approaching and departing. These event-driven phrases are heard against the backdrop of similar notes. Tempo is determined by the amount of movement by the group. The result is cohesion of visual form, behavior and sound and a newfound respect for the conceptual value of sound.

OBSERVATIONS

Proximity Lab was operational for ten days in the Stephen D. Paine Gallery in Boston in April 2005. Over this period, I had an opportunity to observe several people from 3 year-olds to 60-somethings interacting with the platform. I observed users exploring the system without instruction and had the opportunity to explain the underlying principles and mechanics of the system to others. I watched as bystanders observed others interacting with the system.

After nearly three years of work on this project, seeing the first participants interact with the system was a thrill. In a moment, the gap between conceptual exploration and first-hand observation was filled.

general observations

1. Age appeared to be a significant factor in the willingness or reluctance of users to engage the system

- Kids aged 4-12 generally engaged the experience without hesitation
- Some refused to interact with the system even at the encouragement of others; most were men over the age of 50

2. Individual motivation appeared to play a significant role in how satisfied users appeared to be with the experience

- Users that were mainly interested in "playing" and having fun with the system were unaffected by the lack of instruction and undisclosed workings of the system
- In some cases, I observed users spending extended periods of time investigating the system through experimentation, examination and play
- Many users appeared dissatisfied with the lack of information disclosed about the exhibit

3. The vast majority of participants and bystanders I observed showed great interest and curiosity and were eager to participate and learn about the project

- Dialogue was frequent among participants; several theories about the mechanics of the system were expressed
- The lack of instruction and information seemed to increase curiosity and dialogue about the system
- Participants who were given a basic overview of the exhibit appeared more comfortable and satisfied with their relationship with the system

4. Many users attempted to interact with the system based on their own false assumptions about the mechanics of the system

- Pressure sensitivity was the most frequent misconception about how the system works and led to specific types of movement and interaction by users (i.e. exaggerated steps, forcing weight onto the platform surface)
- Some users observed others on the platform without noting the special slippers; they participated without hesitation before becoming aware of this requirement
- For some, the lack of understanding of system mechanics seemed to make them uneasy and less willing to engage the system more fully

5. Users who invested more time on the platform generally showed a more complete understanding of the system

- Some system rules remained undiscovered to all users I observed
- Other users were able to form more complete understandings of the cause and effect relationships governed by the system after extended periods of interaction

design flaws

1. Differences in the interaction rules and system response between the two programs was problematic for many users

- For example, participants who viewed others using the Loop Holes program before participating with Social Circles program carried their knowledge of the user-system relationship over based on first-hand observation
- These users immediately arrived at false conclusions about cause and effect that influenced their interaction
- Many were able to overcome this barrier and revise their understanding of the system with further interaction
- Others were unable to overcome this and their frustration seemed to diffuse their motivation for further exploration

2. Logic for sound spot reconfiguration in Loop Holes program flawed

- The cause of sound spot reconfiguration (random for first three loops, targeted to least interactive user in last three loops) created unnecessary confusion about system mechanics
- The original approach (progressive degrees of relocation based on least interactive user) may have decreased confusion
- Leveling or standardizing reconfiguration behavior across all six loops would have likely decreased confusion further

3. Iconic approach to main menu flawed

- Relying solely on visual forms and kinetic properties to represent the two programs on the main menu was problematic
- The iconic menu looked so similar to the programs that most users were unaware of the distinct function the menu served
- Users generally triggered a program unknowingly since they had no knowledge that the menu was forthcoming and their physical position usually intersected with one of the two activation spots

4. System failed to clear user positions at the end of sessions causing the false identification of tags on the platform

- This created auditory and visual responses not based on actual participant interaction and created significant confusion

CONCLUSIONS

Proximity Lab was operational for only ten days. Thus, the exhibit provided limited opportunities to draw conclusions. However, the exhibit is supported by three years of research, testing and peer discussion and critique. It is against this backdrop that I offer these conclusions.

1. The absence of explicit instruction is generally not a barrier for participation

- However, when system complexity is moderate or high, lack of instruction can limit the extent to which users can interact with the system
- Disclosure and instruction needs to be balanced to (1) minimize the appearance of complexity when users first encounter the system, and (2) clarify fundamental concepts and introduce the seeds of possible interaction to users

2. The basic principles of advertising and communication design are echoed in the management of exploratory systems

- attract: the first step involves getting users to take note and investigate further; requires an emotional, sensory appeal
- engage: requires action on the part of the user; involves tapping into user's existing interests and desires
- retain: user actions must translate quickly into payoff; discoveries must be made early if user is to invest additional time

3. Personal experience plays a leading role in (a) a user's willingness to engage exploratory systems, and (b) the extent to which users can modify and develop their understanding of the system

- Noteworthy differences exist between initial engagement and exploration
- While children readily engage such experimental systems, they generally lack the ability to consider the complexities of the system
- Older adults are most likely to observe but not participate, perhaps being more dependent on disclosure and instruction to overcome reluctance to participate in front of others

4. The ability for people to observe others exploring systems plays a critical role in how users understand and interact with exploratory systems

- Enables observers to form and modify their understanding of the system
- Provides precedence; can decrease anxiety about performing in public
- It creates opportunities for some to interact with more immediacy than is possible with conventional computer interfaces

beyond observation

Important lessons have been learned from observing users interacting with Proximity Lab. Most noteworthy is the need to balance ambiguity and instruction to leave room for individual interpretation impeding usability. Some level of clarity is advisable even with exploratory, open-ended systems. Still, the underlying promise of elevating user experience and opportunity for discovery by empowering users to take a leading role in the exchange is compelling.

Interactive experiences that allow users to innovate and create new relationships with the system—re-interpreting and re-defining the interface—achieve the highest levels of discourse and collaboration between the architect and participant.

While specific context and content is important, it is possible to independently evaluate the opportunity for self-directed interaction and discovery offered by the interface architecture. Consider the following levels as a tool for such evaluation:

- *Level 1* – Ambiguity favored over instruction to promote self-directed interaction and discovery
- *Level 2* – Users can interact in a variety of ways (multi-dimensional interface)
- *Level 3* – Architect relinquishes control to extent that users are able to invent new

methods of interaction at moment of use; discrete levels of observation and system logic employed to extend interaction possibilities; users can create new relationships with system

a (revised) appeal to designers

In an early draft, I spoke preachingly about the need for interactive design professionals to rethink conventional interfaces and input devices. In the weeks that followed, I had the opportunity to experience more fully the work that goes into experimental systems requiring fabrication, custom engineered electronics and real-time data processing.

While this basic sentiment holds, I do have a new perspective on the issue. I have a better understanding of why experimental systems like Proximity Lab are not embraced more often. The truth is that it requires a combination of skills, multidisciplinary collaboration and extremely generous time frame and budget. This is as rare in academic circles as it is in the commercial design community.

There are several examples of innovative work in this space, but cost and the steep hill of coordinated multidisciplinary expertise and technical know-how limits it from entering the the mainstream.

For the foreseeable future it will remain on the fringe, inspiring some to think beyond traditional conventions. Such work will undoubtedly influence the next generation of integrated interface systems. Momentum is building in artistic and commercial design communities where best of breed interactive systems are easily identified for what they lack—a keyboard and mouse.

LOOKING AHEAD

Proximity Lab is a fully functional hardware and software system that can be modified and redeployed with minimal delay. I have considered two main possibilities for the next generation of this system.

One of the early application concepts for Proximity Lab involved an exploratory installation for kids. A modified version of the platform may be appealing to local venues like The Boston Children's Museum or The Museum of Science. Proposals to these museums are in the works, including recommended modifications to program logic and industrial design based on the focus of the institution and visitor demographics.

As we ask how users will interpret their role with the system, we should be similarly interested in how other artists and architects make use of it. Their unique experiences and influences will shape the aesthetic and structural choices they make. To what extent control is shared, guarded or relinquished by these architects is of great consequence to the collective experience.

Based on an open source model, the platform could be made available to graduate and/or undergraduate students in progressive academic programs. The platform could travel from school to school, accumulating an archive of authored interactive experiences reflecting the intellectual territories and experiential and aesthetic goals of the "guest architects" who hosted the platform.

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