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# The interior life of iPoi: Objects that entice witting transitions in performative behaviour

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## Abstract

This article charts the development of the iPoi project which we introduced in a previous edition of this journal (see 'New shapes on the dance floor: influencing ambient sound and vision with computationally augmented poi', IJPDAM, April 2005, 1.1). The work further explores our investigations into playful encounters with exertion interfaces. We consider the notion of wittingness (Sheridan 2006) and how it may be used as a device for tempting performative interactions within the context of a playful arena (Bayliss 2004), such as a club, party or social event where behaviours, expectations and embodied dialogues are already fluid and dependent upon exchanges with others. We further expand upon our concept of the performance triad model where the modes of performer, observer and participant are intentionally blurred and in flux. Whilst this article analyses in depth one particular deployment of iPoi in a live performance setting, the wider brief of this research lies in readdressing humans' relationships with technological objects by uncovering how one might use wittingness to stimulate performative behaviour and thus extend the capacity for creative expression through the affordance of these objects.

**Keywords**

DIY performance, wittingness, playful arenas, performative interaction, tangible computing, exertion interface, poi

## Introduction

Many objects have begun to have an interior life of their own which we have come to take for granted. Embedding tiny sensors and computers in everyday objects is commonplace. Think about the number of computers and sensors you encounter simply by waking up and making a cup of tea. They tell us when to get out of bed, how hot our shower water is, and that our kettle has been boiling for five minutes. Our day-to-day encounters with technological objects are often practical. Technological objects help regulate and organize our lives making us more productive, more efficient. As an antidote to these many labour-saving devices, technologies have been developed to fill in the gaps of our time-rich existences, systems which are designed to enhance our experience of and access to the ever-expanding worlds of entertainment and communication. Material objects such as iPods, MP3 players, mobile phones, game consoles have become fetishised and value-laden commodities, signifers of culture, wealth and status. Many of us walk around our cities with at least one wireless device about our person. These devices keep us in touch with the world, with the office, with our friends and family even though they may be on the other side of the world. They make us look busy. We appear to be in demand, invaluable to others and yet, often these devices serve to cover the reality of being solitary, in transit, alone in a crowd. They can prevent us from talking to strangers or shield us from communicating with those who stand next to us in the bus stop, or on the tube. We are seemingly prepared to have more intimate relations with

the objects in our pockets and the wires going to our ears than we do with the people who breathe the same air as us. There is no doubt that wireless technology has revolutionized the way we live. It influences the ways in which we work and play in many positive respects and yet there lurks in the background a nagging doubt that much of the pervasive computing embedded deep inside physical objects is subtlety changing how we relate to others, how we interact with people face-to-face and how we view our own place in the transmission of information, feelings and ideas.

As a response to questions about this sense of unease, our interest as researchers and artists is in designing, developing and deploying embedded computing into objects that actively encourage witting transitions in face-to-face, human-to-human interaction within the performative mode. Wittingness (Sheridan 2006) is the knowledge or awareness of the performance frame (Bateson 1955) and is used as a device for tempting performative interaction, or the interaction that occurs within and as a result of the performance frame. We define performance framing as an activity done within the intended frame 'by an individual or group' who have some established knowledge about the frame, and are 'in the presence of and for another individual or group' (Schechner 1988). Mediating wittingness allows us to, among other things, implicate bystanders in a performance and to tempt them into crossing the boundaries of 'normal' human behavior (Bayliss et al. 2004; Sheridan et al. 2004). This provides an opportunity to destabilize our notions of reality and to extend the action of 'looking (fixing one's gaze on another) to voyeurism (pleasure from extended gaze) to spying (surreptitiously studying the actions of another)' (Rush 2004) and to create a blurring of fiction and everyday life.

A classic example of low-tech unwitting performance is Vito Acconci's Following Piece (1969). In this work, Acconci followed a person around a city, taking notes on what they did and where they went, until they went into a place where he could not enter (such as the person's home). Acconci inverted direct human-to-human interaction so that the person being followed was unwittingly performing for Acconci inasmuch as they were completely unaware that they were being implicated in a performance.

With the addition of digital technologies we can, for example, invert the usual interface of direct human-computer mapping so that performative interaction is unwitting. For example, in performance artist Stelarc's Ping Body (1996), he used body-worn sensors to demonstrate how the body can be actuated by internet activity. Sensors placed on Stelarc's body were activated by network traffic activity, thus causing Stelarc's body to move and twitch. Rather than having his body actuated by direct key presses from a witting and present audience, the sensors read network data streams from an anonymous and unwitting audience – those creating the internet traffic were oblivious to the fact that they were being implicated in the performance. This example extends Acconci's piece by using remote and networked participants whose participation is reduced to electronic bits. This calls accountability into question – the indirect key presses caused Stelarc, in some instances, physical pain. Can an unwitting audience be accountable for its actions and what ethical implications does this have for the artist and producers of the work?

Accountability is much clearer in cases where interaction is voluntary and public – or witting. For example, in the case of Flashmobs (Wasik 2006) participants opt into a

performance by communicating via their mobile phones. The participants in these cases are witting in that those involved are completely aware of the performance frame prior to their engagement with the technology. Flashmob participants have a choice – whether to step in or out of the performance frame. In other words, they enter the performance frame wittingly. In the case of witting interaction, participants are highly accountable for their actions, particularly when the actions occur in front of a live audience. In these two examples, wittingness focuses on experience and gives us, among other things, the flexibility to invert the complex causal mappings of direct manipulation and to expose concerns such as accountability.

The issue of accountability is just one example of many questions raised when encouraging witting transitions in the performative mode. What then of wittingness and technological objects? Since our interest is to readdress our relationship with technological objects through witting transitions within the play mode, we intentionally look to augment a pre-existing object which already has a certain performative quality. We found this capacity in poi.

Poi is an ancient Maori art (see www.homeofpoi.com). Poi are simply balls attached to chains or cords that are held in each hand and swung around the body in a range of circular movements to create complex patterns in the air around the dancer (Figure 1). In Maori culture they were originally constructed with a small rock on the end of a flaxen cord and were traditionally used by men and women to improve flexibility, strength and co-ordination for both work and war. Today poi are popular objects adorned with tails and ribbons that glow in the dark or can be fixed with tiny flashing lights and are regularly used at clubs and festivals as a means for clubbers, or ‘poiers’,

to gain access to and merge with the driving 4/4 beat of techno and trance music within the dance space (Bayliss et al. 2005). Poi work very simply through momentum and gravitational and centripetal acceleration. Small circular hand movements and wrist rotations are amplified at the end of the cord and thus the momentum and impact is increased creating a dynamic and fluid visual display. By embedding a traditional set of poi with wireless technology we aimed to augment this amplification still further so that the relationship between the performer (the poier), the performed object (the poi) and its performance output (physical, visual and auditory manifestations) was extended and stretched to capacity. As swinging poi is generally a solitary activity and poiers regularly claim they are unaware of people watching them dance, we wanted to investigate how external manifestation of the object's movement through space could influence and increase the desire to interact with others and with the aesthetic environment created as a direct result of the poi's flight. We call our system iPoi.

iPoi is not a game although it is intended to be playful. iPoi has no winners but it can be competitive and even combative. It does not require particular training but it can encourage people to teach, learn and share skills through watching, doing and being the performance. It is based on multiple participants performing their own version of an ancient Maori dance translated to a contemporary context using VJ and DJ tools as a basis from which to make music, images and sounds. Our participants are not formally trained dancers, musicians or artists, but rather the general public who are being invited to play. And, unlike many technology objects, our system is not goal or task-driven. We do not consider our participants system 'users' but rather participant–performers and inter/intra-actors.

To examine transitions in witting behavior, we performed iPoi in several playful arenas (Bayliss et al. 2004), contexts such as bars, parties or clubs.
In these locations, networks of interaction are already in play, codes of behaviour are rather more relaxed, group dynamics are constantly in flux and reconfigured as the narrative of the social environment unfolds over the course of a night. With iPoi we aimed to explore the extent to which participant– performers, and indeed audience–observers, were aware of the fundamental link between object and sound, object and visual.

Figure 1: Time-lapsed photograph of a poier swinging poi to create various patterns.

Would the system encourage interaction between multiple players? Would it mediate an emergent relationship between performer and its digital output? To what extent would augmenting the object's capacity alter the manner in which that object is performed?

In this article, we describe how we began with a single object and performer and after several prototypes created a multi-object system that allowed for multi-participant, ensemble performative interaction. Although iPoi has been tested in several playful arenas, we describe a more 'traditional' performance in detail in this article. We show how our system allows participants to make quickly and easily the transition from unwitting observer to witting participant–performer and attempt to question the nature of the relationship between the poi as performed and performing objects and the

bodies who made them spin in the performance space. iPoi examines how one might use wittingness to stimulate performative behaviour and extended the capacity for creative expression these objects afford.

**Prototyping iPoi**

Our intention with the prototyping phase of the project was to augment poi so as to facilitate witting transitions in performative behaviour. As such, we consciously made several design decisions at the beginning of each prototyping phase which would examine this facilitation. In this section, we describe how we began with a wired prototype and eventually built a wireless, multi-participant prototype. We examine how each prototyped object worked closer to our goal of facilitating witting transitions.

**Wired interface**

Our first consideration was to understand the affordance (Norman 1988) of our chosen object and how we could use affordance in our design. Poi affords, among other actions, swinging. The action of swinging is based on momentum and basic gravitational pull. To better understand momentum and basic gravitational pull, our first step was to attach a sensor on the object itself (the poi ball) in order to read data from a swinging poi. We determined that we required a sensor that was small and lightweight enough so as not to interfere with the action of swinging yet complex enough to provide us with detailed sensor readings. We chose an accelerometer (for a discussion of why we chose to use an accelerometer, see Sheridan 2006). Attaching an accelerometer to poi allowed us to collect data from the swinging poi in real time and helped us to understand the effects of momentum and

gravitational pull. We could then turn this data into a readable form for analysis.

We glued the accelerometer directly onto the surface of the poi. The accelerometer was directly wired to a Smart-It sensor board (http://www.smart-its.org). The Smart-It was fitted with a PIC micro-controller which allowed us to store and run a customized program for reading acceleration data. The Smart-It was then attached to a MIDI interface and the MIDI interface was attached to a PC via a serial cable (Figure 2). We ran our customized program on the Smart-It, and collected streaming acceleration data from the accelerometer. As we swung the poi in the air, we could then see the acceleration changing on the PC screen. We streamed the MIDI data through GarageBand (http://www.apple.com/ilife/garageband) to hear the audio output.

Figure 2: Configuration of wired poi prototype with attached accelerometer. As the poier swings poi around their body the accelerometer sends the acceleration data in realtime to the Smart-It over a wired connection. The Smart-It converts the data to MIDI notes which are then read by the MIDI interface. The MIDI notes are sent from the MIDI interface to a music instrument which can read MIDI or to a PC. The MIDI notes are then read in any program on the PC which can read MIDI such as Garageband. So as the poier swings the poi, he creates musical notes or controls video.

We tested our system in a lab with several beginners, intermediate level and expert poiers. There was a marked difference in how the various poiers responded to the requests of people observing them perform. The expert poiers engaged in conversation with the observers while they were performing. They could change the

speed of the poi or repeat fluid patterns with ease. Beginners took a lot longer to complete the test and were completely distracted by the MIDI being produced as a result of them swinging the poi around their body. Beginners repeated the same move over and over again whereas the experts completed the test extremely fast and were overly keen to test the system with more complex moves. As well, both of our expert poiers wanted to interact with the MIDI software as well as swinging the poi so that they could create even more layered sounds. Intermediate poiers again were somewhere in the middle, neither entirely distracted by the MIDI nor able to completely lose themselves in the performance.

Experts were able to more fully engage with the complete system, meaning that they interacted with the investigators both verbally and non-verbally, often gesturing when to change the volume or choice of instrument so that they could experiment with the acceleration and varying the pattern. Expert poiers were able to understand 'the bigger picture'; how the augmented poi would effect how they performed. They were keen to test the system in a real-world situation with VJs and DJs. They were eager to improvise and could appreciate how the augmented object may enhance their usual poi performance and stretch the audience experience. Whilst beginners were 'wowed' with the system, they spent more time trying to complete moves rather than engaging with the MIDI interface. Their concentration was split between managing each move and listening to the types of sounds they were able to make and so they often tangled the poi and had to redo a pattern. Intermediate users slid between trying to get the patterns right and testing various speeds. They experimented with the MIDI somewhat but generally would stop performing and ask questions rather than continue performing as the experts did.

Whilst the data transmission and accelerometer worked adequately for translating acceleration data into musical notes, the awkwardness of the wires meant that the poi object itself restricted the performer's freedom of movement. In other words, our witting poier was physically limited – the poi as material object hindered smooth performance rather than encouraging or enhancing it. We determined that to achieve synergy between object, performer and performance outcome, our next prototyping phase had to focus on realizing full wireless data transmission and needed to address the aesthetic clashes between bodily movement and sonic outputs which at this time caused distraction and interference rather than coherent composition between the various elements involved.

**Wireless interface**

Our development goal for our second prototype was to allow poiers multiple degrees of freedom and non-restricted movement. To do this, we required a wireless interface. For our second prototype system we custom designed a sensor board with an attached accelerometer that was small enough to fit inside a poi ball. Our design was purposely simple and included our original accelerometer, a radio transmitter for wirelessly transmitting data from the poi to the Smart-It, a PIC microcontroller containing the poi code, a 3V Lithium-Ion flat battery, and two LEDs for indicating when the poi was on and when it was transmitting data (Figure 3).

Figure 3: Custom-designed iPoi board and configuration of first wireless prototype. Poi is embedded with a round sensor board with an attached accelerometer. Acceleration data is transmitted wirelessly to the Smart-It. The

Smart-It translates the acceleration data to MIDI notes which are read by the MIDI controller and sent to the PC via a wired connection. The poier swings the poi with multiple degrees of freedom of movement and the acceleration data is translated into musical notes or controls visual output.

We tested the system in our lab again with the expert poier. Without the limitations of a wired interface, the poier was immediately able to perform complex poi moves just as he would with non-computationally augmented poi. The poier experimented with different moves to try and produce interesting and pleasing audio and video. The wireless interface certainly increased the possibilities for witting performance in that the poier was able to begin the transition from experimenting with poi to performing with the poi. The intentionality of the poier's moves changed as he began to move beyond a physical investigation of the system's functionality towards a more deliberate attempt to play with its creative potentialities. We tested the system several times in the lab until it was fairly robust. The poier was extremely keen to try the system in a nightclub and so we approached a local pub that hosted a weekly club night and they agreed to allow us to come in and perform with the system. The agreement was that we could perform on the dance floor and project visual images but that the club DJ had control over the music. Again we were interested in observing unwitting observation and witting participation.

One performer and one VJ (video jockey) agreed to perform at the beginning of the evening. The VJ's job was to map the poi acceleration data to various visual effects, such as 'scrub' and 'rotate', using a VJ software tool. As the poier performed various moves, the visuals would change based on which visual effect the VJ had chosen. The

acceleration data changed the speed of the effect. So if the VJ selected ‘rotate image’ then as the poier swung poi, the image would rotate faster or slower depending on how fast the poier was swinging the poi. The VJ varied the effects depending on the response of the people observing the performance and the response from the poier.

After setting up our equipment, the poier went into the middle of the dance floor and began performing (Figure 4). Initially, the poier paid a lot of attention to the VJ screen, testing how different moves affected the visuals. He performed the moves quite slowly at first and repeated the same move several times and then later experimented with varying the speed. His wittingness allowed him to perform in new ways by varying the speed and patterns according to the audio and visual feedback. After a short amount of time, he was able to change the visual output to suit the music as well.

Figure 4: In-situ set up for the guerilla performance in a nightclub. The poier was wirelessly connected to a VJ (video jockey) who determine how the acceleration data would change the visuals.

Eventually, the poier looked over at the VJ and gave her a nod and a wink and then launched into complex, flowing moves for several minutes. He changed his patterns and rhythm in conjunction with the beat of the song. Occasionally, he would look at the projected image but rarely back at the VJ, who was hunched over a screen in a darkened corner.

Over time, we observed that our system encouraged not only witting transitions but

communal transitions in many ways. For example, the distance between the VJ and the poier, as well as the concentration on their respective activities, meant that they had communicate with each other using non-verbal communication (Fels 2002). On many occasions, the poier would slow his pace and repeat a simple move whilst facing the VJ. Sometimes the poier would over-emphasize a smile, stick out his tongue or wink at the VJ. The VJ glanced continually over at the poier, changing the visuals to suit the poi movement by mapping effects in the GUI to the acceleration data. Since the DJ had a pre-programmed set list, she did not directly interact with the poier or VJ but rather watched the performance as a witting observer. The distance between the VJ, poier and DJ meant that whilst there was a direct human-computer link, there was an indirect human–human communication link. The
VJ did not tell the poier which effects she was changing. Likewise, the poier did not tell the VJ which moves he was going to make. And neither the VJ nor the poier knew which songs the DJ was going to play.

At the beginning of the performance, observers sat on the periphery of the performance, not paying much attention to what was happening. However, within a short amount of time (about 10 minutes) people began crowding around the poier and the VJ, asking what they were doing. They stood around the performer until they were able to try out the system themselves.

Since we did not announce our performance, we expected that anyone entering the event would be an unwitting observer, simply because they did not have any knowledge of the performance frame. However, they became aware of the frame though a number of visual cues. Unlike the DJ, one observer said that the direct link

between the poier and the VJ was obvious since the poi activity was carried out in front of a large screen on the dance floor and that the images on the screen were moving in time with the poier's movement. This visual connection became most apparent when the poier varied the speed of movement. As this observer stated, 'I was watching him and from where I was situated he was in front of the video on the dance floor so it seemed like they [the poier and VJ] were connected visually and it [the poier and the screen] was connected visually.' However, this particular spectator did not trust completely what he was seeing. He said he felt it necessary to come and speak with us because he wanted confirmation that this wasn't a 'Wizard of Oz' performance. This happened repeatedly throughout the evening. As new people came into the venue, they wanted to know what was going on. We noticed that as more people became witting observers, a kind of 'social infection' occurred, where they 'spread the word' about what was happening so that we no longer had to explain or confirm our involvement in the performance. Soon the room was full of more witting than unwitting observers and several witting observers wished to transition to participants. We describe participant interaction here.

Those that participated in the performance were able to carry out beginner poi moves within a few minutes and were able to immediately see the effects that their movements had on the visuals. One unwitting observer said that he was 'blown away' when he realized that he could both physically and digitally interact with the performers and the art objects (the poi themselves) and change effects through physical action. He said one of his biggest frustrations is that he can't physically activate the technology he uses (computers) except for typing on the keyboard. He said that the liveness and immediacy of the action inspired him to think outside how

he normally perceives technology and art.

Another observer said that she had seen poi at festivals but had never performed with it although later she admitted to being a majorette in her early years. She had always found poi compelling. She had come to the event to dance, and when she saw how poi was being used she felt a sudden urge to be more physical. She said she wanted to see if she could use it as a 'fluid element to dancing'. For her, the allure of the poi was that they were tactile objects that anyone could use (albeit with different skill levels). By observing others, the poi objects became a material invitation to play that could be passed amongst participants and the resulting performance, in turn, was shared around the room.

**Wireless, multi-channel prototype (iPoi)**

Both our wired and first wireless prototypes certainly encouraged witting performance to some extent. However, the limitations of both of the systems meant that we could only transmit data on a single channel; only one poier and one poi ball could be used at any one time. This limitation meant that the data flow was transmitting from one poi ball only and therefore captured data from one poi in motion (in other words, half of the poi pattern being performed). To detect full poi patterns, we required a system that would allow us to collect data from both poi in real time.

Our final prototype focused on allowing multiple users to mutually engage (Bryan-Kinns and Healey 2007) with each other using poi to create one communal, dynamic sound and visual piece. This meant that we needed to extend our wireless interface to

allow for multi-channel data transmission (i.e. transmitting signals from multiple poi simultaneously). The Mote board provided this interface (http://www.moteiv.com). It was also at this prototyping phase that we decided to formally name our system iPoi so as to distinguish the system from the more traditional forms of poi.

The Mote itself is placed in a long sock and swung around the body.
Data from the swinging poi is transmitted to a base Mote attached to a PC.
The acceleration data is then wirelessly transmitted to another PC running Max/MSP which we used to create visual imagery and audio soundscapes.
The audio/visual output in Max/MSP changes according to the acceleration data produced when the poier swings poi. The system we developed is dynamically reconfigurable allowing us to connect several poi and computers on the fly to create ad-hoc installations for example allowing DJs and VJs to interact with the data from the swinging poi (Figure 5).

Figure 5: Configuration of wireless iPoi prototype using Motes. Motes are placed inside long knee socks. The Motes send acceleration data wirelessly to a controlling PC. The controlling PC has an attached Mote which reads the acceleration data and translates this to MIDI data. The MIDI data is wirelessly transmitted to another PC running Max/MSP which is used to control audio and video output.

**Performance labs and real-world testing**

We demonstrated iPoi at two conferences; the Culture, Creativity and Interaction Design symposium in London, United Kingdom and at Ubicomp'06 in Orange County, California. The third installation took place

at Ludus Dance Studios in Lancaster, United Kingdom as part of the f.city Digital Cultures Festival. We describe this studio performance in detail here as it provided us with a much richer group of poiers, context and environment than both of the conferences and was framed as a performance event rather than as a theoretical demonstration.

iPoi was the first performance in a two-week festival which was open to the public. The public was invited to the event through the center's website, email invitations and pamphlets distributed through the center's mailing list. A steady stream of people attended the two-hour evening event, coming and going as they pleased. Their engagement with the system provides is discussed in the remainder of this article.

**Technical and spatial installation**

The installation had three basic components: sets of poi embedded with Motes, three computers, and projector facilities. The event took place in a location which usually functioned as a dance studio – a large rectangular room with tall windows down one length of the room and at one end, mirrors along one end and a balcony (Figure 6). As there was no method of attaching a projector to the ceiling, we had to fix our projector on a large stepladder in the middle of the room that was covered with black cloth. (This in itself became an unintentional but rather significant object in the room, the effect of which will be discussed later.)

Figure 6: iPoi set up at the dance studio.

From our earlier guerilla performance, we recognized that not everyone is comfortable performing in front of groups of people and that sometimes the expert poier made the system look difficult to use. To address this issue, we secreted a Mote inside a small teddy bear. The teddy bear afforded the action of shaking, a subtler movement and a rather more inconspicuous object than the poi.

We used three computers to control the audio and visual elements. One computer collected the real time data wirelessly from the Motes. This data was then sent wirelessly to the audio application running on another computer.
Both of these computers sat in the far corner of the room underneath the balcony in a metal box. Our third computer sat underneath the projector on the ladder in the middle of the room. This computer, which ran our visual output, was connected to the projector. The projector then cast the resultant image onto a white wall. To create a more defined performance space within what was otherwise an empty room with no lighting to direct focus or delineate particular areas, we placed several iPoi on a plinth between the projector and the projection wall.

Each iPoi had the capacity to generate one pre-recorded audio soundscape and one pre-made visual. So swinging one iPoi would create both a soundscape and an image layered over the top of the background image and sound. Swinging several iPoi would create additional layers in much the same way as a DJ or VJ might layer tracks and images over each other to create an individual interpretation of the raw materials available. For this particular installation one iPoi controlled a digital animation of a shadow puppet dog on the left hand side of the screen. The longer a performer swung the poi, the dog would move closer to the middle of the projection (Figure 7).

Figure 7: Layered projected image created when spinning several iPoi simultaneously.

A different poi controlled a similar dog on the right hand side, another controlled random words and a fourth created a real time plot of acceleration data on the bottom of the screen. (Important to note is that the sounds and visuals did not cancel each other out – images and visuals were calibrated so that they complemented each other to create one coherent layered soundscape and visual projection.)

Two soundscapes (referred to as 'fx' and 'dog music') were created for the piece and played using Ableton Live (http://www.ableton.com). Each consisted of a continuously playing loop of five structured musical tracks which were selectively activated by the objects when they moved, and one track which continuously played a simple heartbeat. Both soundscapes had a dance/techno feel and played at 120bpm (although 'fx' had a softer, more organic quality than 'dog music'). The audio soundscapes were changed half way through the evening so that the performance stayed engaging and fresh.

**Unwitting observation to witting observation**

Prior to the performance, the doors to the room were shut so that people gathered outside. We can say that initially the audience was 'unwitting' because even though they entered the performance space knowing that a performance was going to happen, they did not know how iPoi worked. People entered the room in one group, and stood where they wished. A default projection (red bubbles) played on the screen and single sound (a heartbeat) played on the speakers. Two witting performers stood in within the crowd. When the crowd had settled in, we began an orchestrated performance in an attempt to entice various transitions in 'witting' performance. Since we expected that many people were unfamiliar with both the art form and the technology, this

introductory performance acted as both a demonstration of poi as a dance and display of some physical dexterity and as a demonstration of the augmented technology. In this initial performance, observers were given visual and audio clues as to how they could interact with the system. In this way we aimed to help the audience move from unwitting observation to witting observation.

The two performers purposely wore simple clothing – a t-shirt and jeans to show that the technology did not rely on someone wearing special clothing to interact with the iPoi. One performer emerged from the crowd and walked up to the plinth. She took one iPoi in her hand and stood silent for a moment. She then swung the poi around her body slowly in a circle at first, and then gradually increased the action with speed and changing patterns. Whilst doing so a new image and sound filled the projection and speakers. Occasionally she would stop spinning, which would cause the sound and image to disappear. Eventually she picked up another poi and swung both of them around her body, again creating new layers of sounds and images. She continued performing for several minutes as the audience stood back and watched. After some time, she placed the iPoi back on the plinth and walked back into the crowd. When she did this, a second performer emerged from the crowd and repeated this performance but with more intensity and with a different range of established poi patterns. After several minutes, the first performer returned and picked up two poi. The two performers swung poi around their bodies and together they created layered visuals and audio soundscapes with the intention of bringing to the audience's attention the correlation between the objects moving in space and the resulting change in the digitally mediated environment. After the initial performance, the two performers walked into the audience and offered the iPoi to people in the crowd.

Upon giving the crowd the poi, we were interested in noting the transitions from witting observation to witting participation, and from witting participation to witting performance. In the rest of this section we explore the effect our prototype had on these transitions.

**Witting observation to witting participation**

Our aim was to create a playful environment in which people could slide easily from witting observation to witting participation. Simply moving the poi or shaking the bear caused sound and visuals to be produced giving immediate feedback. Right after the initial performance a few brave, witting observers took the iPoi, walked in front of the projection screen and began swinging them. They continued swinging and spinning them until someone else came up and asked to try it out or until they passed it on to one of their friends or someone else in the audience. This passing (a further example of social infection facilitated by performance) sometimes included a short discussion on how to use the object – a self-constructed narrative as we had not provided any explanation – but more often than not people just gave the objects a go to see what happened. Certainly these self-constructed narratives increased levels of interaction and engagement within the room and became an interesting facet of the event as theories, ideas and reactions to the performance filtered amongst the participants both verbally and through the embodied movement facilitated by the objects themselves.

Several people spent a significant amount of time swinging iPoi, trying various patterns, and swapping different iPoi with other people. As they did, they transitioned

from witting observers to witting participants who had an understanding of the effect of their action on the performance frame. A few expert poiers began swinging the iPoi as they normally would spin traditional poi but with greater attention to the effect they were able to have on both the sounds and images generated and in tandem with those spinning poi near them.

In terms of design, it seemed that it was easier for participants to relate their movements to the sound produced rather than the video. From this point of view it was through understanding the audio interaction that participants were able to transition to participation. Interestingly, this understanding was usually gained by stopping the movement of an object. Indeed, we observed a pattern of participants moving the objects, being unsure what was happening, stopping the movement, concentrating on listening for what was missing from the audio mix, looking at the screen, and repeating until they 'got it', and in doing so transitioned to witting participation. After a few stops and starts participants would typically let out a short 'ah-ha' expression and then use the object without such focused attention to what they did, but with more appreciation of how they may be contributing to the performance frame. At this point they started on their journey towards becoming witting performers in the space.

Whilst many people transitioned to participants, it was clear that they had some difficulty in determining what audio they were affecting. Indeed, when all tracks were playing it was very difficult for participants to understand what was going on in general, let alone what they had control of. This was probably due to the large number of tracks that could be playing at any one time, the changing structure of the tracks,

and the similarity of some of the prerecorded music. We see this problem as hindering a transition from witting participation to witting performance – whilst participants were aware that they were doing something they were not able to contribute to or manipulate the performance frame as much as we had hoped.

**Witting participation to witting performance**

Despite the limitation described above, several participants did begin to structure their performance with respect to the soundscape and to each other which indicated to us that they had transitioned from witting participants to witting performers. Two main forms of structure emerged which indicated witting performance and acknowledgement of the performance frame. We classified these as trading spaces and emphasizing beats. In trading spaces performers interacted with each other by purposely pausing one of their tracks whilst the other played, and vice-versa. Anecdotally, this had a similar structure to the convention of trading licks in jazz improvisations, but utilised the ability to turn tracks on and off to create the opposite effect. More experienced poiers who used iPoi for an extended period of time developed this trading of space to encompass four tracks which generated a performance with significant auditory depth. The second form of structure involved emphasizing beats by playing their track only for one beat (for example, at the start of a bar). This structure was seen in individual interaction and as ensemble interaction where the aim was to emphasize beats of the other participant, or to jointly emphasize beats in the soundscape itself. The development of these structures by performers relied on eye contact, adherence to the beat of the soundscape, and very little verbal communication. As such it illustrated the expressive power of an environment with very simplistic but intuitive and naturalistic control mechanisms.

Interestingly, as the speed of poi swinging had no influence on the speed of audio, the poiers tended to spin their poi in time with the music. This reinforces the idea that performers were not simply operating the poi in isolation, but were part of the collective experience.

**Unwitting and witting observation**

Although many people transitioned to participants and performers, there were still those who did not 'get it' or refused point blank to interact with the objects even when invited to do so by others or the co-ordinators. For those who did not 'get it', even though they tried to have a go with the objects, the mapping from object to audio and visuals was clearly inadequate to allow them to transition to witting participation, and they remained as witting observers. For those who remained unwitting observers and abstained from interaction altogether, other issues may have come into play such as the fear of making a fool of oneself in public. As with many public performances which attempt to involve the audience, it is clear that not all people who attend will want to become full participants in the action; our intention as designers is to facilitate the transition from observer to participant but to respect people's right to remain in the spectator role and to acknowledge its significance in maintaining the core of what it is to engage in live performance where people observe others at some physical and psychical distance.

**Some considerations when designing objects for witting transitions**

Our investigations with iPoi led us to consider a range of practical and pragmatic considerations when developing technologically mediated works which play with the witting and the unwitting and the facilitation of movement between observer,

participant and performer. Prototyping several objects and testing them in real-world environments has raised a number of issues about how to design technological objects that encourage witting transitions in the performative mode. We consider some of these issues here.

**Orchestration is critical**

We soon discovered that orchestration is critical to encouraging witting transitions. Having an orchestrated performance (albeit an informal one) at the beginning of our final event to demonstrate how people could perform with iPoi allowed observers to understand the possibilities and limitations of the system in a distanced and low-risk manner. It served as performative modelling and gave clues to spectators as to how they might engage with the objects themselves. This orchestration functioned as a rapport-building exercise at the start of the evening where observers were invited into the action in the same way guests may be drawn into a conversation at a party. The orchestrators acted as hosts and handed over the performance tools (objects, space and context) to the audience so that they could make it their own.

**You can lead a horse to water but you can't make her interact**

Some people are reluctant to engage physically with interactive installations and performances regardless of their simplicity. Whether they are too embarrassed to experiment, have a fear of revealing a lack of understanding in front of others or simply do not feel compelled to accept the invitation to respond to the work, these are all issues that need acknowledging and respecting. In our own investigations with iPoi, it was noticeable that the Mote embedded in a teddy bear had a much greater tendency to promote interaction for those who felt unable to explore the system with

poi.

**Performance as 'social infection'**

As well as providing dramatic effect, an interactive performance of this kind has a 'Chinese Whispers' effect – the audience learns how the technology works through observing each other in the space, through their own encounters with the objects and by word of mouth, or 'social infection' (Sheridan 2006). The instances of human-to-human interactions within the performance space became part of the performance outcome as people played together, talked about what they had seen and encouraged others to experiment and perform.

**Experts as audience**

Having several expect poiers in the audience contributed significantly to the success of our performances. They were the first ones who wanted to participate once the performance was opened to the audience and the last ones to leave. In our final event, one expert poier interacted with iPoi for the entire event and he was keen to show people how it worked and to interact with them in the performance space. Whilst this may not always be the case and cannot be planned for, in this instance it helped us pass the ownership of the piece from orchestrators to witting participants smoothly.

**Adapting to suit the environment**

Since no two spaces are alike, performers must continually adapt their performance to suit the space that is given to them. We had originally asked to perform outdoors since we wanted people to realize how easy it would be to perform in an unanticipated performance space. However, the curators had not confirmed where the performance

was going to occur until the final days leading up to the event. This meant that we saw the space only on the day of the event so we had no choice but to deal with the space in the best way possible.

**Non-stage and breaking the 'mystery'**

In our final event, having a projector on a ladder in the middle of the room caused several problems. Firstly, it broke the 'mystery' of the technology since many people assumed that there was something hidden under the ladder which was controlling the visuals and soundscapes. Because the ladder was so big, it obstructed the view for the audience and split the room into two spaces – a 'performance space' and an 'observation space'. We did not want a 'stage' but rather encourage people to move about the room and perform anywhere. However, the large ladder prevented this from happening. In future performances, we will provide detailed diagrams and a video of the performance so that the curators understand the technical requirements.

**Direct manipulation and unfamiliar manipulation**

The limited control of the audio soon became apparent during the event, especially with experienced poiers. There were expectations that swinging poi in different patterns, at different speeds, or with different strength would somehow change the audio. Typically performers expected that swinging the poi quickly would increase the volume or speed of their track. The limitations of the technology meant that whilst swinging poi did indeed change the visuals and audio it was not to the extent some of the poiers expected. Some participants were unsure what they were actually affecting. To some poiers, this was not problematic – they knew that they were having some effect and that was enough to keep them engaged. Generally, these were people who

were already familiar with poi in its traditional form. When designing interfaces for communal engagement particular attention should be paid to whether direct manipulation is important [i.e., how their input (in this case swinging poi) is effecting their output (in this case audio and video)].

**Discussion**

What kind of interaction is iPoi? Performing with wirelessly networked peer-to-peer objects is not something that many performers are used to. We could say that it is tangible, since you hold iPoi in your hand, and physical since you swing iPoi around your body, but what about the action of swinging itself? Does this action fit into the current tangible taxonomies? PDAs and mobile phones have been used in performance, but these devices have interfaces which demand visual attention – the loci of attention is with the visual interface. Conversely, with iPoi, performers can close their eyes and continue to interact; rather than 'pointing and clicking', they swing and shake the objects in 'natural' and intuitive ways.

In this paper we have illustrated how technologically mediated objects could be used to dismantle the division of spectator-participant roles in witting performance. Rather than digitally mediated objects interrupting our sense of the live and the living, we have used them to enable people to become performers for themselves and others. The intimate and unassuming nature of our objects encouraged face-to-face communication and interaction rather than separating those who are 'in the know' from those who are not. Indeed, to engage with technology in a playful and performative way, we suggest that conditions have to be such that people are invited into the work on the understanding that their contribution to the performance and

manipulation of the digitally mediated object is prioritised over any cognitive awareness of how the system operates. To feel able to engage physically with a digital artwork in the presence of others, there needs to be a relatively low entry fee and an immediate and tangible sense of reward. The next steps in the pursuit of this goal are to explore the nature of the intersubjectivity in this rich, collective, performance contract.

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