

# Designing Interfaces for Public Places

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## ABSTRACT

We analyse existing interfaces to articulate the challenges involved in designing interaction for public settings such as exhibitions, galleries, museums, staged performances and the streets. We consider interaction in terms of four key components: interface, performers, spectators and orchestrators. We show how a spectator's experience of a performer's interaction can be described in terms of manipulations and effects, which include their actions around the interface (gestures, movements, expressions), as well as their direct interaction with it. By trading off how manipulations and effects are hidden, revealed, transformed and amplified, designers can create radically different experiences that we label secretive, expressive, magical and suspenseful. We then consider the possibilities of interactive spectators and performer awareness of spectators. Finally, we address support for behind the scenes orchestration and making transitions between different modes of engagement.

## Author Keywords

Public experiences, design framework, museums, galleries, art, performance, spectators, orchestration

## ACM Classification Keywords

C2.4 Distributed Systems; H1.2 User/Machine Systems; H5. Information Interfaces and Presentation.

## INTRODUCTION

The growing interest in cultural, artistic and entertainment applications of interactive technologies in settings such as museums, galleries, theatres and even clubs, combined with the spread of mobile devices into the streets, means that interaction with computers is increasingly becoming a public affair. Crafting interaction for public settings raises a host of new HCI challenges, shifting the focus of design away from the individual's dialogue with their interface to also consider the ways in which interaction affects and is affected by bystanders. While these certainly include

familiar issues such as mutual awareness and privacy, there are also many further issues to consider such as expressiveness, surprise, handovers and orchestration.

This paper considers what it means to 'perform' with an interface in a public setting. We take a broad view of performance that ranges from explicitly staged interaction by musicians, actors and artists in front of an audience, through to more implicit performance, where users almost unconsciously perform their interactions for others to see in a public setting. While workplace studies have already shown us that users often subtly conduct their interaction so as to be visible to others, promoting mutual awareness [15], we shall see how this becomes a more deliberately designed affair in settings such as exhibitions, galleries and museums, where watching others interact is part of the experience and where there is a need to frequently handover an interface between visitors. We will also consider situations where people perform their use of a technology in everyday settings, for example conducting mobile phone conversations in bars, restaurants, on trains and in the streets.

Drawing on example interfaces and previous studies of interaction, we identify key design issues for public interfaces and propose new taxonomies to show how these can be related to one another. Our aim is to provide designers with a comprehensive view of the issues, particularly the trade-offs, involved and to make explicit what often appears to be implicit craft knowledge.

## MANIPULATIONS VERSUS EFFECTS

We begin with a common, but over simplistic, idea: the separation between public and private interaction. Some interactions such as personal phone calls are essentially private and might ideally be shielded from others when conducted in a public setting, for the benefit of both the conversant and bystanders. In the most extreme cases, the technologies are embedded in private booths that are placed in the public setting, for example in interactive photo kiosk. Other interactions are clearly intended to be public, such as those of an electronic musician or performance artist whose use of interactive technologies is a carefully staged spectacle. Other interactions fall somewhere in between, such as museum installations, which as Heath et al. observe, involve multiple levels of engagement, including those who are directly interacting,

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those in an immediate co-located group who share the interaction, and bystanders who observe from a distance, learning by watching others and waiting their turn [23].

We argue, however, that this basic distinction between public and private is not sufficiently rich to capture some of the important design features of existing public interfaces. In particular, it is important to consider exactly what aspects of an interaction are revealed to bystanders and in what way. We therefore introduce a further distinction in order to help us express the various possibilities; we consider interaction in terms of manipulations and effects.

### **Manipulations**

Manipulations are the actions carried out by the primary user of the interface who we shall henceforth refer to as the ‘performer’. They include manipulations of physical controls (buttons, mice, joysticks and so forth) as well as gestures, movements and speech that are otherwise sensed by the interface.

Manipulations also include actions that take place around the interface *but that do not directly result in input to it*. For example, performers may assume a particular orientation so as to make themselves more or less visible to others in the environment, henceforth referred to as ‘spectators’. Performers also often gesture around the direct use of the interface, performing distinctive movements prior to, or following on from, the actual moment of interaction. This can be seen in traditional performance contexts such as musicians playing conventional instruments or sportspeople striking balls. Such gestures play two important roles. First, interactions are not only about the moment of contact; preparation and follow through are essential components of a skilfully performed physical action, perhaps best illustrated by a golfer’s swing. Second, such gestures are an essential aspect of deliberately performing interactions for others to see and appreciate, expressing skill and control and introducing an aesthetic component to the use of technology. Rosen [16], for example, describes how performer gestures at the piano fundamentally influence spectator appreciation of the skill and emotion involved in the performance of a piece of music. Previous work in HCI has discussed the similar role of such performative gestures in playing electronic instruments [7].

It is also important to consider the ways in which performers engage with and disengage from interactive technologies. The movements and gestures involved in approaching the technology, for example in moving into sensor range or putting on a wearable interface such as a head-mounted display, are also part of performing although they may not directly result in input to the system. Similarly, performers may disengage from

technology in order to rest or reposition themselves before resuming a performance.

Finally, on this issue, interactive technologies may often be used to enhance more traditional forms of performance, for example sensing and responding to the movements of dancers on a stage. In this case, performers will continue dancing as they interact with the technology and furthermore, spectators primary interest will continue be in the movements and gestures of dance.

### **Effects**

Effects are the results of these manipulations, for example the display of images, graphics and sounds or the actuation of physical objects. Effects include the ‘content’ of the performance, but may also include other visible effects of the performer’s manipulations of the system, for example the appearance of menus, icons, cursors and so forth that are necessary part of manipulating the contents.

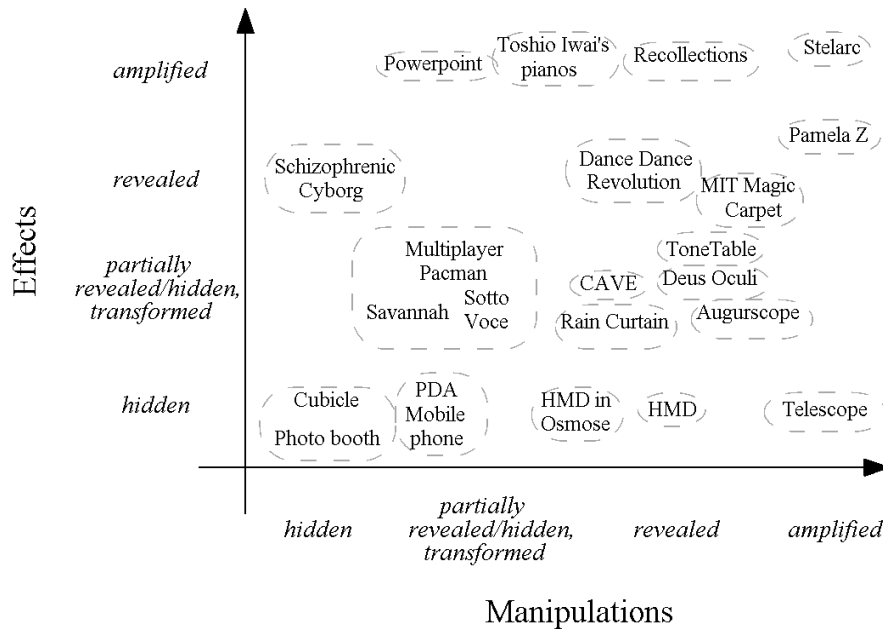
Effects also include the apparent action **of** the interface on the performer. These may be direct effects such as when the performer is tethered to the interface, for example is riding a motion platform that enables the interface to move them about, or in a more extreme case may involve the system actively controlling the performer’s body as can be seen in the work of the performance artist Stelarc in which the system causes his body to move through a series of electrical impulses, triggered in the first instance by spectators [22]. Performers also display a reaction to the interface, deliberately or involuntary, so that some gestures, movements and expressions around the interface might be seen as being part of effects.

As a final note, manipulations and effects are not the same as input and output, the key difference being that they include surrounding actions that are not *directly* sensed or driven by the interface, but that are an important part of describing how someone performs with it in public.

### **DESIGNING THE SPECTATOR’S VIEW BY REVEALING OR HIDING MANIPULATIONS AND EFFECTS**

We are now ready to revisit and expand on basic ideas of public and private, further developing them in terms of the varied ways in which a spectator can perceive a performer’s interaction. We can classify a wide range of existing interfaces according the extent to which they hide or reveal a performer’s manipulations compared to the extent to which they hide or reveal the corresponding effects. Figure 1 shows the resulting taxonomy, populated with a range of example interfaces.

At the bottom-left we see what is traditionally considered to be private interaction in which both manipulations and their effects are hidden from the spectator, an example being any interface that located in a private booth such as the photo kiosk example mentioned previously. Top-right



**Figure 1:** Classifying interfaces according to how they hide or reveal manipulations and effects

we see the most public interactions in which both effects and the manipulations that cause them are revealed to spectators. An interactive whiteboard belongs in this general area, as do many conventional examples of single display groupware in which people collaborate openly around a shared display [24

Re].

The areas to the top-left and bottom-right are somewhat less conventional. Top-left are interfaces in which effects are revealed but manipulations, including the performer themselves in extreme cases, are hidden. Here we find ‘wizard of oz’ interfaces, for example a performer speaking through a real-time animated character from off-stage. Wizard of oz techniques are also sometimes used in the early prototyping stages of interface design.

Bottom-right we have the converse, manipulations are revealed but effects are hidden. Here spectators can watch a performer using a display but cannot share in the content of their experience. Examples include immersive head-mounted displays when used publicly in exhibitions and theme-parks and also peep-hole displays, for example the Telescope, stand-mounted augmented reality display that was deployed in a visiting experience; performers rotated a large display and then looked through a small eye-piece to see an augmented view of a physical target [25].

Next, we consider other examples of public interfaces that involve more subtle trade-offs between hiding and revealing manipulations and effects.

### Mobile personal displays

Due to their small size, many of the fine details of interaction with mobile personal displays such as PDAs and phones may be hidden from most spectators. However, there are some subtle distinctions here. A spectator is who close by, for example looking over the shoulder of someone who is using a PDA, may be able to observe their manipulations and the resulting effects. More distant spectators will miss small manipulations such as key presses, but will still be able to see that the device is being used due to characteristic “phone gestures” [11]. Mobile phones in particular project some of their manipulations and effects into the surrounding environment, including ring-tones and the performer’s talk, which sometimes appears to be at least in part deliberately performed for spectators in the local environment as well as for the distant conversant. The Finally, Sotto Voce museum guide system [1] is especially interesting because a spectator can elect to eavesdrop on a fellow participant’s audio (participants were arranged into pairs, and proximity did not affect the overhearing of this audio content). The choice over whether to reveal or hide a co-visitor’s guidebook manipulations was, in this example, controlled by a secondary performer.

### Interactive installations

Interactive installations demonstrate a variety of approaches to hiding and revealing manipulations and

effects. Some interfaces rely on spectator comprehension of manipulations and their mapping to a revealed effect for their entertainment value. Dance Dance Revolution arcade machines, for example, present players with a set of footpads (usually with eight ‘buttons’) that must be triggered in specific sequences in time with an accompanying soundtrack. Much of the entertainment is that players are on public display, standing on a podium in front of a screen so that both manipulations and effects are revealed to spectators.

Projected 3D displays such as CAVEs reveal both manipulations and effects to co-present spectators. However, only a single tracked performer receives the full 3D experience that is correct for their physical perspective, giving spectators a downgraded experience.

With the ToneTable [5], an interactive table-top display that was exhibited in a science exploratorium, four performers at a time used trackballs to interact with a simulated physical model. There was a non-linear mapping between performers’ manipulations and revealed effects, so that while it was clear that performers were interacting, the nature of cause and effect was not immediately obvious, requiring further reflection.

We have already high-lighted the Telescope as an example of an installation that reveals manipulations while hiding effects. Related to this is the Augurscope, a stand-mounted mobile display for viewing 3D models from different physical vantage points when outdoors [26], which displays effects on a laptop-sized screen, so that spectators grouped around the display can see effects, while those further away cannot not.

### **Performances**

Artists who interact with technologies in front of audiences are not always content with revealing manipulations, but make actively seek to amplify them into to make their performances more expressive. Musician Pamela Z [21] uses gesture controllers in her performances in order to control electronic instruments in tandem with her voice. By using more expressive sensing interfaces, she both reveals and then amplifies the manipulations that are normally involved in the playing of electronic instruments. As a different example, Toshio Iwai’s pianos [20] are enhanced with automated lighting effects that amplify his manipulations of a conventional piano keyboard . Some of Stelarc’s performance pieces, such as Stimbo [20], where muscle stimulators were attached to Stelarc’s body and accessible via a touch-screen, see him assuming the role of the interface. In this case, effects rather than manipulations are amplified.

However, not all performance interfaces involve amplification. In the Schizophrenic Cyborg [18], a performer ‘cyborg’ had a digital display fixed onto their torso, the content of which was manipulated by a

‘parasite’ human controller who was located in the same space. The manipulations designed to be hidden from all concerned retaining their anonymity, whereas their effects were made visible on the cyborg’s body and so became a talking point – for spectators.

As a final example, we briefly draw attention to a quite different and more everyday kind of performance, that of giving presentations using tools such as Microsoft Powerpoint. While such tools clearly provide powerful and indeed popular facilities for creating and displaying audio-visual material to support a spoken presentation, we suggest that they suffer from some limitations in terms their ability to support fluid performance, and that these can be explained in terms of our taxonomy. Conventional presentation packages display all of the activity on the desktop including cursors, menus, buttons, system alerts and often the contents of the desktop as the performer begins or ends a presentation or switches applications midstream. While we accept that both performers and spectators may have become accustomed to seeing such information, we feel that there is something inherently clumsy in performance terms about publicly revealing all of the background manipulations of the underlying interface as well as the intended effects (i.e., the crafted presentation material). As presenters, we have often wanted to be able to secretly alter later slides as a presentation progresses, perhaps in response to time pressure or questions from the audience, without this being visible to all. Maybe current mainstream presentation packages should be redesigned to support a clearer separation of manipulations and effects?

### **SECRETIVE, EXPRESSIVE, MAGICAL, SUSPENSEFUL**

We now revisit our taxonomy in order to draw out some design principles from the varied examples that we have described. We propose that there are four general approaches to designing public interfaces, each of which addresses different concerns.

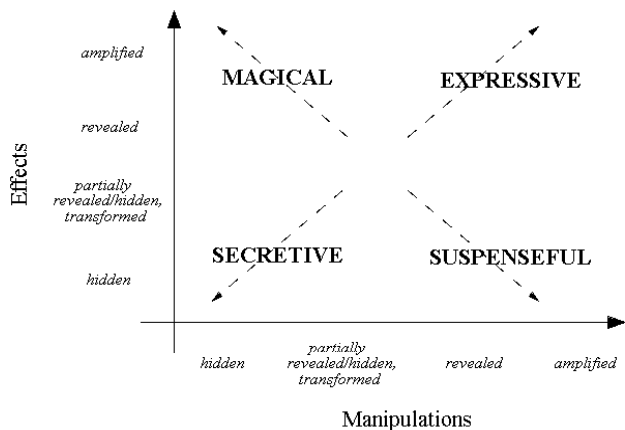
**Secretive** interfaces tend towards hiding both manipulations and effects. They respond primarily to the desire to maintain a performer’s privacy and to minimise annoyance for spectators.

**Expressive** interfaces tend towards revealing, even amplifying, both manipulations and effects. For performances, their primary concern is to entertain spectators by enabling them to appreciate how the well a performer is interacting with the system, for example admiring the skill of a virtuoso user or being entertained by a new user’s attempts to use the interface. For installations, expressive interfaces are concerned with attracting spectators and then enabling them to learn by watching so that they can prepare themselves for their own turn with the interface.

**Magical** interfaces tend towards revealing effects while hiding the manipulations that led to them. Lamont and Wiseman [13] discuss the fundamental base of magic as relying on “methods” which lead to “effects.” A magician may use many different methods to achieve the same effect, however the magician’s skill lies in ensuring the spectator is only aware of the effect. An important design decision for magical interfaces is whether to reveal the performer, making clear that they are causing the effects while not giving away exactly how, or to hide the performer altogether, in order to impress spectators with the implied capabilities of the interface alone.

**Suspenseful** interfaces tend towards revealing manipulations while hiding effects. While at first sight this may appear to be the most surprising of the four strategies, it does offer some interesting possibilities. As with expressive interfaces, spectators may be attracted by seeing the interaction and may be able to learn something of what to do by observing, but will not experience the effects until it is their turn. Watching others manipulate and react to the interface may serve to build suspense, heightening the ‘payoff’ delivered when it is finally their turn. This is particularly appropriate in situations where visitors have to pay for each individual experience, for example interactive rides in theme-parks, in which case only those who pay experience the actual content, while people who are in line waiting their turn experience a heightening of suspense.

Figure 2 positions these approaches on our taxonomy. It also extends its axes to show more possibilities than simply revealing or hiding manipulations and/or effects.



**Figure 2:** comparing secretive, expressive, magical and suspenseful approaches to designing public interfaces

Our example interfaces demonstrate a wide range of approaches to this issue including:

**Partially revealing:** effects and manipulations may be partially revealed, either as a result of scale and distance

(e.g., PDAs, mobile phones and the Augurscope) or perhaps through more explicit means (e.g., we could redesign presentation tools so that background user interactions were prevented from being projected along with the primary content).

**Transforming:** we may transform manipulations, for example by using non-linear algorithms or by aggregating multiple inputs when mapping them onto effects. Such techniques are used by artists to introduce an element of unpredictability or ambiguity to an interface in order to provoke curiosity and reflection (a more detailed discussion of potential benefits of ambiguity for interface design can be found in [27]). Alternatively, manipulations may be transformed into unrelated actions by a performer in order to mislead spectators, such as a magician’s intentionally misleading bodily conduct that hides the methods employed to produce a trick [13].

**Amplifying:** performers may deliberately amplify their manipulations and effects rather than merely reveal them. Again, this may be as a result of physical scale (manipulations of a large device are inherently more visible) or through technical augmentations such as using expressive sensing based interfaces or introducing additional visualisations or sonifications of their movements alongside the primary effects. For example, Ed Tannenbaum’s video installation Recollections [20] tracks the performer’s body movements and projects these as silhouettes on a public display, layered to produce a vibrant collage of the their movements over time.

**FURTHER ISSUES FOR SPECTATORS**

So far, we have considered how a spectator perceives a performer’s interaction with an interface, a combination of how they perceive the interface and also how they perceive the performer. However, designers also need to attend to other important relationships within this performer-interface-spectator triangle, including how does the performer perceive the spectators, and how does the interface perceive the spectators, or more simply, can the spectators interact with the interface rather than just passively observing it?

**Performer awareness of spectators**

Public performance, be it explicit or implicit, is fundamentally about the relationship between performers and spectators. The performer’s awareness of the presence, activities and reactions of spectators is clearly an important aspect of this relationship and will shape the way in which they conduct their interaction in public.

In a typical staged performance, theatrical or musical, a performer needs to be highly aware of audience presence and reaction. In many situations, a performer will communicate with an audience and will respond to feedback such as cheering and applause. Even where

audiences are more restrained, the manifest presence of an audience is clearly critical to the sense of ‘liveness’.

Recent mobile performances that are played out on the city streets have introduced a quite different twist to the performer’s awareness of spectators. For example, Uncle Roy All Around You is a game-like performance in which members of the public, equipped with wireless PDAs, search the city streets for a mysterious character, guided by remote online players and also sometimes encountering live actors and even interacting with members of the public (e.g., asking strangers for help) as they go [28]. The experience is carefully designed to give street players (the performers in the sense of this paper) the unnerving but exciting sense of being involved in a conspiracy that potentially implicates everyone around them, even casual bystanders. The key here is a performer’s experience of interaction in public space is greatly enhanced by an *implied* awareness and involvement of spectators, even though this is often not the case. As one player reported after the experience:

“My initial feelings were of slight paranoia because you knew you were probably being watched and certainly monitored. I felt very much on my own with no one to confer with or discuss how to do it, or if it was the right way. This was accentuated by the thought that people may be watching you ‘doing it wrong’. I couldn’t help but look around me to see whom else might be in on it”

A more conventional awareness of spectators can be found in museums, exhibitions and galleries. Studies of interaction in such settings have identified different levels of engagement, including directly interacting with an exhibit, being part of a local co-visiting group gathered around it, and being a bystander [14]. One implication is that designers may need to engineer different kinds of performer awareness of co-visitors as compared to bystanders. Having sufficient awareness of co-visitors is clearly important to a successful shared experience. Highly personal interfaces such as audio-guides with headphones can be problematic in this regard, motivating approaches such as *Sotto Voce* described above [1]. Awareness of bystanders may be a different issue however. An important factor here will be the pressure felt by the performer, both in terms of the embarrassment of potentially appearing stupid in front of strangers, as well as the pressure to move on and let others have a turn. Whether such pressure is a positive or negative factor depends upon the situation, for example balancing the performer’s enjoyment of the experience against the pressure to maintain a high visitor flow.

We do stress however, that it is not always desirable for a performer to be aware of spectators. Some contemplative artistic experiences deliberately isolate the performer, an interesting case being the virtual reality artwork *Ozmo* where the performer was placed behind a screen so that they could not see spectators, but where the spectators

saw a shadow projection of them using an HMD (an example of partially revealing manipulations) [29].

### **Interactive spectators**

Another important possibility to consider is whether spectators can themselves interact with the display, albeit as a secondary form of interaction. Once again, this might be desirable or problematic depending upon the situation.

There are two main ways in which spectator interactions can be a problem. The first is interference, especially accidental interference with sensing-based interfaces. This is perhaps most obviously a problem with video-tracking systems where spectators can unintentionally interfere by moving into camera view, casting shadows or causing changes in ambient lighting (e.g., blocking light sources, opening or closing doors and blinds, or switching lights on and off). The second potential problem concerns safety. It is important to keep spectators at a safe-distance from heavy and fast moving equipment, an issue for almost any kind of theme-park experience. Both of these problems can be overcome through appropriate ‘set design’, i.e., the use of barriers, partitions, viewing platforms and so forth, although sensor interference might also be dealt with through careful sensor placement or redesign of sensing software to filter out interference.

It may also be desirable to enable spectators to interact, for example providing direct audience feedback or more subtly shaping an experience according to their collective attention. Given that there will often be many spectators involved, possibly thousands in a large audience, this raises the issue of how to aggregate many individual inputs into a meaningful interaction. Perhaps the most familiar example is the use of voting systems by television audiences, typically involving the use of a remote-control device. Video-tracking of large audiences offers further possibilities, with the most famous example being *Cinematrix* [ref] in which individuals in a large audience waved red or green paddles in order to play a collecting game of Pong that was projected onto a large screen. Other systems are able to track audience gestures without objects [14]. A more general discussion of aggregation techniques is beyond the scope of this paper. However, before closing, we note that designers need to consider the following key issues:

- To what extent does each individual feel that they are making a legitimate input? In this regard, Maynes-Aminzade et al advise that “what matters is what the audience thinks is going on, not what is really going on.” [14]
- Do spectators directly see the combined effect? This is likely to be the case for direct audience feedback, although the social aspects of voting will be different depending on whether the emerging result is seen during voting or announced afterwards. For artistic

applications, collective spectator interaction may be less obviously mapped onto a final effect.

- To what extent are spectators aware of each others' input? The use of physical artefacts such as the Cinematrix paddles makes this more visible, encouraging social interaction among an audience.

## **ORCHESTRATION**

Up to this point, we have discussed public interaction solely in terms of performer, interface and spectator, although we have already begun to see that this simple categorisation is not rich enough to express all of the design issues involved, for example in dealing with the distinction between co-visiting spectators and more general bystanders. We now introduce a fourth major component – orchestrators.

Conventional staged performances usually involve an element of orchestration, a set of activities that are concerned with ensuring the smooth running of the experience. In a conventional performance, these typically include the activities of 'front of house' staff such as ushers, receptionists, and announcers, as well as those 'behind the scenes', such as stage managers, floor managers, prompters and an extensive technical crew (sound, lighting, stagehands and so forth).

Brenda Laurel has argued that interactive experiences can also be thought of in terms of orchestration [30]. Studies of interactive performances show that they too rely on a significant element of orchestration, although the roles, processes and technologies involved differ. Desert Rain was a touring performance in which six 'players' at a time carried out a time-limited mission in a mixture of a shared virtual world and a physical stage set. At the heart of Desert Rain, was a technology called the 'rain curtain', a projection screen made of a fine water spray that could hold a back projected image of the virtual world and through which the players as well as actors could pass. An ethnographic study of Desert Rain revealed the subtle ways in which actors and technical crew orchestrated the experience, introducing players, assisting players who were struggling, hindering players who were doing too well, and dealing with technical problems [33]. Ideally, much orchestration was invisible to the players, for example subtly repositioning their avatars via a remote console. At other times, actors would make carefully timed and delivered interventions, either over an audio channel or face-to-face. In both cases, orchestrators would invisibly monitor players' activities from behind the scenes, via secondary displays of their avatars' viewpoints, or through the asymmetric rain curtain (it appeared transparent from the far side, allowing surreptitious monitoring of players)

A study of a second, this time mobile and distributed, performance called Can You See Me Now? in online

players were chased through a virtual model of a city by actors running through the actual city streets, similarly highlighted the importance of orchestration, showing how technical crew and actors worked together to monitor the operation of the technology and resolve problems [31].

Although we have focused on staged performances, we note that orchestration occurs in many public settings. Exhibitions in museums and galleries for example, employ docents to manage visitor flow and explain concepts and technologies, and of course have resources for fixing displays that are 'temporarily unavailable'.

These studies highlight the importance of orchestration and identify a series of common concerns including: introducing participants to an experience; managing their exit; handling transitions between different phases of a performance when engagement may easily be broken; managing technical problems; and finally, maintaining the pace of an experience so that it reaches a climax at an appropriate time. In order to deal with these issues crew and actors need to closely but invisibly monitor players physically and virtually, manipulate them, and communicate with one another.

In terms of manipulations and effects, orchestrators will ideally be aware of the manipulations and effects of other participants, both performers and spectators, while having their own manipulations hidden (and effects disguised) from spectators and possibly also from performers where these are members of the public.

## **TRANSITIONS**

Our final issue for **consideration?** is that of dynamic transitions between different modes of engagement. Many experiences involve moments of transition, for example interacting with museum exhibits may involve quite fluid transitions between being a spectator and performer, or between performers within a co-visiting group as they hand control of the interface to one another. Designers need to consider how frequent and fluid such transitions will be and chose their technologies accordingly. For example, handing over a wearable technology such as an HMDs will be more difficult than walking up to and away from a stand-mounted display. Designers also need to consider the traditional issue of admission; how do people enter the experience in the first place: at timed intervals or whenever they like: as a stream of individuals or in groups: and of course, do they require tickets?

The concept of 'traversable interfaces' accommodates transitions between spectating and performing by enclosing a performer and interface within a secondary projected display (e.g., placing them behind a large screen) while leaving spectators outside [34]. This fulfils several purposes. First it isolates the performer and the interactive technologies from interference by the spectators. Second, it allows for a spectator view of events

to be generated separately which may not show all of the performer's effects, maintaining an element of surprise. Third, by designing the screen so that spectators can physically pass through it, it supports dynamic transitions between spectating and performing. An example is the Storytent, a two sided screen shaped like an A-frame tent [32]. Spectators see only the public of the tent, but than can then step inside and sit down to interact at which point they also get to see the private side.

Another example of a public experience that relies on rapid transitions is Deus Oculi [12], a large renaissance-style painted scene featuring two figures whose faces were painted on small doors. When a visitor, assuming the role of a performer, opened a door and peered inside, an image of their face was captured on a hidden video camera and then displayed on a separate screen nearby. As a result, performers could not see the effects of their own manipulations, where as spectators could, resulting in highly engaging collaborative exchanges as they pointed them out to the performers and/or other spectators.

As an aside, there is a broader and longer term sense in which some interactive installations and performances are encouraging transitions, by turning previously 'passive' spectators into now 'interactive' performers. As a consequence, the traditional role of actors may also be in transition, from being performers to being orchestrators, shaping and embellishing public performance rather than being the primary focus of attention or in some more extreme cases to being the interface itself.

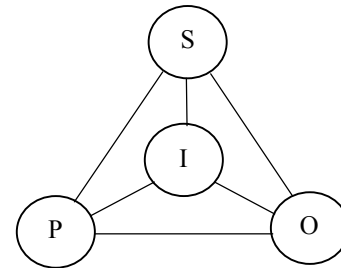
**SUMMARY: DESIGNING PUBLIC INTERFACES**

The first lesson from this paper is that designing interfaces for public places is a complex task, raising significant new challenges for interaction design. We also see that experience designers are already able exploit extensive craft knowledge when creating public installations and performances, drawing on a wide range of existing examples that embody innovative approaches to public interaction. We suggest that as computers continue to spread from the workplace, where they originated, into public life, so mainstream interface designers will increasingly need to deal with these same issues. In short, designing engaging, expressive and appropriate interaction with computers in public places will become a core part of interaction design, just as usability is today.

We have therefore reviewed and compared a variety of existing examples in an attempt to distil key issues and approaches and articulate some general design principles, which we now briefly summarise.

A good starting point is to consider four general components of a public interface as shown in figure 3: the *interface* itself (I), including both its physical and software manifestations; *performers*, the primary users of

the interface (P); *spectators*, others in the public setting who observe the performers' interactions (S); and *orchestrators*, those who steer the interaction, often from behind the scenes (O). The designer needs to consider to what extent each of these is present and also whether it makes sense to further divide them into sub-categories, for example, distinguishing between co-visiting spectators and more general bystanders in a museum exhibit, or distinguishing between control-room and mobile staff in a mobile performance.



**Figure 3:** Interface, Performer, Spectator, Orchestrator

Next, it is important to consider the possible relationships between these components. In what ways should each of performers, spectators and orchestrators be able to interact with the interface and how should such interactions be perceived by the others? A useful approach to these questions is to consider interactions in terms of *manipulations*, including direct interaction and as well as performative action around the interface; and *effects*, including displayed output as well as human reactions.

**Designing the spectator experience**

Perhaps the central issue for spectators is how they perceive performers' interactions. We have identified four design strategies which differ according to whether they seek to hide or reveal manipulations and/or effects:

*Secretive* interfaces tend towards hiding both, minimising annoying distractions when personal technologies are used in public settings, or maintaining complete surprise until it is their turn to perform.

*Expressive* interfaces tend towards revealing both, enabling spectators to appreciate performers' skill in using an interface and their emotional engagement with it.

*Magical* interfaces tend towards revealing effects while hiding the manipulations that caused them, encouraging spectators to believe that either the interface or the performer has some capabilities that they in fact do not.

*Suspenseful* interfaces tend to reveal manipulations while hiding effects, engaging spectators attention, building anticipation and enabling them to prepare for interaction by watching others, while preserving the 'payoff' of the content until it is their turn to perform.



However, designers have more options than simply hiding or revealing; they can in fact partially-reveal, transform, aggregate and also amplify manipulations and effects, leading to a wide range of different interfaces as we have evidenced by just the small selection that we reviewed.

A final issue for the spectator experience is whether spectators can interact, even if they are not the primary users of an interface. Designers may need to prevent this, perhaps for safety reasons or to prevent them interfering with sensing technologies such as video-tracking. Alternatively, they may wish to encourage it, enabling spectators to provide feedback during an experience, drawing on mass interaction techniques if a large audience is present.

### **Designing the performer experience**

The performer experience has been the traditional focus of HCI and there is already a wealth of literature covering usability, engagement, emotional response, interacting with sensors and so forth. We do however, emphasise two particular issues from this paper.

The first is deliberately designing space around the interface where performers can act without making input to the system, enabling them to make expressive gestures, supporting preparation and follow through for precise gestures, and generally enabling the technology to be embedded within other activities such as dance and acting. In turn, this requires that performers can easily engage with and disengage from the technology.

The second is to consider whether performers should be aware of the presence of spectators or not. While such awareness is a vital part of live performance, it may potentially put performers under pressure when using installations (although we have seen that the feeling of being watched is a powerful aspect of some experiences).

### **Designing the orchestrator experience**

Orchestration is an important issue for public experiences and introduces further demands of the interface. Orchestration covers a range of tasks including inducting participants, managing their exit, handling transitions, managing technical problems, and maintaining pace, all of which involve three underlying activities: *monitoring* the physical and virtual states of performers and spectators; *intervening* in different ways, and *communicating*.

Very often, it will be important to hide orchestrators' manipulations and even effects from the other participants, requiring specialised interfaces that enable them to observe and intervene without being noticed. For staged performances however, some aspects of orchestration may be revealed to performers (who are in on the act) while remaining hidden from spectators.

The final issue to be considered by experience designers is that of transitions; how do people move into and out of these different modes of participation? In particular, how do they enter an experience in the first place and then how do they subsequently move from being a spectator to a performer and back again. Specialised technologies such as *traversable interfaces* may have a role to play here.

While we hope that this paper has helped gather together some of the key design issues for public interfaces, we finish by noting some issues that it has not addressed. First is a greater specialisation of modes of engagement. We have already seen that there may be different kinds of spectators and the same may be true of both performers and orchestrators who may assume specialised roles within an experience. Second is a consideration of distributed experiences that connect multiple interfaces and environments. For example, the familiar idea of having a remote presentation to a live audience via a video link raises complicated design issues in terms of seeing manipulations and effects that are transmitted between two different interfaces. Finally, is the idea of designing an overall visiting experience in which performers and spectators move between multiple installations, raising further challenges in terms of transitions and ways of linking different performances. These issues provide topics for further work..

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