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Exhibiting Performance: Co-participation in science centres and museums

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There is a growing commitment within science centres and museums to deploy computer-

based exhibits to enhance participation and engage visitors with socio-scientific issues. As

yet however, we have little understanding of the interaction and communication that arises

with and around these forms of exhibits, and the extent to which they do indeed facilitate

engagement. In this paper, we examine the use of novel computer-based exhibits to explore

how people, both alone and with others, interact with and around the installations. The data

are drawn from video-based field studies of the conduct and communication of visitors to the

Energy Gallery at London's Science Museum. The paper explores how visitors transform

their activity with and around computer-based exhibits into performances, and how such

performances create shared experiences. It reveals how these performances can attract other

people to become an audience to an individual's use of the system and subsequently sustain

their engagement with both the performance and the exhibit. The observations and findings

of the study are used to reflect upon the extent to which the design of exhibits enables

particular forms of co-participation or shared experiences, and to develop design sensitivities

that exhibition managers and designers may consider when wishing to engender novel ways

of engagement and participation with and around computer-based exhibits.

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For informal science institutions, like science centres and museums, inspiring individuals to engage with science has long been a primary goal (cf. Csikszentmihalyi & Hermanson, 1995; Hennes, 2002; Perry, 1989, 1993; Semper, 1990). As a result such institutions grapple with ways to support visitor engagement with science, and are thus concerned with visitor attitudes towards both science and representations of science. The authors of this paper, being a mix of academic researchers and practitioners at a science museum, respect that museum educators and exhibit developers take seriously the challenge of making subjects commonly perceived as boring or difficult engaging and have worked to develop ways to draw visitors into exhibits that aim to teach complex concepts from which most visitors would normally shy away. As such, a common task for those within the museum community, and perhaps more broadly within science education, is – how do you make the seemingly tedious engaging?

Computer-based exhibits, particularly simulations and games, are often seen by museum educators and designers as a way forward – a means of engaging visitors with complex concepts in innovative ways (Farmelo & Carding, 1997). Interestingly, however, the innovation rarely goes beyond designing exhibits that rely primarily on conventional human-computer interfaces such as keyboards, pushbuttons and touch screens (Heath, vom Lehn, & Osborne, 2005). Although research suggests that technologically-rich exhibits attract and hold visitor attention (cf. Sandifer, 2003), we have little understanding of how visitors examine and make sense of computer-based exhibits. The little understanding we do have

relies on making sense of one form of social interaction, namely visitors' conversations

(Leinhardt, Crowley, & Knutson, 2002; Leinhardt & Knutson, 2004).

This paper seeks to contribute to the knowledgebase by looking at participation, and

in particular how shared experiences arise both in and through visitors' performative activity

with and around computer-based exhibits in the Energy Gallery at London's Science

Museum – exhibits that have been designed with, among other aims, the intention of

engendering a range of activities that might be of interest to both the user(s) and the

observers. Drawing upon field observations and video recordings of visitors' verbal and

bodily conduct, this paper explores the social organization of visitors' 'performances' that

arises at the exhibit face and adds to recent debates that point to the importance of social

interaction and conversation within the visitors' experience of exhibits (cf. Leinhardt,

Crowley, & Knutson, 2002; Rennie, Feher, Dierking, & Falk, 2003). In so doing, we wish to

put forward the argument that shared experiences in the form of performative activity can

both create and sustain visitor engagement at computer-based exhibits.

Background

Imagine being charged, as was the Science Museum, London, with creating an

interactive gallery targeted at children aged 7 to 14 to support science education around the

socio-scientific issues associated with energy and its use. From an educational perspective,

this is a challenging task as energy has proven to be a complex subject to teach. Research

within the constructivist movement on teaching and learning provides significant evidence

that students hold a range of alternative conceptions of energy (cf. Brook, 1986; Pfundt &

Duit, 1991). The students' difficulty is, perhaps, understandable considering that although

one can sense energy in the form of light or heat, explanations or even samples of the

phenomena are unavailable within everyday experiences. As such, a tangible material, such

as water, might be used to describe energy – a substance not easily obtainable for inspection

without complex tools. For example, for electricity, the metaphor emerging from the

comparison could then liken the flow of electrons to a stream of water (Harré, 1986: 76).

In addition to the difficulty of making sense of an abstract concept like energy, the

main remit of the Energy Gallery – to discuss socio-scientific issues surrounding energy –

furthers the distance between the topic and the macroscopic world. Whereas physical

phenomena – like forces and even energy transfer – can be displayed through

decontextualised mechanical interactive exhibits that allow visitors to explore the properties

of both the exhibits and the phenomenon simultaneously, socio-scientific issues necessitate a

different sort of exhibit medium (cf. Bradburne, 1998; Pedretti, 2002). Pedretti (2004)

suggests that

> [c]onventional installations often convey science as void of any social cultural
>
> context, and negate raising questions about the status of scientific knowledge. A more
>
> authentic portrayal acknowledges the tentativeness and purposefulness of knowledge
>
> creation, and views science as a human and social activity. (p. S36)

She argues that exhibits should be designed to 'enhance learning by personalizing

subject matter, evoking emotion, stimulating dialogue and debate, and promoting reflexivity'

(p. S45). She provides examples of two exhibitions both of which employ simulations, either

multimedia or theatre, as tools to engage visitors. The Energy Gallery, in London, which is

almost entirely comprised of computer-based interactives, appears to correspond to Pedretti's

concept in its intended approach to tackling the chosen subject matter. Exhibits in this gallery

range from simulations – one of which places visitors in charge of balancing politics, natural

resources, the economy and the impact on the environment to meet the energy needs of an

imaginary country – to a physical experience which aims to shock (literally) visitors into

reflecting on the balance between the necessity and yet physical danger of energy. Thus, considering the general attitude of the target audience towards science and the difficulties inherent in the nature of the subject, there are two key questions: What are the appropriate media to convey such content? And, what are the desired behaviours to encourage engagement with the exhibits?

It appears that as the focus within museums on such issue-based topics grows, so does the prevalence of computer-based interactive exhibits that might, for example, simulate scenarios and environments (Pedretti, 2004). Gammon (2005) suggests that computer interactives can be a useful medium when one wants to deliver large quantities of information in an appealing and accessible manner under the control of the visitor, or to allow visitors to experience and experiment with environments possible only through the use of multimedia digital simulations. Within a range of literature, various methods of investigating engagement with computer-based interactives has emerged, from those within visitor studies (cf. Dierking & Falk, 1998; Economou, 1998; Sandifer, 2003), to evaluations from within the museums (cf. Gyllenhaal & Perry, 1998; Haywood & Burch, 2005; McIntyre, 2003), to studies from research in science education (cf. Eberbach & Crowley, 2005; Stevens & Hall, 1997). Sandifer (2003), for example, suggests that exhibits displaying technological novelty and open-endedness showed increased average holding times. That is, such exhibits not only attract the attention of visitors, but they contribute to the exhibit's success at keeping individuals engaged in the activity.

Because this paper focuses not just on whether visitors engage with computer-based interactives but on the details of that engagement, previous studies exploring how computer exhibits can mediate learning become relevant. Unfortunately, relatively few studies investigate how computer-based interactives feature in the social interaction of visitors. One such study suggests that people like to gather around and examine computer exhibits

collaboratively (Flagg, 1994). Another provides evidence that a computer animation of plant

pollination generates more conversation (and specifically talk about processes within the

plant) between visitors than does a live plant (Eberbach & Crowley, 2005). While these

studies have made an important contribution to our understanding of the impact of computer

systems on visitors' experience of exhibits, they provide relatively little detailed information

on how computer-based interactives are used in social interaction. Heath, vom Lehn and

Osborne (2005) investigate how stationary touch-screen systems affect the ways in which

people explore and make sense of exhibits. Their findings suggest that such exhibits often

limit the emergence of more complex forms of collaboration and co-participation at the

exhibit face. The research to be presented in this article aims to build on such work but with a

focus on investigating the details of action and interaction at computer-based exhibits that

employ a range of user interfaces, and how such exhibits might open-up possibilities for

greater social interaction.

   With the growing focus on socio-cultural learning as one of the primary modes of

learning within informal science institutions (Rennie, Feher, Dierking, & Falk, 2003), social

interaction and collaboration have recently been highlighted by a large number of studies.

The majority of such research focuses on how social interaction within family and school

groups enhances an individual's learning (cf. Blud, 1990; Borun, Chambers, & Cleghorn,

1996; Diamond, 1986; Dierking & Falk, 1994; McManus, 1988). Many studies highlighting

the importance of social interaction place a strong emphasis on the role of conversation and,

in particular, learning conversations (cf. Ash, 2003, 2004; Crowley & Callanan, 1998;

Gelman, Massey, & McManus, 1991). However, conversation is but one form of social

interaction occurring at the exhibit face. A few researchers (cf. Carlisle, 1985; Lucas &

McManus, 1986; Puchner, Rapoport, & Gaskins, 2001; Weier & Piscitelli, 2002) have begun

to make note of the existence of non-verbal behaviours in interactive galleries. Yet, except

for a few examples (cf. Diamond, 1986; Rahm, 2004), little analytic attention has been given to how people's talk is interwoven with their bodily and material conduct.

This paper draws on recent research concerned with the ways in which people experience computer-exhibits in and through social interaction. Yet, rather than focusing on talk and conversation, it focuses on a form of social interaction and participation that we see as being performative in nature. That is, in using all types of exhibits in science centres and museums, visitors press buttons, turn cranks, touch touch-screen displays and point at objects. Their activities might go unnoticed by others. However, it is becoming increasingly recognised that visitors take notice of or even study the actions of others in order to make sense of certain aspects of an exhibit and its functioning. For example, Heath, Luff, vom Lehn, Hindmarsh and Cleverly (2002) discuss how people discover the functionality of an interactive art installation through their interaction with others nearby. And, as is demonstrated in vom Lehn, Heath and Hindmarsh (2001), visitors negotiate access to exhibits based on their interactions with others at the interactives. Here, we build on this work but concentrate specifically on the individuals who are being 'watched' by others – those who are, in essence, the performers.

More specifically, we are interested in the design and function of performative activity, and how individuals might create an unfolding performance that communicates aspects of their actions to others. There has been a long-standing interest in the social sciences to treat human conduct and interaction as performance. The early work of Goffman (1959) is perhaps exemplary in this respect. In this paper, we adopt a different standpoint. Rather than treating all action as performance, we build on Turner's (1986) work which directs attention to the ways in which the participants themselves differentiate 'doing something' from displaying or performing. Thus, through this paper we seek to provide insight into the following questions: What does performance look like at a computer-based

exhibit? How might aspects of the immediate environment, including the affordances of the

physical design of the exhibit and interactions with other individuals present, shape the

activity into a sequence of organised actions, or indeed, a performance? And, what are the

ways in which actions are fashioned that enable other individuals to become aware of and,

perhaps, part of the activity?

Methodological Considerations

As Erickson (1992: 202) suggests, ethnographic research of educational settings is

increasingly concerned with 'identifying and documenting the processes by which

educational outcomes are produced' (Erickson, 1992: 202). Ethnographies of schools,

museums and the like, shed light on how individuals within those settings go about creating

the context of the educational environment and generating specific outcomes. However, as

Erickson suggests, within such ethnographic research there is a growing concern that because

of the habitual and situated nature of many of the activities that occur, both practitioners and

researchers often overlook the details of educational practices. For example, whereas more

traditional ethnography often claims an understanding of the intention and meaning of

participants' actions, it can disregard the practices in and through which social interaction is

accomplished – practices that underpin education both in formal and informal environments

(Erickson, 1992: 204). In this regard, there is a growing interest in unpacking the fine details

of conduct and interaction, and drawing on resources such as video recordings to address the

particulars – the talk, bodily and material conduct – of the situated, collaborative

accomplishment of activities within learning environments.

The systematic inspection of video data requires a framework to manage the analysis

of its complexity. In the recent past, various analytic frameworks have been employed to

examine people's conduct and interaction in formal and informal educational settings (Lucas

& McManus, 1986; Roth, in press; Tunnicliffe, 2000; von Aufschnaiter, 2003). Our own

research utilises methodological developments within the social sciences which are

concerned with the situated character of practical action (cf. Goffman, 1959, 1981; Garfinkel,

1967; Sacks, Schegloff, & Jefferson, 1973; C. Goodwin, 1981; Erickson 1992). More

specifically, we draw on ethnomethodology (cf. Garfinkel, 1967; Heritage, 1984) and

conversation analysis (cf. M. H. Goodwin, 1990; Heritage, 1997; Sacks, 1992; Sacks,

Schegloff, & Jefferson, 1974) in conjunction with Goffman's (1959, 1963,1981) insights on

face-to-face interaction. Together, these perspectives provide the methodological and analytic

framework to address the conduct and interaction of visitors with and around exhibits in

science centres and museums.

Our framework is concerned with taking the participants' perspective seriously by

examining their actions and activities as they arise, and exploring how visitors organise their

conduct and experience in interaction with others (Heath, 2004; vom Lehn & Heath, in press)

– both those they are with and those who just happen to be within 'perceptual range of the

event' (Goffman, 1981). Video recordings, augmented by fieldwork, provide important

analytic resources in this regard. They enable repeated and detailed access to the conduct and

interaction of participants, and more specifically, the interplay of talk, bodily and material

conduct and the ways in which the visitors' engagement with exhibits contingently arises

both in and through their emerging interaction with others. We subject the video recordings

to detailed scrutiny to uncover how action and interaction emerge from and are part of the

context in which they are occurring. Here, 'context' refers not only to the physical

environment but to the unfolding nature, or moment-by-moment production, of the activity

that arises (Heath & Luff, 2000).

The data, including the video recordings, field observations and discussions with staff

and visitors, have been gathered at the Energy Gallery at the Science Museum in London – a

computer-based exhibition designed to facilitate engagement and discussion of socio-

scientific issues by engendering a variety of forms of activity with and around the exhibits.

The gallery is targeted at a school-aged audience but as a public exhibition attracts a wide

range of visitors. Altogether we have collected approximately 20 hours of video data and a

substantial corpus of field observations recorded both on weekday afternoons and on

weekend days. The filming days were chosen to ensure that there would be a variety of types

of visitors within the gallery - including families, groups of friends, and some scout troops.

The analysis involves the detailed transcription of short fragments of video – single

instances of discrete phenomena, here, visitors' performative activities – including

participants' talk and bodily comportment. (For sample transcript and notes on transcription,

see Figure 4.) By comparing and contrasting characteristic actions and activities among

various fragments, we begin to identify the patterns and organization of the conduct and

interaction. In common with more traditional ethnography, the fragments discussed in this

paper have been selected because they provide particularly clear instances which are used to

reflect upon the more common themes that we explore (Heath, 2004; vom Lehn & Heath,

2004, in press).

Recording video data in science centres and museums raises certain practical and

ethical issues. It is argued that when being filmed people inevitably react to the camera,

rendering the data unreliable (Gottdiener, 1979). Yet, research in museum studies shows that

that video recording is less obtrusive than field observation and reduces the reactivity to

observational methods (Morrissey, 1991; Phillips, 1995). Both in undertaking field

observation and video recording, we like other field researchers (C. Goodwin, 1981;

Grimshaw, 1982; Harper, 1994), are highly sensitive to our part within and influence on the

scene. We take precautions to both reduce 'reactivity' and assess data for the influence of the

recording. For the present study, the camera was separated from the action by mounting it to

a wall or attaching it to a tripod some distance from the exhibit itself. Once set up, the camera

was set to record the action with the researcher only returning in order to change tapes. Very

few visitors glanced at the camera and even fewer pulled faces, waved or otherwise

observably responded to the camera (see also Hensel, 1987 for similar findings).

To address ethical issues of undertaking video recording in a public area, we placed

notices at the entrances to the gallery to inform visitors and secure their support. The notices

explained the purpose of the project and that data would be used only for research and

teaching purposes. We also provided visitors with the opportunity to refuse to be recorded

and offered them the opportunity to have the recordings destroyed if they had any

reservations after the event. A number of visitors approached either the researcher or a

member of the museum staff to discuss the nature of the project further, but no visitors

showed any reluctance to being recorded; indeed many were interested in the research. All

procedures were agreed with the museum staff before filming began and were conducted in a

similar manner to those described in studies conducted by Gutwill (2002, 2003) which

explored the assumptions underlying such a method of gaining implicit consent at a museum

exhibit.

Analysis of Performative Activity at the Exhibit Face

'Doing' and 'Displaying Doing'

The commonplace understanding of a performance is one in which the activities

displayed – the talk and bodily action – are scripted and prepared, and typically undertaken

for the entertainment of an audience (Schechner, 2002). However, within the social sciences,

some have broadened such a perspective to include notions of 'everyday' performances. For

example, in viewing performance as a metaphor for all social action, Goffman (1959) offers

insight into the ways individuals might produce unscripted performances to manage the

impression they project of themselves. And, rather differently, by developing the concepts of

'theatricality' and 'performativity', cultural anthropologists have highlighted the

communicative function of the aesthetic quality of everyday actions (Hymes, 1974; Turner,

1986; Willems & Jurga, 1998).

The designers of the Energy Gallery aspired to engender a variety of forms of

participation and engagement. In so doing, they sought to create exhibits that might engage

not only the principle user but also those visitors who might gather around and observe the

activity. The following fragment offers insight into how such activity might arise at the

exhibit face in the form of performative activity. It has been recorded at an exhibit entitled

Making Energy Useful. The exhibit challenges visitors to a game in which iconic

representations of energy resources, such as coal or wind, slowly fall down on the screen (see

Figure 1). As they reach the bottom, they pass through one of three boxes representing ways

of converting the resources into useful forms of energy – for example, one box might

represent a wind turbine. Each of the three boxes corresponds to one of three footpads on the

floor in front of the screen. Visitors try to catch the falling energy resources by stepping on

one of the footpads and activating the box on the screen. If they are successful in catching the

resource with the correct capture mechanism, it is converted to useful energy and they receive

a point.

[Insert Figure 1 about here]

We join the action while Mark is in the midst of the game (see Figure 2). He taps the

footpads with his feet and alternates the direction of his gaze between his feet and the screen.

In so doing, he attempts to coordinate his actions on the footpads with those on the screen,

responding both to the images presented, and his own successes and failures. Mark first steps

on the footpads, one-by-one, and monitors the system's response. As he recognises the

organization of the game he uses it to transform his actions to a dance, choreographed by the

game's structure and his attempts to complete it successfully. His actions are elaborate and

embellished, going beyond the simple movements required to interact with the exhibit.

Playfully and with finesse, he moves his feet across the footpads and raises his arms as if

dancing to music.

[Insert Figure 2 about here]

He repositions himself quickly and dramatically, using large gestures and bodily

movements. His pauses in action are momentary and infrequent. He jumps between stances,

reorienting his body to reach the various footpads more effectively. He incorporates his arms

as much as his legs into his action, often with his fingers widely spread. Mark concludes the

sequence of activities represented above with a smile – not a pause in action, but an

acknowledgement of enjoyment of his own activity. Here, his smile displays that his activity

is one that both accomplishes its goals and is fun or interesting. His performance is not only

enjoyable to execute but may also be interesting to watch. His neatly organised activity goes

beyond the pragmatic aspects of actions produced to accomplish a task. That is, the aesthetic

qualities of his actions – the visible and accountable phenomena that other people can see and

orient to – become a critical part of their accomplishment in the public environment of the

exhibition (Knoblauch, 1998).

Unlike the behaviour we see from Mark, some visitors are aware that they are acting

in a public space where others might pay attention to their activity. When they have figured

out what an exhibit does, they may utilise the exhibit in a way that highlights the

performative aspects of their actions in order to create an experience for other participants.

And, in so doing, they develop techniques that may make their activity with and around a

computer system interesting for others to watch. To explore this notion, let us consider

another fragment that has been recorded at an art installation in the centre of the gallery

entitled, *Do Not Touch*. The exhibit consists of a tall metal pole standing inside concentric

circles painted on the floor along with the words 'Do Not Touch' (see Figure 3). When

visitors approach the pole and hold their fingers to the metal bars in the centre, they get a

slight electric shock. The physical experience, which is accompanied by a loud zapping noise

audible across the gallery, is intended to provide visitors with an appreciation of the physical

power of energy and to engender a range of responses to it.

[Insert Figure 3 about here]

The fragment begins as Carol, a mother who has previously experienced the electric

shock given by the pole, encourages Vivian, the grandmother, to play a trick on their family.

She instructs Vivian on where to touch the pole and how to react as if she has been shocked.

With her family situated just off-camera in a location that might be considered front row,

stage right, Vivian designs her activity (see Figure 4) to obscure any clear view they might

have of her touching the pole.

[Insert Figure 4 about here]

With her body blocking their visual access to the 'active' area of the pole, Vivian

leans in towards the pole and asks Carol to check whether the rest of the family are watching.

As Carol confirms that the family is looking, Vivian glances briefly at her audience before

returning her gaze to the pole. Allowing them no time to make sense of her actions, as soon

as her finger hits the metal she exclaims, 'Oh', while pulling her finger away from the pole as

if having just received an electric shock. She holds her finger with her other hand and

displays an experience of pain. As she clutches her 'hurt' hand, Vivian and Carol turn

simultaneously towards the rest of the family. Carol smiles at her family as Vivian produces

further sounds of pain. Then, with a slight smirk and one quick wink at the family, Vivian

concludes her performance (see Figure 5).

[Insert Figure 5 about here]

Vivian's actions are designed to create an experience for her family by demonstrating a suffering that never was. She displays the pain and surprise of having received an electric shock, although, as evidenced from a lack of zapping sound emitted from the exhibit, she never did. Vivian's response to having been 'shocked' is fairly believable – following a slight exclamation, she pulls her finger from the metal and grabs hold of her hand. One might imagine doing the very same thing upon receiving a mild shock. In fact, countless examples of other visitors getting an actual shock reveal that her actions are not out of the ordinary. Oddly though, Vivian never turns to look at the offending object. Rather she and Carol turn towards their family – Vivian holding her hand and Carol smiling, thus revealing that Vivian's 'doing' was a performance to kindle a reaction from the others. While one might take Vivian's wink as assurance that she has survived the pain of the shock, the other elements of her immediate display give credence to the idea that she is acknowledging her own performance – the trick she has played on the family.

The two fragments reveal how performative activity arises in the Energy Gallery. The visitors create elaborate and embellished actions with and around the exhibits – activities that can be characterised as 'performances'. Such performances are produced in the moment at hand. The 'performers' not only use the exhibits but also create engaging and enjoyable experiences, both for themselves and those observing them. Mark transforms the systematic tapping of the footpads into a dance that he himself, as well as others observing his action, might enjoy. The dance, while primarily produced for pragmatic purposes, namely the successful completion of the game, also provides Mark with an enjoyable experience. Vivian's performance is of a different kind – she designs her actions to create an engaging experience for her family by producing performative actions that attract their attention to the pole. Thus, the analyses show how performances can be an effective means to support and

enhance the experience around and understanding of an exhibits' functionality, not only for those using the exhibits but also for those observing the activity.

Drawing an Audience

Exhibits are often designed to be attractive to visitors, to draw them in to take a closer look, or possibly even become physically engaged. Designers work with a range of approaches. For example, they might create an exhibit casing that is large and colourful, or they might depend literally on an exhibit's bells and whistles – the sounds it makes – to provide the necessary draw. As such, many designers consider an exhibit's attractiveness to be built in to the design of the exhibit and its environs (Bitgood, 1991, 1994; Shettel, 1973). Perry (1989, 1993), for example, conducted considerable research to create a model for designing intrinsically motivating exhibits. There is also a small body of research which suggests that the 'social influence' created by the presence of other people at an exhibit might affect the visitors' experience at the exhibit (Bitgood, 1993). Various studies reveal how individuals work to draw their companions' attention to exhibits, for example, by calling them over and posing questions (cf. Diamond, 1986) or by modelling effective exhibit use (J. Koran, M. Koran, Foster & Dierking, 1988). While the latter study showed that modelling does indeed influence visitor activity, the models involved were museum staff rather than visitors engaged in more natural or spontaneous activity. Despite the existing literature, we still know relatively little about how people may be drawn to exhibits by virtue of other visitors' actions with and around them.

Consider the following fragment recorded at *Energy Everywhere*, a large-screen computer interactive intended, as the name suggests, to illustrate that energy is all around us. Visitors trigger various energy transformations by mimicking the actions of an on-screen silhouetted figure, for example, clapping to make lightening strike a tree (see Figure 6).

Visitors can see on the screen a representation of energy transferred among a variety of

forms, ranging from kinetic energy to potential energy to light, heat and sound.

[Insert Figure 6 about here]

We join the action as three children – Patrick, Christina and Nicholas – face the

screen where a silhouetted figure of an individual raising her hands to clap appears along

with the words 'clap your hands to make lightening strike' (see Figure 7). As Christina

begins to lift her hands into a clapping position, Patrick and Jackie, the children's adult,

simultaneously read the text aloud. A moment later, Christina and Patrick start clapping.

Nicholas stands nearby and looks towards the 'energy square' drawn on the floor - the spot

where visitors are instructed to stand to make the exhibit function properly. He steps in front

of the other two children, squats down and begins to clap. The on-screen display zooms to

present a tree, a cloud and the prompt – 'Start clapping! Try to hit the tree!' As such, the space

– including the energy square on the floor and the screen in front of the children – occasion

how the children arrange themselves and begin their performance.

[Insert Figure 7 about here]

Because the exhibit is designed to be open on both ends, people often pass through

the gallery, and even the exhibit, without noticing it. Yet, when the exhibit is occupied it can

draw the attention of individuals who happen to be simply walking past. Let us return to the

fragment as the three children are clapping in unison and lightening bolts begin to form from

a cloud moving about on the screen. Their accompanying adult, Jackie, leans against the wall

to observe the unfolding events. Lightening bolts strike the tree twice before the tree

explodes. Fractions of a second before the bolt hits the tree a visitor, James, who does not

know Jackie and the children, comes into view from behind the screen. He appears to be

walking past the exhibit with his gaze turned away from the action.

After a few moments, he notices the children clapping and looking at the large screen. While slowly walking ahead James turns his head to the children to see what they are doing and what the spectacle they are creating involves (see Figure 8). Upon hearing Christina exclaim, 'yeah, we got the tree', James rapidly shifts his gaze towards the screen before turning once again back to the children. Taking a final step towards the wall behind the exhibit, he again looks to the side where he can see the children's actions and the events on the screen.

[Insert Figure 8 about here]

As the action continues and James stops, one of the three children – Patrick – lowers his hands, stops clapping, exclaims, 'ah, that's better' and takes to rubbing his seemingly sore palms on his thighs. Nicholas, the child in the middle, quickly follows suite and steps out of the centre – out of the 'energy square' – to form a line with the others in order to watch what might happen next. Just as the last child, Christina, produces one final clap, James turns his head away from the activity and begins to take his leave.

The fragment begins to reveal how visitors' activity with and around exhibits can be appealing to others who just happen to pass by. The children's embellished actions, their audible clapping and gross gestures in front of the large screen, are produced to play the game. However, such activity also kindles a stranger's interest in the exhibit and thus generates an audience to the activity. The children's actions provide their audience with an understanding of both how the exhibit works and what it might be about. That is, members of the spontaneous audience - including both Jackie and James – are afforded the opportunity to view the on-screen information about the energy cycle and engage, even if only superficially, with the exhibit content. As such, the analysis shows that performative activity can inadvertently draw individuals, including complete strangers, to an exhibit and allow them to observe how others engage with and respond to the exhibit. Accordingly, the attractiveness of

an exhibit is not only embodied within its physical design, but rather it emerges contingently

along with the visitors' activity. That is, the social influences created through the elaborate

and embellished design of the visitors' actions both attract others to the exhibit and provide

them with resources to make sense of the exhibit's functionality.

Sustaining Engagement

Exhibition designers, managers and evaluators are often concerned with individuals'

engagement with exhibits. They seek answers to questions such as - do they stop at an

exhibit? Do they spend considerable time with it? And, do they understand what the exhibit is

about? For example, researchers and exhibit designers at the Exploratorium in San Francisco

collaborated on a project in which they sought to design exhibits that foster 'Active

Prolonged Exploration' (Humphrey & Gutwill, 2005). Essentially, their work investigated

what might keep visitors at an exhibit for an extended amount of time and how exhibits could

be designed to engender such behaviour. In general, however, research on visitors' responses

to exhibits largely focuses on the relationship between an exhibit and its viewer or user

(Shettel, 2001). Indeed, relatively little is known of how people try to keep their companions'

attention at an exhibit through the ways in which they design their own activity.

Consider the following fragment, again recorded at the *Energy Everywhere* exhibit.

We join the action after Sarah has managed to draw the attention of her sister, Rosemary, and

then her mother, Carol, to the exhibit (see Figures 9 and 10). When Rosemary begins to

disengage from the exhibit Sarah and Carol use the display on the large screen as a resource

to produce a performance that draws Rosemary back in and sustains her orientation to the

exhibit. Carol's utterance – 'Ah, it's the sun shining on us. Can you feel it? – occasions her

daughters to orient to the screen. Sarah confirms her mother's feeling of the warmth and says,

'Ah I'm so warm'. Carol responds by saying, 'Ah, I'm so hot I need to put my knickers on

and nothing else'. Thus, Carol and Sarah create a theatrical dialogue and turn-by-turn

performance that engages Rosemary with the exhibit.

[Insert Figure 9 about here]

[Insert Figure 10 about here]

However, despite Carol's efforts, Rosemary takes to fidgeting a bit. Sarah prompts

Rosemary to respond to the performance with an expression of dislike for the heat from the

pretend sun. She shakes Rosemary's arms back and forth providing her with a physical cue

to engage. Rosemary responds by mimicking the sound her sister has made. The girls'

responses are fashioned by the nature of the pretend atmosphere Carol has created – a hot

environment where the fewer clothes one wears, the better. Carol, perhaps encouraged by the

girls' responses, further develops her performance. She declares her intended action by

proclaiming that she is about to take off her clothes (see Figure 11). Then, she moves to what

is essentially centre stage – a position where anyone looking at the screen would also see her

actions. She places her hands on her hips and stares directly at Rosemary to check her

attentiveness to the performance. After Sarah produces a noise of disgust, Carol moves her

hands towards the fly of her jeans and pretends to unbutton her trousers. Sarah physically

prompts Rosemary to respond by shaking the younger girl's arms, which are by now raised

above her head. With her trousers still on, Carol then steps back into her original position.

David, the father, who had been watching attentively from the side, turns his gaze away from

Carol and back towards the screen. In so doing, he marks the silent end to her performance.

[Insert Figure 11 about here]

As the performance concludes, both Rosemary and Sarah respond one last time with

exclamations of disgust. While it is not clear whether the girls are responding to their dislike

of being hot or the image of their mother without clothes, there is little doubt that their

responses are derived from the performance displayed. That is, both being hot and watching

Carol remove her clothes are ideas occasioned by the performance itself. More specifically, we have seen each of Sarah's responses following on sequentially from Carol's prompts and/or displays. Rosemary's responses tend to follow in turn from both Sarah's own statements and a physical provocation from her older sister. The performance reaches an ultimate conclusion as Carol verbally directs the focus of attention from herself back to the activity on the screen – the fact that the tree begins to glow with warmth. She returns to her very first (and previously unnoticed by her family) action of reaching her arms out towards the screen, as if warming her hands in front of a fire. Sarah responds as though the performance might continue by stating, 'Mummy's gonna get warm – it looks like we may have ta, might have ta…'. Sarah looks down at Rosemary, and Carol looks at David. Their father calls the activity to an end by questioning the exhibit itself, which is still cycling through its narrative, by asking 'What is this?' Although the girls might be willing to continue the activity longer, first Carol, and then David, turn to leave the exhibit.

      The fragment shows how people can use aspects of an exhibit as resources to create a performance for others. The performance is not scripted but ongoingly and contingently produced in the interaction between the participants. In this case, Carol uses the display on the screen as a resource to build a performance that is engaging for her daughters. When Sarah joins into her mother's performance, Carol's actions become increasingly lively and animated; she moves in front of the screen facing the girls and her husband. She then acts out the feeling of the warmth of the sunshine while her family view the performance and occasionally respond to it. By choosing to design her activity around everyday conceptions of energy and the sun's heat, Carol's strategies to kindle both the audience's interest and response to her actions prove to be an effective way of sustaining her family's attention.

      The analysis reveals how visitors may design their activity – their performance – to engage their companions. Like street performers (Mason, 1992; McIlvenny, 1996) museum

visitors appear to know how to draw and hold others' attention with their actions. They can

differentiate between attentive and inattentive audience members, and even re-engage those

becoming disinterested with the activity. As evidenced by the fragment presented, such

performances are characterised by a spatial and temporal arrangement, where the physical

structure of the exhibit helps to obtain and organise the audience. For example, the outer-

shell of the exhibit and the necessary arrangement of people in front of the screen act as

guides for appropriate viewing locations for audience members. By choosing particular

positions with regards to others, the performers can both configure an audience and

orchestrate their experience with the activity. This performative activity can bring exhibits to

life through, for example, the performer's embodiment of actions – seen here in the way

Carol demonstrates the effect of the heat of the pretend sun on her own body. In essence,

performative activity at the exhibit face may serve to enhance and sustain engagement with

the content communicated by the physical objects.

Discussion and Implications

Building onto current debates on informal learning and visitor behaviour, this paper

examines performative activity that arises in the setting of an informal science experience,

namely the Energy Gallery at the Science Museum in London. It reveals that visitors may

knowingly or unknowingly exploit certain design features – such as multiple interfaces, large

screens and the various spaces around exhibit components – to configure their actions in

elaborate and embellished, and thus more noticeable, ways that can attract and hold other

people's attention with the exhibit. Such performances may bring to light both how an exhibit

works and what it is about, and as such, might become 'talking-points', occasioning the

verbal forms of social interaction which are increasingly considered to be critical resources in

shaping people's experience of and learning from exhibits (Leinhardt, Crowley, & Knutson,

2002; Leinhardt & Knutson, 2004; Tunnicliffe, 2000). Indeed, the performances themselves

can mediate the relationship between the exhibit and the audience.

Like conversation – the more commonly studied form of social interaction at exhibits

– performance is both a way for individuals to create shared experiences and a form of shared

experience itself. However, performance allows individuals to share a seemingly private

experience in a way that conversation cannot. For example, in merely following the

directions on a computer screen to make lightening strike down a tree as in *Energy*

Everywhere, visitors passing by are able to ascertain how the exhibit works and, perhaps,

even some of the intended content. In addition, we would suggest that having shared

experiences, like those created through performative activity, open future possibilities for

conversation. Such experiences might form the basis for conversations visitors may conduct

later during their visit or at home (Crowley, 2000; Ellenbogen, 2002; Haywood & Burch,

2005)

Visitors who are drawn to a performance, and therefore an exhibit, assemble as an

audience to the action. Members of such audiences can regulate their degree of interaction

with the performance by, for example, selecting where to stand – specifically, how they

situate themselves around physical barriers such as walls and other people. Together the

audience and the performer(s) create a dynamic environment. Similar to more traditional

performances, at times the performer(s) at the exhibits might undertake considerable work to

sustain the separation between themselves and their audience. For example, they might

protect their space from possible audience participation by physically moving out of range or

by treating their audience as spectators, and in fact calling them as such (cf. Becker, 1951;

McIlvenny, 1996). Conversely, performers, like Carol and Vivian, might desire audience

response and participation. Indeed, we saw earlier how the two women fashioned their

activity around the physical location and response of their intended audience.

In a similar way that the analysis has attempted to unpack the tacit nature of performance as a form of participation, it has also begun to lead to a more detailed understanding of the role observation plays in creating shared experiences. Through the analysis we begin to see the manner whereby individuals observe, and sometimes even purposefully deviate from their intended path, for the benefit of watching another person's activity. Such behaviour is reflective of Rogoff et al.'s (Rogoff, 2003; Rogoff, Paradise, Arauz, Correa-Chavez, & Angelillo, 2003) notions of intent participation – a term coined to focus on a particular way in which individuals learn through inspection. Of critical importance for the type of observation exhibited within intent participation is that the children intend to participate in the activity that they are witnessing. The children listen in and observe of their own initiative and actively join the activity in their own time. In so doing, they change participation status from being an active observer to a full collaborator in the activity. In this sense Rogoff (2003: 178) focuses on 'observation as an aspect of participation', not something that occurs only prior to participation.

While the thoughts on observation made throughout this paper have much in common with aspects of intent participation, they attempt to further the understanding of what it truly means to observe – to attend to another's activity – and how individuals might configure their activity for observation. That is, the fragments offer details such as how the specific manner in which one's gaze follows another's activity allows for the communication of information about exhibit usage. Or, at what point within an individual's observation he or she might desist from watching, or solely watching, and begin to engage in the activity. The fragments also show how performers, knowingly or unknowingly, design their activity for the benefit of those observing their actions.

Shared experiences, and in particular performative ones, appear to be an effective means to create engagement and participation with museum exhibits and, subsequently

perhaps, the scientific issues they contain. While we note that considerable interest within

this paper has focused on the socio-scientific content and novel interfaces of the exhibits

studied, we do not wish to suggest that the performative activity observed results from the

specific exhibit content. Rather, our interest in the content at hand lies in the ability of the

emerging performative activity to draw interest to exhibits with content that is challenging to

make appealing to visitors. A line of further enquiry might delve into the role of content in

engendering performative activity. Here, we suggest that such activity does not occur at all

exhibits but only those that have certain characteristics, and are deployed in an environment

that is beneficial to the emergence of performances. As such, this research provides guidance

on how to design environments and opportunities for performances to emerge.

Firstly, whilst designers are often concerned with creating interfaces that facilitate

simple and intuitive use, such designs may constrain possibilities for social interaction and

co-participation. The analysis presented here points towards the need for interfaces that take

into consideration the complex and contingent nature of social situations arising in museums

(see also Borun et al., 1998). Large interfaces and displays provide opportunities for more

than one visitor not only to see the actions of the user but also their interactive relationship to

the unfolding events on the screen. Here, we do not intend to contradict the work of Allen

and Gutwill (2004) which suggests that designing exhibits to support multiple simultaneous

primary users can be detrimental to visitor experience. Rather we suggest that exhibits should

engender various levels of participation to support the emergence of an audience and open up

possibilities for shared experiences.

Secondly, the space around exhibits bears greatly upon the likelihood that an audience

might emerge around a performance. Designers might consider visitors' sight-lines in order

to accommodate for the viewing of both the exhibit and its user(s). Visitors appreciate

standing at or behind walls, or similar physical boundaries to separate themselves from the

activity. Providing such partitions allows individuals to participate in the performance from a

distance and to slip off silently when their interest wanes. In addition, it appears to be useful

to design spatial boundaries that have variable properties (Koleva, Schnädelbach, Benford, &

Greenhalgh, 2000) – for example, those that act both to divide spaces and provide areas for

viewing.

And finally, the content and structure of the exhibit are important resources to enable

participants to create a performance in which multiple parties can participate. For example,

we saw in the analysis how Carol designed her performance at *Energy Everywhere* by

drawing upon the exhibit narrative. Her desire to wear nothing emerged from the context and

structure of the exhibit itself. Other exhibits might be designed to pose questions to visitors

that might structure their physical activity in visually appealing ways. Thus, we suggest that

visitors be provided with resources to create and shape each other's experience.

Apart from these implications for the design of exhibits our observations also have a

bearing on recent debates about social learning in museums. By focusing on performances as

a particular kind of communication, this paper wishes to extend the current focus on

conversation to include looking more broadly at the creation of shared experience. With such

experiences come notions of mediation for learning – how objects and visitors assist others in

understanding how to engage with both the function and content of an exhibit. Research in

museums is beginning to shed light on the ways this might occur, for example in using video

of visitor behaviour at an exhibit to prompt further inquiry at the exhibit itself (Stevens &

Hall, 1997). In this paper, we suggest that the visitors' activity itself, and in particular

performance, might be another tool for such mediation.

From the outset we postulated that performance might be one way whereby designers

build on individuals' curiosity to create at least an initial engagement with an exhibit. That is,

even at exhibits which offer controls for only one or two people – e.g. at *Making Energy*

Useful where four sets of footpads allow for parallel rather than collaborative or cooperative
use – there are ways exhibits can be designed to allow participants to create an experience
that can be, and is, shared by many others. The examples provided in this paper, have enabled
us to show that performance does more than just create the initial engagement – rather, it is a
public display of activity – one that establishes and allows individuals to communicate
exhibit function and usage (knowingly or unknowingly) with others and to create shared
experiences around the exhibit at hand. As the research presented in this paper suggests,
conversation is but one form of meaningful participation at an exhibit. Shared experiences –
including those created through performance – are another. We conclude, then, with a
question for both the researcher and practitioner communities. Is there a conflict between
always wanting visitors to be both deeply engaged at an exhibit and actively conversing with
one another? Or, might it be that shared experiences, including but not limited to
conversations, allow visitors to create a memorable experience upon which to build both in
the moment at hand and in the future?

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Notes on Contributors

To come

References

Allen, S., & Gutwill, J. (2004). Designing with multiple interactives: Five common pitfalls. *Curator, 47*(2), 199-212.

Ash, D. (2003). Dialogic inquiry in life science conversations of family groups in a museum. *Journal of Research in Science Teaching, 40*(2), 138-162.

Ash, D. (2004). How families use questions at dioramas: Ideas for exhibit design. *Curator, 47*(1), 84-100.

Becker, H. (1951). The professional dance musician and his audience. *American Journal of Sociology, 57*(2), 136-144.

Bitgood, S. (1991). Suggested guidelines for designing interactive exhibits. *Visitor Behavior, VI*(4), 4-11.

Bitgood, S. (1993). Social influences on the visitor museum experience. *Visitor Behavior, 8*(3), 4-5.

Bitgood, S. (1994). Designing effective exhibits: Criteria for success, exhibit design approaches, and research strategies. *Visitor Behavior, IX*(4), 4-15.

Blud, L. M. (1990). Social interaction and learning among family groups visiting a museum. *Museum Management and Curatorship, 9*(1), 43-51.

Borun, M., Chambers, M., & Cleghorn, A. (1996). Families are learning in science museums. *Curator, 39*(2), 123-138.

Borun, M., Dritsas, J., Johnson, J. I., Peter, N. E., Wagner, K. F., Fadigan, K., et al. (1998).

Family learning in museums: The PISEC perspective. Philidelphia, PA: The Franklin

Institute.

Bradburne, J. M. (1998). Dinosaurs and white elephants: The science center in the twenty-

first century. *Public Understanding of Science, 7*, 237-253.

Brook, A. (1986). *Children's understanding of ideas about energy: A review of the literature.*

Paper presented at the Energy Matters: Proceedings of an invited conference:

Teaching about energy within the secondary science curriculum, University of Leeds.

Carlisle, R. W. (1985). What do school children do at a science center? *Curator, 28*(1).

Crowley, K. (2000). *Building islands of expertise in everyday family activity: Musings on*

family learning in and out of museums (No. MLC-05). Pittsburgh: Museum Learning

Collaborative.

Crowley, K., & Callanan, M. A. (1998). Describing and supporting collaborative scientific

thinking in parent-child interactions. *Journal of Museum Education, 23*(1), 12-20.

Csikszentmihalyi, M., & Hermanson, K. (1995). Intrinsic motivation in museums: Why does

one want to learn? In J. H. Falk & L. D. Dierking (Eds.) *Public institutions for*

personal learning: Establishing a research agenda (pp. 67-77). Washington, DC:

American Association of Museums.

Diamond, J. (1986). The behavior of family groups in science museums. *Curator, 29*(2), 139-

154.

Dierking, L. D., & Falk, J. H. (1994). Family behavior and learning in informal science

settings: A review of the research. *Science Education, 78*(1), 57-72.

Dierking, L. D., & Falk, J. H. (1998). Understanding free-choice learning: A review of the

research and its application to museum web sites. Institute for Learning Innovation.

Eberbach, C., & Crowley, K. (2005). From living to virtual: Learning from museum objects.

Curator, 48(3), 317-338.

Economou, M. (1998). The evaluation of museum multimedia applications: Lessons from

research. *Museum Management and Curatorship, 17*(2), 173-187.

Ellenbogen, K. (2002). Museums in Family Life: An Ethnographic Case Study. In G.

Leinhardt, K. Crowley, & K. Knutson (Eds.), *Learning conversations in museums*

(pp. 81-101). Mahwah, NJ: Erlbaum.

Erickson, F. (1992). The interface between ethnography and microanalysis: Intellectual

antecedents and aims of microanalysis. In M. D. LeCompte, W. L. Millroy & J.

Preissle (Eds.) *The handbook of qualitative research in education* (pp. 202-225). San

Diego: Harcourt Brace & Company.

Farmelo, G., & Carding, J. (Eds.). (1997). *Here and now. Contemporary science and

technology in museums and science centres.* London: The Science Museum.

Flagg, B. N. (1994). Visitors in front of the small screen. In ASTC (Ed.) *What research says

about learning in science museums* (Vol. 2, pp. 21-24). Washington: ASTC.

Gammon, B. (2005). Outlook express - Using computer interactives. Retrieved March 15,

2006 from Heritage365.com Web site: http://www.heritage365.com/articles/outlook-

express-using-computer-interactives.asp

Garfinkel, H. (1967). *Studies in ethnomethodology.* Englewood Cliffs: Prentice Hall.

Gelman, R., Massey, C. M., & McManus, M. (1991). Characterizing supporting environments for

cognitive development: Lessons from children in a museum. In L. B. Resnick, J. M. Levine

& S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 226-256). Washington,

DC: American Psychological Association.

Goffman, E. (1959). *The presentation of self in everyday life*. Great Britain: Penguin Books.

Goffman, E. (1963). *Behavior in public places: Notes on the social organization of*

gatherings*. New York: The Free Press.

Goffman, E. (1981). *Forms of Talk*. Oxford: Basil Blackwell Publisher.

Goodwin, C. (1981). *Conversational Organization: Interaction Between Speakers and*

Hearers*. New York: Academic Press.

Goodwin, M. H. (1990). *He-said-she-said: Talk as social organization among black children*.

Bloomington, IN: Indiana University Press.

Gottdiener, M. (1979). Field research and video tape. *Sociological Inquiry, 49*(4), 59-66.

Grimshaw, A. D. (Ed.). (1982). *Sociological methods and research. Special issue on sound-*

image records in social interaction research.*

Gutwill, J. P. (2002). Gaining visitor consent for research: testing the posted-sign method.

Curator, 45(3), 232-238.

Gutwill, J. P. (2003). Gaining visitor consent for research II: Improving the posted-sign

method. *Curator, 46*(2), 228-235.

Gyllenhaal, E. D., & Perry, D. L. (1998). Doing something about the weather: Summative

evaluation of Science Museum of Minnesota's Atmospheric Explorations computer

interactives. *Current Trends in Audience Research and Evaluation,* 11, 25-35.

Retrieved March 15, 2006, from http://www.selindaresearch.com/perry2.htm

Harper, D. (1994). On the authority of the image: Visual methods at the crossroads. In N. K.

Denzin & Y. S. Lincoln (Eds.) *Handbook of qualitative research* (pp. 403-412).

Thousand Oaks, CA: Sage Publications.

Harré, R. (1986). *Varieties of Realism*. Oxford: Basil Blackwell Ltd.

Haywood, N., & Burch, A. (2005). Summative evaluation: Energy - Fuelling the Future.

London: Science Museum.

Heath, C. (2004). Analysing face-to-face interaction: Video, the visual and material. In D. Silverman (Ed.) *Qualitative research: Theory, method and practice* (2nd ed., pp. 266-282). London: Sage Publications.

Heath, C., & Luff, P. (2000). *Technology in action*. Cambridge: Cambridge University Press.

Heath, C., Luff, P., vom Lehn, D., Hindmarsh, J., & Cleverly, J. (2002). Crafting participation: Designing ecologies, configuring experience. *Journal of Visual Communication*, 9-34.

Heath, C., vom Lehn, D., & Osborne, J. (2005). Interaction and interactives: Collaboration and participation with computer-based exhibits. *Public Understanding of Science, 14*(1), 91-101.

Hennes, T. (2002). Rethinking the visitor experience: Transforming obstacle into purpose. *Curator, 45*(2), 109-121.

Hensel, K. (1987). *Families in a museum: interactions and conversations at displays.* Unpublished doctoral dissertation, Columbia University, New York.

Heritage, J. (1984). *Garfinkel and Ethnomethodology*. Cambridge: Polity Press.

Heritage, J. (1997). Conversation analysis and institutional talk. In D. Silverman (Ed.) *Qualitative research: Theory, method and practice* (pp. 161-182). London: Sage.

Humphrey, T., & Gutwill, J. (2005). *Fostering active prolonged engagement: The art of creating APE exhibits*. San Francisco: The Exploratorium.

Hymes, D. (1974). *Foundations in sociolinguistics*. Philadelphia: University of Pennsylvania Press.

Koran, J. J., Koran, M. L., Foster, J. S., & Dierking, L. D. (1988). Using modeling to direct attention. *Curator, 31*(1), 36-42.

Knoblauch, H. (1998). Pragmatische Ästhetik. Inszenierung, Performance und die Kunstfertigkeit alltäglichen kommunikativen Handelns. In H. Willems & M. Jurga

(Eds.) *Inszenierungsgesellschaft. Ein einfuehrendes Handbuch* (pp. 305-324).

Opladen, Wiesbaden: Westdeutscher Verlag.

Koleva, B., Schnädelbach, H., Benford, S., & Greenhalgh, C. (2000). *Traversable interfaces between real and virtual worlds.* Paper presented at the CHI2000, The Hague.

Leinhardt, G., Crowley, K., & Knutson, K. (Eds.). (2002). *Learning conversations in museums*. Mahwah, NJ: LEA.

Leinhardt, G., & Knutson, K. (2004). *Listening in on museum conversations*. Walnut Creek, Altamira Press.

Lucas, A. M., & McManus, P. (1986). Investigating learning from informal sources: Listening to conversations and observing play in science museums. *International Journal of Science Education, 8*(4), 341-352.

Mason, B. (1992). *Street theatre and other outdoor performances*. London: Routledge.

McIlvenny, P. (1996). Heckling in Hyde Park: Verbal audience participation in popular public discourse. *Language in Society, 25*, 27-60.

McIntyre, M. H. (2003). *Engaging or distracting?: Visitor responses to interactives in the V&A British Galleries* (Evaluation). Manchester, UK: Morris Hargraves McIntyre. Retrieved on March 15, 2006 from www.vam.ac.uk/files/file_upload/5877_file.pdf

McManus, P. M. (1988). Good companions: More on the social determination of learning-related behaviour in a science museum. *International Journal of Museum Management and Curatorship, 7*, 37-44.

Morrissey, K. (1991). Visitor behavior and interactive video. *Curato*r, *34*(2), 109-118.

Pedretti, E. (2002). T. Kuhn meets T. Rex: Critical conversations and new directions in science centres and science museums. *Studies in Science Education, 37*, 1-41.

Pedretti, E. (2004). Perspectives on learning through critical issues-based science centre exhibitions. *Science Education, 88*(Suppl. 1), S34-S47.

Perry, D. L. (1989). The creation and verification of a development model for the design of a

museum exhibit. (Doctoral dissertation, Indiana University, 1989). *Dissertations*

Abstracts International, 50 (12), 3926.

Perry, D. L. (1993). Designing exhibits that motivate. In M. B. P. McNamara, S. Grinell & B.

Serrell (Eds.), *What research says about learning in museums* (Vol. 2, pp. 25-29).

Washington DC: ASTC.

Pfundt, H., & Duit, R. (1991). *Bibliography: Students' alternative frameworks and science*

education. Universitat Kiel, IPN.

Phillips, D. (1995). Evaluating time-lapse video evaluation. *Museum Management and*

Curatorship, 14(1), 19-29.

Puchner, L., Rapoport, R., & Gaskins, S. (2001). Learning in children's museums: Is it really

happening? *Curator, 44*(3), 237-259.

Rahm, J. (2004). Multiple modes of meaning-making in a science center. *Science Education,*

88, 223-247.

Rennie, L. J., Feher, E., Dierking, L. D., & Falk, J. H. (2003). Toward an agenda for

advancing research on science learning in out-of-school settings. *Journal of Research*

in Science Teaching, 40(2), 112-120.

Rogoff, B. (2003). *The cultural nature of human development*. Oxford: Oxford University

Press.

Rogoff, B., Paradise, R., Arauz, R. M., Correa-Chavez, M., & Angelillo, C. (2003). Firsthand

learning through intent participation. *Annual Review of Psychology, 54*, 175-203.

Roth, W.M. (in press). From action to discourse: The bridging function of gestures. *Journal*

of Cognitive Systems Research.

Sacks, H. (1992). Rules of conversation sequence. In *Lectures on conversation* (pp. 3-11).

Oxford: Blackwell.

Sacks, H., Schegloff, E. A., & Jefferson, G. (1974). A simplist systematics for the

    organization of turn-taking for conversation. *Language,* 50, 696-735.

Sandifer, C. (2003). Technology novelty and open-endedness: Two characteristics of

    interactive exhibits that contribute to the holding of visitor attention in a science

    museum. *Journal of Research in Science Teaching*, *40*(2), 121-137.

Schechner, R. (2002). *Performance studies: An introduction*. London: Routledge.

Semper, R. (1990). Science museums as environments for learning. *Physics Today, 43*(11),

    50-56.

Shettel, H. (1973). Exhibits: Art form or educational medium. *Museum News, 52*(9), 32-41.

Shettel, H. (2001). Do we know how to define exhibit effectiveness? *Curator, 44*(4), 327-

    334.

Stevens, R., & Hall, R. (1997). Seeing Tornado: How Video Traces mediate visitor

    understandings of (natural?) phenomena in a science museum. *Science Education,*

    81(6), 735-747.

Tunnicliffe, S. D. (2000). Conversations of family and primary school groups at robotic

    dinosaur exhibits in a museum: what do they talk about? *International Journal of*

    Science Education, 22(7), 739-754.

Turner, V. (1986). *The anthropology of performance*. New York, Performing Arts Journals.

vom Lehn, D., & Heath, C. (in press). Social interaction in museums and galleries: a note on

    video based field studies. In R. Goldman, R. Pea, B. Barron & S. Derry (Eds.), *Video*

    Research in the Learning Sciences.

vom Lehn, D., Heath, C., & Hindmarsh, J. (2001). Exhibiting interaction: Conduct and

    collaboration in museums and galleries. *Symbolic Interaction, 24*(4), 189-216.

von Aufschnaiter, C. (2003). Interactive processes between university students: Structures of

   interactions and related cognitive development. *Research in Science Education, 33*,

   341-374.

Weier, K., & Piscitelli, B. (2002). Hot and sweaty in the museum: Young children learning

   about nature, culture and science. *Submitted to Journal for Education in Museums*.

Willems, H., & Jurga, M. (Eds.). (1998). *Inszenierungsgesellschaft. Ein einführendes*

   Handbuch. Opladen & Wiesbaden, Westdeutscher Verlag.

Footnotes

[1] Notes on Transcription:

- Each bar in the timeline represents one second.

- The beginning and ending times are marked on either end of the timeline.

- One participant's activity is marked on each side of the line (above or below). The name of the participant represented is labelled in each section.

- When used in the transcript, a participant's name is abbreviated by their first initial.

- When there is a change in action, the individual activities - including talk, gesture and gaze - are marked by arrows.

- Gaze is indicated in italics.

- When present, talk is indicated in the space between the timeline bars. The location of the talk along the timeline represents the beginning of the utterance.

- When present, exhibit screen text is indicated between the lines in capital letter. The location of the talk along the timeline represents the appearance of the text on-screen.

[2] Notes on Transcription:

- The beginning times are noted for each action.

- Bold text represents participant's talk.

- Italic text represents relevant participant movement.

- Capital letters represent exhibit screen text.

Figure Captions

Figure 1. Screen shot from *Making Energy Useful*

Figure 2. Mark interacting with *Making Energy Useful*

Figure 3. *Do Not Touch*

Figure 4. Transcript 1 – Vivian and Carol's activity at *Do Not Touch*[1]

Figure 5. Vivian and Carol's activity at *Do Not Touch*

Figure 6. Screen shot from *Energy Everywhere*

Figure 7. James and the children at *Energy Everywhere*

Figure 8. Transcript 2 – James and the children's activity at *Energy Everywhere*

Figure 9. Carol and the children at *Energy Everywhere*

Figure 10. Transcript 3 – Carol and the children at *Energy Everywhere*, part 1[2]

Figure 11. Transcript 4 – Carol and the children at *Energy Everywhere*, part 2

Figure 1

Exhibiting Performance   40

Figure 2

Figure 3

Figure 4

Exhibiting Performance   43

Figure 5

1: Vivian raising finger after 'shock'

2: Vivian saying, 'ooo ooo', Carol laughing

3: Vivian winking at family

Figure 6

Figure 7

1: *from l to r:* Nicholas, Patrick, Christina – mom against wall

2: James appears around screen, children clapping

3: James glances at children

4: James glances at screen

Figure 8

JAMES

Walking past exhibit, *gaze away*　　*Gaze to kids*　　*Gaze to screen*　　Orient body to screen　　*Gaze to kids*　　Step back to wall, stop walking　　*Gaze away from exhibit*

11.00　　LIGHTENING HITS TREE
　　　　TREE DISSOLVES　　　　　　　　　　　　　　　　　　　18.00

C: Yeah, we got the tree　　　　　　**P:** Ah, thatÕs better

Kids clapping, *gaze on screen*　　P tilt head to C　　*P gaze at C*　　P clap harder　　N clap once more　　C stop clapping　　P bend knees　　P rub knees

P stop clapping　　N lowers hands　　N step to side
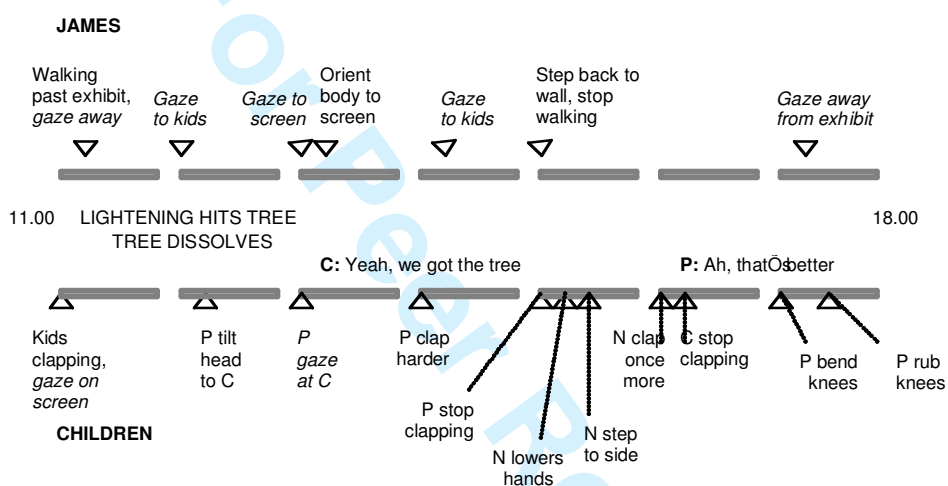
CHILDREN

Figure 9

1: Sarah struggles to leave the exhibit

2: Sarah watches the on-screen activity

3: Carol pretends to take off jeans to cool off

Figure 10

41.07	**C**	**Ah – it's the sun shining on us – can you feel it?**
42.07		*S returns head to facing screen*
42.12		*R turns gaze towards screen*
43.17		*R leans further forward and begins to twist under S's arm*
44.01	**S**	**Ah I'm so warm**
44.14		*D turns gaze towards C*
44.20	**C**	**Ah I'm so hot I need to put my knickers on and nothing else**
46.15		SUN MOVES TO CORNER OF SCREEN
48.13		*C begins to lean to the side*
49.03	**S**	**Eww say eww**
49.14		*R leans back onto S's legs, C glances down at R*
50.05		*S shakes R's arms using her own*
51.07	**R**	**Eww**

Exhibiting Performance   49

Figure 11

51.08	**C**		**Oh well – right – that's it – I'm gonna strip cause I'm so warm**
	52.06		*C begins to step forward*
	52.18		*C places hands on hips, steps forward, orients gaze to R*
	52.22		TREE APPEARS WITH SUN
53.11	**S**		**Eww**
	53.16		*M steps out in view of girls, moves hands to button fly*
	54.10		*R raises hands above her head, S orients gaze to R*
	54.13		*C pretends to undo her button*
	54.16		*S shakes R's arms*
	55.01		*C lowers hands, steps back into previous place and returns gaze to screen*
56.28	**R**		**Eww**
	57.02		*C steps further behind original position*
57.21	**S**		**Yucky**
	57.21		*D returns gaze to screen*
	57.24		*R begins to wiggle in front of S*
58.01	**C**		**Oh look it's making the tree all warm – ahh**
	59.03		*M raises right arm out straight*
	1:00.04		*M moves outstretched arm in circle, D gaze on M*
1:01.07	**S**		**Mummy's gonna get to warm it looks like we may have ta, might have ta**
	1:01.07		*S orients gaze to R*
	1:02.08		*C turns head to look at D*
1:03.11	**D**		**What is this?**
	1:03.24		*S pull R up to standing*
	1:05.00		*C turns too leave, D stands up from leaning on wall*