End of Award Report

Communicating Science through Novel Exhibits and Exhibitions

1. Background

Substantial public and private sector funding has recently been made available to science centres and museums to enhance the quality and appeal of their exhibition areas, to improve access and to facilitate public engagement with science (see for example, Wellcome-Trust 2002). These initiatives have led to a corresponding interest in developing novel, often more 'interactive' exhibits and exhibitions that are believed to enhance communication, debate and learning (Bradburne 2000; Caulton 1998). In many cases digital technologies underpin these exhibitions and provide new forms of interaction between the visitor and the exhibit (Bradburne 1998). It is believed that digital technologies can provide a more interactive experience and enhance the communication of information to, and engagement of, visitors. Despite substantial investment and commitment to 'interactivity' and the participation of the public, we know little as to how visitors respond to these novel exhibits and exhibitions, still less, about the forms of interaction, communication and learning that they serve to facilitate or engender.

These initiatives reflect, and in part arise from, developments within education, learning, and the cognitive sciences. The wide-ranging critique of formal, mental processing models of cognition, the growing interest in situated, practical reasoning, and emphasis on 'informal learning', have led to a burgeoning interest in talk and communication and the ways in which learning and cognitive development arise through interaction in everyday environments (Billig 1996; Gee 1996; Millar et al. 1998). It is argued that (potential) learning contexts become increasingly effective when people are encouraged to talk and interact and provided with the opportunity of developing socially situated and organised practices and procedures (Rogoff et al. 1996; Roschelle 1995; Wenger 1999). These arguments have provided general academic and educational support for the learning agenda of museums and galleries and increasingly encouraged the design and deployment of exhibits and exhibitions that facilitate and even engender interactivity and interaction. Surprisingly however there remain relatively few studies, despite the burgeoning body of visitor studies (Falk et al. 2000; McManus 1992; Rennie et al. 1996), that examine the conduct and interaction of visitors in exhibitions and the ways in which they, both alone and with others, approach, explore, discuss, and draw conclusions from exhibits (save for some contributions in, Leinhardt et al. 2002; Paris 2002).

These more applied concerns resonate with contemporary developments within sociology and emerging fields such as CSCW (Computer Supported Cooperative Work) and Human Computer Interaction (HCI). Over the past decade or so, we found a burgeoning interest in the object and the ways in which objects, artefacts, tools and technologies figure, are embodied in, and constituted through, social relations, networks and interactions. In CSCW (Computer Supported Cooperative Work) for example, there is a growing corpus of studies of the workplace concerned with the ways in which people, both alone and with others, interact with

and around new technologies, objects and artefacts (see for example, Goodwin et al. 1996; Harper 1997; Heath et al. 1992; see for example, Hutchins 1992). These studies, largely ethnographies of cooperation and collaboration in the workplace, provide insights and findings into situated constitution of objects and artefacts, and some methodological and conceptual resources with which to begin to address the highly contingent, fleeting and flexible form of participation that arise in public spaces and in this case science museums, centres and galleries.
In summary therefore, the project arose in the light of, and we hope contributes, a range of convergent academic and applied concerns that arise in a number of disciplines and fields in the social sciences.

2. Aims and Objectives

The aims and objectives of the project include:

i. video-based, ethnographic studies to produce a body of knowledge and conceptual distinctions concerning visitors' conduct and interaction with and around novel science exhibits;
ii. studies of the development and deployment of science exhibits and exhibitions to produce observations and insights into the design process and into how concepts and models of the 'visitor' as well as of 'interaction' and 'learning' influence the design of new and novel science exhibits;
ii. contributions to our understanding of the relationship between participants' activities and the communication and learning agendas of the museum managers, curators and designers,
iii. involvement in the design and assessment of prototype and experimental systems and exhibits in science centres and museums to bring to bear social scientific concepts and theories in the design and deployment of these systems and installations;
iv. using findings from the studies of visitors behaviour in science exhibitions and of the design process to develop design sensitivities and (video-based) methods for museum educators, managers, designers to explore and evaluate conduct and interaction at novel, "interactive" exhibits.

3. Data Collection and Analysis

Conduct and interaction in science centres and museums
The principal aim of the project is to examine the ways in which people, both alone and with others, encounter and respond to exhibits in science centres and museums, in particular exhibits and installations that (attempt to) create new forms of 'interactivity' and engagement. As we have suggested above, to a significant extent, the activities that arise, with, and around, exhibits in museums, science centres and galleries, largely remain disregarded in both the

social sciences and humanities. A prerequisite to undertaking the project was gaining access to a range of science centres, museums and galleries in order to undertake data collection. With our interest in new forms of interactivity, and innovative exhibits, installations and exhibitions, it was critical to gain access not only to a range of relevant institutions but institutions that house both highly complex interactive installations, often utilising computer based technologies, as well as those that include more conventional exhibits.

In this regard, we successfully gained access to a range of institutions to undertake data collection, in particular field studies and video-recordings. These institutions include some of the leading science museums and science centres in the UK and abroad, such as the Science Museum (London), the Exploratorium (San Francisco), and the Glasgow Science Centre, as well as a range of smaller national institutions such as Explore-at-Bristol, Snibston Discovery Centre, the Providence Children's Museum (Rhode Island), and the Centre for Life in Newcastle. These institutions exhibit some of the more innovative interactive installations as well as more conventional hands-on exhibits and object-rich exhibitions. For comparative purposes we also gathered data in a number of museums, galleries and exhibitions, that display more conventional exhibits such as pictures and decorative arts. These include the V&A, Manchester Museum and Art Gallery, and more curiously the Body Worlds Exhibition. In this way, we were able to gather data, video-recordings and field observations of visitors encountering, and using, a diverse range of exhibits, installations, objects and displays. In total we have gathered at least 300 hours of video recording and undertook approximately 80 days of field work over the course of the project. These materials have been augmented by interviews of visitors, both before and after their visit to the museum or science centre, and interviews and discussions with a range of museum personnel, designers and educationalists.

Data collection in science centres, museums and galleries raises important ethical considerations that we were at pains to address at the beginning of the project. In discussion with visitors, museum managers, curators, and fellow social scientists, we decided to inform visitors of the research by placing successive notices at the entrance to the museum and the particular galleries. The notices not only informed visitors of the project and sought their permission to record, but also enabled visitors, at any stage of the proceedings to request the recording cease and materials be destroyed. To assess whether visitors understood and were aware of data collection, we interviewed a range of visitors during data collection. In practice, we found that visitors were in large part more than happy to help with, and participate in the research. However, both museum personnel and visitors whilst happy to allow the specific team to have access to the data, and it be used for research and presentation purposes, were not willing to make it more generally, or publicly available.

Aside from addressing the ethical issues posed by undertaking this form of research, we found that video-recording in science centres, museums and galleries, posed major practical and methodological problems that we had to resolve as part of the project. These issues and problems include:

- successfully recording (video and audio) the conduct and interaction of the complex range of actions and activities that arise when a number of participants approach and examine exhibits and installations;
- recording not only actions of the participants but the information on various displays, and the details of use of various input/interface devices that accompany many 'interactives';

- developing a satisfactory transcription system that enables the actions of a number of participants, often accomplished through talk, visual and tactile conduct, to be exposed and located.

These, and a range of related, but significant practical and methodological problems, were resolved to enable data collection and analysis to progress, but there remain a number of outstanding challenges for those undertaking related research in the coming years. As stated in the proposal, analysis drew on developments in sociology, namely ethnomethodology and conversation analysis, and in particular the growing corpus of naturalistic, interactionally focused research concerned with the 'multi-modal' accomplishment of practical action including the so-called 'workplace studies'. In this regard, however, the investigation of conduct and interaction is highly demanding and poses some interesting analytic problems. For example, unlike many settings interaction involves highly variable forms of participation and co-participation amongst both people who are together and others who happen to be in the same space; interaction that involves the interplay of talk, visual and material conduct and that does not necessarily involve a single focus of attention, alignment or common topic. These fragmented, fluctuating, and highly contingent, ecologies of participation, raise issues concerning the sequential organisation of particular activities and the relations that arise between, and inform the accomplishment of particular actions and events. In this regard, we have tended to focus on 'bolder' more explicit patterns of conduct and sequence but some interesting challenges remain. We continue to work on the materials and are exploring ways of addressing more subtle delicate features of the data; features which are also of some more general relevance to the analysis conduct and interaction in public spaces.

Ethnographic Studies of Design

The second strand of work in the project consists of studies of the design, development and deployment of science exhibitions. The design of exhibitions often takes a year or longer from the initial concept for an exhibition to its instantiation in a science centre or museum. The length of the design process requires a longitudinal approach to the research and therefore allows us to focus on only a small number of exhibition developments that fit into the scope of the project. We decided to focus our research on two exhibitions, the Wellcome Wing at the Science Museum in London and Extraordinary! an exhibition at the Snibston Discovery Centre.

The study of the design of the Wellcome Wing is principally based on interviews conducted after the exhibition had been deployed and evaluated. We were fortunate in gaining access to personnel who were key-players in the development of the Wellcome Wing. We seized the opportunity to undertake qualitative interviews with these managers and designers. The qualitative data provide us with important insights into the design process and obstacles to it, such as unanticipated cuts in funding, changes in personnel and the like.

The research on the development of Extraordinary! at the Snibston Discovery Centre is based on ethnographic fieldwork, participant and non-participant observation, in numerous design meetings. We took field notes, collected written materials, plans and sketches and audio-/video-recorded some of the meetings. These data are augmented by qualitative interviews with members of the design teams and companies that provided us with additional information about design work and the design process. For example, the designers explain in

interviews issues and problems of the design process that would remain unmentioned in the design meetings; they illuminate how concepts and ideas develop between meetings through discussion with family members and friends. They also shed light on difficulties they anticipate with the progress of the project and provide accounts for those difficulties.

Apart from the longitudinal studies of design work at the Snibston Discovery Centre we gathered data at design teams in museums, such as Explore@Bristol, the Museum of Science and Industry in Manchester, and at design companies such as Land Design ltd. and Glassborow Associates. The selection of these design teams and design companies emerged in the course of the project and was supported by our dissemination work;- participation in events by the British Interactive Group (BIG), the offering of workshops and short-courses on video-based field studies, and colloquia on science communication that we held at King's College London.

4. Results

The project has generated observations and findings that bear upon contemporary research within various field and disciplines. These observations and findings and their relevance to various areas of research are exemplified in the range of publications that have emerged from projects and publications in fields such as museum studies, the sociology of science, qualitative research methods, and the learning sciences. They also bear upon recent developments in areas such as Computer Cooperative Work (CSCW) and Human Computer Interaction (HCI).

The main thrust of the project's contributions are concerned with the analysis of the conduct and interaction of people with and around science exhibits in museums and galleries and in particular the sequential organisation of the participants' activities; activities that are accomplished through the interplay of talk, visual and material conduct. Of particular interest, is the patterns of conduct or action that arise at 'conventional' computer based exhibits; exhibits that are designed and deployed to create 'interactivity'. The research demonstrates that these exhibits serve to engender highly routinised patterns of conduct from visitors in which individual participants produce successive actions in response to prompts from the system. Tightly synchronised trajectories of action emerge that primarily involve two part sequences, where the visitor produces the second part to each successive prompt. The structures of action, engendered by many computer based 'interactives', coupled with features of the interface and scale of hardware components (such as screen size) prioritise the individual (and successive actions from the same individual) and in various ways exclude co-participation and collaboration. Indeed, our research suggests that 'interactivity' of this form is often conflated with social interaction and yet many of these conventional computer based exhibits undermine interaction between people at the exhibit (other than co-participants forming an audience or helping people to learn how to use the system). It should be added that even with highly sophisticated, multiparty 'interactives' it is not unusual to find participants producing independent, rather than interdependent contributions (Heath et al. forthcoming).

Interactive, computer-based exhibits at the Science Museum in London

Our research suggests, that this stands in marked contrast to ways in which people engage with more conventional and non-computer based exhibits and installations. We find rather different patterns of conduct and interaction, which reveal more cooperation and collaboration. We have shown for example how people configure the ways in which others examine and inspect exhibits, the ways in which they transpose and embed actions on aspects of the exhibit, and how they animate exhibits to create a particular response from co-participants. In other words, we find more contingent, active, mutually engaged spectator(s), whose experience arises in and through their interaction with each other.

Occasioned Explanation: Embodying an Exhibit

Having said this, however, we have found that visitors have various ways in which they facilitate and encourage co-participation and collaboration with and around conventional computer-based 'interactives'. As we have suggested, first and foremost, co-participants may assist the principal user in learning how to use the functionality of the exhibit, and in some cases may remain to watch the other(s) to undertake particular activities. In some cases, people will await their turn to use the installation, though more rarely maintain the commitment of the first user to witness the proceedings. In all these cases however, one or more visitors inevitably incurs a second hand experience – they have already witnessed at least part of the activity of the other. More interestingly perhaps, our research addressed the various ways in which people attempt to render the individual actions with 'interactive' installations, publicly visible, and thereby encourage others to witness if not participate in the activity. We discuss how these performances arise, how they are tailored with regard to the presence and participation of others, and how they serve to encourage particular forms of co-participation and collaboration (Meisner et al. forthcoming).

Boy “dancing” in Energy (Science Museum London)

The research also contributes to our understanding of the ways in which visitors navigate museum spaces and discover how to use, the functionality, of ‘interactive’ exhibits and installations. In particular, the research reveals how visitors draw on the conduct and actions of others, both those they are with and others who happen to be in the same space (perceptual range of the event), to approach and discover particular exhibits. The analysis delineates the sequences of action through which individuals witness, and re-produce, the action(s) of others and thereby discover, and not infrequently, misconstrue, how to use the exhibit. The analysis addresses the design of these re-productions, and the ways in which different types of re-production can engender, or create the foundation for, different forms of co-participation and in some cases collaboration. In various ways the analysis has, we believe an important bearing, on our understanding of the ways in which exhibits in museums and galleries, in particular their functionality, is discovered and mutually constituted, and provides a foundation for developing a distinctive approach to ‘imitation’ – and the ways in which imitation is interactionally, and contingently, accomplished (Meisner forthcoming). It also raises some important considerations for the design of ‘interactive’ exhibits and associated museum resources.

Imitating Action: Challenge of Materials; Science Museum London

There is a wide-spread interest and commitment to informal learning in museums and galleries, and the turn towards ‘interactivity’ has been in part motivated by providing resources to facilitate communication, explanation and learning. In this regard, the analysis addresses explanation, and the ways in which explanation contingently arise in interaction between people at the ‘exhibit face’. The analysis considers the sequences of action that prefigure an explanation and the forms of response and sequential trajectories that arise. It also addresses how various information associated with exhibits, including labels and instructions, provide resources to visitors for the production, and in some access, receipt, of explanations. A number of patterns of action are addressed in the analysis, including for example, the ways in which questions and queries occasion explanations, the (structured) search for explanation and understanding that participants undertake at exhibits, and the ways in which explanations can serve to curtail mutual engagement and frequently prefigure exit

from the exhibit (vom Lehn et al. in press).

These and various other issues that are addressed in the analysis, we believe, have some bearing on both aspects of theory and method in various field and disciplines of research in the social sciences as well as more applied concerns. In particular, the analysis provides resources for re-specifying the concept of 'interactivity' that underpins contemporary research and practice in museum studies and provides ways of reflecting upon, and configuring a model of social interaction that resonates with the conduct and interaction of visitors. It also bears upon related debates within CSCW and HCI (Heath and vom Lehn forthcoming). The research and its findings also contribute, and provide an alternative approach to, imitation, and our understanding of the 'affordances' of objects and installations and the ways in which affordances are socially, interactionally and contingently constituted (Meisner forthcoming). We also believe, that the analysis contributes to the ways in which we theorise 'objects' and 'ecologies', and the relationship between materiality and artefacts and social action and interaction. More generally, the research also provides the resources for unpacking aspects of 'informal learning' with regard to specific actions and sequences of action that arise for example at the exhibit face. Finally, we very much hope that the research contributes to the growing body of research concerned with multimodality and the interplay of talk, the visual and material in interaction.

The studies of the design and development of 'interactive' rich exhibitions are more ethnographic. A number of issues have emerged that which are of relevance to research within sociology as well as CSCW and HCI. These include:

- the ways in which designers conceptualise the visitor and in particular how the visitor is reconfigured into a 'user' that is attributed various characteristics that give primacy to their engagement, and abilities to engage, with the system.
- the progressive creation and transformation of exhibits and exhibition spaces and the ways in which the 'career' of the exhibit contingently emerges through successive transformations
- the ways in which 'interaction' and 'interactivity' is configured and in particular how 'interactivity' is not infrequently associated even conflated with social interaction. In this regard, it is interesting to note how ideas of co-participation often relegate gatherings to an audience.

These and related issues are currently forming the basis to papers in preparation.

5. Applied contributions of the project

The observations and findings generated by the project are also of some relevance to a range of more practical and applied concerns and to the interests of various types of 'practitioner' (museum managers, educationalists, designers, evaluation teams). Most significantly, the research can contribute, we believe, to the design, development and deployment of 'interactive' exhibits and installations in museums, galleries and science centre, to their evaluation and assessment, and to our understanding of 'informal learning' and the communication of science. In part the more applied and practical contributions of the projects have been enhanced by virtue of the close involvement of practitioners at all stages of the research process and the opportunity for us to participate in, and contribute to, a number of

exhibition development projects. These more practical engagements include:

- participation in a development team at the Science Museum London in which we contributed to the design and evaluation of novel video-labels introduced as part of the redevelopment of the Launch Pad exhibition;
- participation in a development team at the Snibston Discover Centre ("Extraordinary!") in which we were provided advise on visitor behaviour and interaction in science exhibitions;
- contributions to the development of major projects, including for example at the Horniman Museum and the Manchester Museum of Science and Industry.

The research, coupled with these practical engagements, have allowed us to begin to identify various design 'sensitivities' and considerations that will serve to assist practitioners in developing 'interactive' exhibits and installations whilst avoiding some of the pitfalls of conventional computer based 'interactives'. These considerations include: prioritising co-participation and collaboration, providing contingent opportunities for action, enabling various forms of co-participation, interleaving low tech resources with high tech installations, designing for contingent assemblies of exhibits, enabling highly variable navigation patterns, designing for an ecology of participation, etc. The research has also enabled us to begin to develop an applied video-based ethnography to enable practitioners themselves to analyse and evaluate the conduct and interaction of visitors in museum spaces at the exhibit face. The importance of taking action at the exhibit face seriously may seem obvious, but the vast bulk of museum studies, whether practitioner led or academic, have largely relied upon *post hoc* interviews, questionnaires, focus groups and the like. Practitioners increasingly recognise the value of video-based naturalistic studies and have welcomed advice and methodological recommendations. In this light, as part of the project, we have given a range of short courses and lectures to practitioners concerning the use of video-based ethnography for the analysis of visitor conduct and interaction. These include: short-courses on video-based methods and evaluation at meetings of the Visitor Studies Group UK, and lectures at the Science Museum in London and the Victoria and Albert Museum. We now receive numerous requests to undertake these course and assist with design projects and their evaluation.

An important aspect of the project has been the series of colloquia that we have organised. These colloquia have involved both practitioners (museum managers and directors, educationalists, designers, evaluation personnel, artists) and academics from various disciplines and fields (the social, cognitive and cognitive sciences, HCI & CSCW, museum studies, and the humanities). These colloquia have not only generated issues and concerns that have informed the analytic, substantive and practical focus of our research, they also helped disseminate our findings and observations. Most importantly perhaps, the colloquia have provided, we are told, a very rare opportunity, for leading practitioners and academics whose research and practice bears upon exhibit and exhibition development, to meet and discuss ideas, concerns, innovations, best practice, and the like. We organised each of the colloquia around a topic or issue of contemporary relevance to museums, galleries and science centres as well as academic and more applied research. We limited the numbers at each colloquium to no more than fifty but could have easily doubled that figure. They include:

- Innovation in Science Exhibitions (2004)
- Mobilising the Museum Experience (2005)

- Science in the Making (2006).

(see Annex for the programmes of the colloquia)

Participants included academics from the UK, mainland Europe, North America and the Far East, museum personnel from institutions including the Science Museum London, National Gallery, Victoria & Albert Museum, Explore-at-Bristol, Manchester Museum of Science and Technology, Glasgow Science Centre, Exploratorium (San Francisco), Centre for the Cell, Alexander Flemming Museum, Horniman, La Cite; designers from companies such as Land Design, Casson Mann, Science Projects, and representatives from organisations such as ECSITE, Next Generation Foundation, Nesta, Royal Institution, and the Wellcome Trust.

Alongside these more formal events, as part of the project, we have also organised a series of small, more focused workshops, with colleagues undertaking related research in the UK and abroad. These have included workshops with academics from the Universities of Saitama, Tsukuba, Technical University Berlin, Bristol, Limerick and Nottingham.

The project and these associated activities have also formed the basis to a number of related applications and developments including:

- AHRC Seminar Series *The Museum as a Social Laboratory*, with Osborne, J. KCL, Science Museum, London and the V&A (2006-2007)
- British Academy Anglo-Japanese Scheme with Universities of Saitama and Tsukuba, and
- Preparation of applications to EC IST Framework VII Programme (with Technical University of Berlin and others)

6. Output

The principal researcher, Robin Meisner, undertook a part-time PhD while undertaking the research on the project. The issues and themes of her dissertation are of critical interest to the project. The PhD thesis will be submitted at King's College London in Spring 2007.

Robin Meisner. Encounters with exhibits: A study of children's activity at interactive exhibits in three museums. PhD Thesis (King's College London).

In the course of the project we have developed a dissemination profile that covers a range of academic disciplines including sociology, museum studies, computer supported cooperative work and also address non-academic audiences though presentations at conferences and colloquia, workshops, courses by and for practitioners. We have co-organised and contributed to video analysis workshops at the Annual Conference on Computer Supported Cooperative Learning, offered short-courses and seminars at conferences of the Visitor Studies Group UK and gave talks and lectures to practitioners at the Science Museum, Explore-at-Bristol and the Victoria and Albert Museum.

The project outcomes are evidenced by published articles in major academic journals like Social Studies of Science, Sociology of Health & Illness, and the International Journal of Science Education (Heath & vom Lehn accepted; Meisner, vom Lehn et al. in press; vom Lehn 2006), papers presented at key academic and practitioner conferences like Association of Science-Technology Centers (ASTC 2005) American Educational Research Association

(AERA 2007), British Academy of Management Conference (BAM 2005 & 2006), European Network for Science Centres and Museums (ECSITE 2005) and National Association of Research in Science Teaching (NARST 2007). We are currently preparing a number of papers for publication and a monograph concerned with video-based methods to be published by SAGE; including papers concerned with imitation, the social production of body image in hands-on exhibitions concerned with the human body, and the design of exhibitions.

Papers in preparation

Meisner, R., Heath, C. and D. vom Lehn. Unpacking imitative action.

vom Lehn, D. & C. Heath. The Mechanical Body

Heath, C. & D. vom Lehn. Examing exhibition design.

The primary project publications and presentations are presented in Section 2 Dissemination of the End of Award Report form.

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