Albuquerque, New Mexico • June 11 - 14, 2013

(HCI+ISE)

HUMAN COMPUTER INTERACTION IN INFORMAL SCIENCE EDUCATION CONFERENCE

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INDEPENDENT **EX**HIBITIONS

To access and download digital versions of
conference proceedings, learn more about
conference participants, and find out more
about the (HCI+ISE) project, go to:

openexhibits.org/hci-ise/

#HCIplusISE

**http://www.linkedin.com/groups/
HCI-ISE-4862239**

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hci-ise/**

*All photos of the conference are by Catherine McEver
unless otherwise noted*

Cover image: touring Ideum (photo by Ideum)

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The following presentations and discussions took place at the Human-Computer Interaction +
Informal Science Education (HCI+ISE) conference in Albuquerque, New Mexico on June 11-14,
2013. This document is meant to serve as a resource for those who attended, for funding sources,
and for others in the field. Opinions, findings, conclusions or recommendations expressed in this
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Participant comments have been paraphrased and the sequence of participant remarks may have
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capture the content and meaning of the ideas presented.

PARTICIPANTS

Tom Aageson
Executive Director
Global Center for Cultural Entrepreneurship

Sina Bahram
Accessibility Researcher and Ph.D. Candidate
North Carolina State University Knowledge Discovery Lab

Catherine Baudoin
Curator of Photo Archives
Maxwell Museum of Anthropology

Carrie Bruce, Ph.D.
Research Scientist
Georgia Institute of Technology

Olivia Castellini
Senior Exhibit Developer
Museum of Science and Industry, Chicago

Matt Celeskey
Exhibit Design Manager
New Mexico Museum of Natural History & Science

Sebastian Chan
Director of Digital and Emerging Media
Smithsonian Cooper-Hewitt, National Design Museum

Charles Compton
Technology Director
New Mexico Museum of Natural History & Science

Daniel Davis
Media Producer
Smithsonian National Museum of the American Indian

Jennifer B. Elliott, Ph.D.
Cognitive Research Scientist/Senior Consultant
TiER1 Performance Solutions

Karen Elinich, Ed.D.
Director, Educational Technology
The Franklin Institute

Ron Eppes
Community Engagement Manager
Intel

Kate Haley Goldman
Principal
Audience Viewpoints Consulting

Tiya Gordon
Studio Director
Local Projects

Joe Hastings
Executive Director
Explora!

Wesley Hsu
Web and Touchscreen Developer
Balboa Park Online Collaborative

Natasha Martell Jackson*
Media/Communications Manager
Intel

Olivia Jackson
Media Producer
Oakland Museum of California

Brian Kelly
Technical Designer, ARIEL Project
Franklin Institute

Erika Kiessner
Interaction Designer
Aesthetec Studio, Toronto

Susan Kirch
Creative Director
Right Brainiacs, Los Angeles

Wayne LaBar
Principal
ALCHEMY studio

Anna Lindgren-Streicher
Project Manager, Research and Evaluation
Museum of Science, Boston

Marti Louw
Research Faculty and Designer
University of Pittsburgh Center for Learning
in Out-of-School Contexts

Leilah Lyons
Director of Digital Learning, Assistant Professor
New York Hall of Science/University of Illinois at Chicago

CO-CHAIRS

Jim Spadaccini
Creative Director, Ideum
Principal Investigator, Open Exhibits

Kathleen McLean
Principal
Independent Exhibitions

ADVISORS

Jennifer Borland, M.A.
Media Programming and
Learning Technologies Evaluator
Rockman et al.

Robert Ketner
Curator
Independent

Erik Lizee
Director of Exhibit Design and Development
McWane Science Center & Aquarium

Paul Orselli
President and Chief Instigator
POW!

Christine Reich*
Director of Research and Evaluation
Museum of Science, Boston

Chia Shen, Ph.D.*
SEAS Senior Research Fellow, Director of SDR Lab
Harvard School of Engineering and Applied Sciences
(SEAS)

Monica Smith
Exhibition Program Manager
Lemelson Center,
Smithsonian National Museum of American History

*Unable to attend

* Attended pre-conference only

DOCUMENTATION

Catherine McEver
The Bureau of Common Sense

IDEUM STAFF

(Conference roles in parentheses)

Nora Galler
Information Specialist
(Participant and logistics support)

Ken Willes
Manager of Creative Services
(Participant)

Charles Veasey
Project Coordinator, Open Exhibits
(Pre-conference presenter Open Exhibits and CMME)

Asif Ahmed
Developer/Multitouch Programmer (Tech support)

Darold Ross
Graphic Designer (Logistics support)

Maddy Minnis
Motion Graphics Designer and Animator
(Photography)

Rita Sanchez
Assistant Director of Finance (Logistics support)

VOLUNTEERS/INTERNS

Rianne Trujillo
Shailie Thakkar

Paul Marty
Associate Professor
Florida State University

Marco Mason
Marie Curie Fellow
Massachusetts Institute of Technology

Bill Meyer
Director of New Media
Exploratorium

Dan McCulley
Business Analyst
Intel

Slavko Milekic, M.D., Ph.D.
Professor & Chair
Department of Art + Design Education
University of the Arts, Philadelphia

Mike Mouw
Media and Technology Consultant
Gamut Interactions

Kristen Nesbitt
Director of Exhibits
Shedd Aquarium

Dave Patten
Head of New Media
Science Museum, London

Suzanne Pierce
Research Assistant Professor, Assistant Director
The University of Texas at Austin

Graham Plumb
Creative Director
Snibbe Interactive

Allison Price
Director of Education
Lincoln Park Zoo

Peter Samis
Associate Curator of Interpretive Media
San Francisco Museum of Modern Art

Francesca Samsel
Research Professor
University of Texas at El Paso

Tamara Schwarz
Associate Director of Exhibit Content Development
California Academy of Sciences

Markus Seidl
Professor
University of Applied Sciences, St. Pölten

Erika Shugart, Ph.D.
Principal
Erika Shugart Consulting, LLC

Steve Snyder
Vice President, Exhibit and Program Development
The Franklin Institute

Christopher Stapleton
Creative Venture Catalyst
Simiosys

Jason Stevens
Principal and Exhibit Designer
Flutter & Wow Museum Projects

Travis Suazo
Executive Director
Indian Pueblo Cultural Center

Beck Tench
Director for Innovation and Digital Engagement
Museum of Life and Science

Kevin Von Appen
Director of Science Communication
Ontario Science Centre

Charlie Walter
Executive Director
New Mexico Museum of Natural History & Science

Eric Welch
Prototype Developer, ARIEL Project
Franklin Institute

Libbey White
Software Developer
Oregon Museum of Science & Industry

Ben Wilson
Manager, Interactive Media
Museum of Science

Eve Wurtele, Ph.D.
Professor
Iowa State University

Bruce Wyman
Principal
USD Design | Mach Consulting

Charles Xie, Ph.D.
Principal Investigator
Concord Consortium

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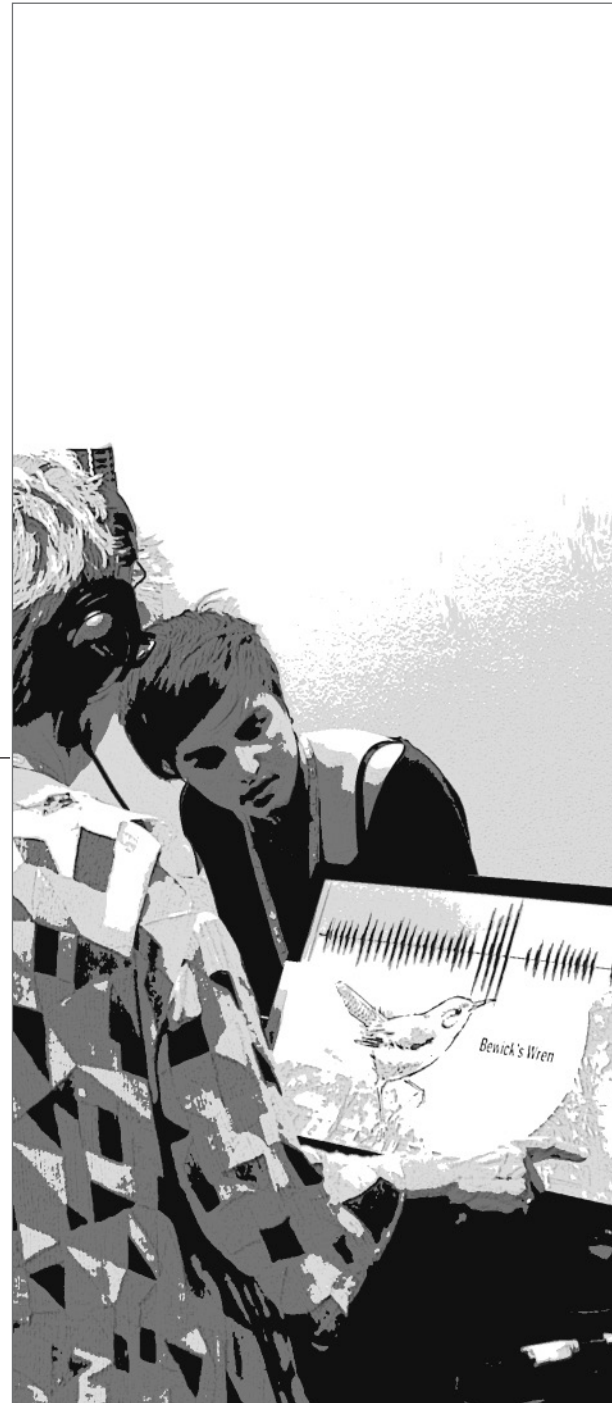
INTRODUCTION

(HCI+ISE)

An Introduction to the Meeting Venue: The Indian Pueblo Cultural Center

Photo: Ideum

100 Years of State and Federal Policy: The Impact on Pueblo Nations exhibit at the Indian Pueblo Cultural Center. A custom timeline exhibit using a stretched LCD custom touch overlay. The software and custom hardware was developed by Ideum.

Travis Suazo
Executive Director, Indian Pueblo Cultural Center

The Indian Pueblo Cultural Center is an institution that is deeply grounded in who we are as Pueblo people. There are 19 Pueblos, individual tribes along the Rio Grande as well as north and west of Santa Fe. Collectively, since time immemorial in our eyes and our view of creation, we have resided in this area in our aboriginal lands. We are very fortunate in our history, in that we were never removed from our aboriginal lands, so we still reside in the same lands that our ancestors once occupied, which is very important in terms of our self-identity. We continue to educate our people regarding who they are in this very fast-paced and changing environment in which we all operate. The Cultural Center itself is owned and operated by the 19 Pueblos in New Mexico, and they are all share holders.

We also have a 501(c)(3) nonprofit, which is the part that I oversee. Everything cultural that the Center presents to over 250,000 visitors each year is handled by my team and our staff. We also have some for-profit entities, initiated by tribal leaders once the Cultural Center was established, that help support the nonprofit. As those of us in the nonprofit world know, relying on outside resources can be tight, and we are very fortunate that the tribal leaders had the foresight to establish a for-profit side with business enterprises, and worked to assure the self-sufficiency and operation of those for-profit entities, so that the nonprofit side could continue to do great work.

The Cultural Center's mission is to preserve and perpetuate Pueblo Indian culture and to share the ongoing accomplishments of our Pueblo people. We have had a great partnership with Jim Spadaccini and Ideum and

his team of remarkable miracle workers, which has been instrumental in a special exhibition called *100 Years of State and Federal Policy: The Impact on Pueblo Nations*, which received support from the W.K. Kellogg Foundation. Another aspect of that project was K-12 curriculum based on the Common Core Standards. The curriculum, written from a Pueblo perspective, was based on the exhibition and on Pueblo core values. That foundation of core values includes love, respect, community, knowledge, and faith. You will see those core values reflected in the exhibition itself, coupled with images of those core values as they exist in our communities, both past and present. You will also see a unique, single-touch overlay timeline that has textual information, images, and also video clips.

The video component of that project is very important in terms of capturing oral history and personal experiences from elders, from professionals, and from Pueblo community members, talking about everything from education, to sovereignty, to land, to natural resources, to joining the military in World War II and having your number called. There is a wide gamut, and we are very fortunate in being able to capture and share these not only with our current visitors, but also with our next generation, those who may not have grown up in a Pueblo community, but who are Pueblo and for whatever reason in their lifetime or their families' lifetime have become disconnected from their community. In their hearts, in their minds, they know they are Pueblo, but what is it to really be Pueblo? We hope we can help them gain that knowledge, that we can spark their interest and desire to reconnect. In serving that mission, we also have the ability to educate others about who we are culturally, historically, and in the present day.

Opening Remarks

WHY ARE WE HERE?

Jim Spadaccini
Creative Director, Ideum
Principal Investigator, Open Exhibits

The following quote is from the original proposal that Kathy McLean and I wrote two years ago and serves as a reminder regarding why we are gathered here.

> "The goals of the meeting are to advance the current state of knowledge about the complex challenges and opportunities that exhibit designers and developers encounter in technology-based exhibitions and suggest strategies for enabling them to share theoretical and implementation approaches and methods." - NSF Proposal for HCI+ISE

This is going to be a long journey in terms of where human-computer interaction (HCI) is going, and where and how it gets incorporated in informal science education (ISE) and the museum world. However, I think we passed an interesting point a couple of years ago when it became possible, at a cost-effective level, for people to start creating interesting things that don't involve a track pad, a keyboard, or a mouse. That was the impetus for creating this gathering.

Another stimulus that started us down the road to initiating this conference was the Open Exhibits Design Summit, a smaller gathering that some of you attended. After that summit it seemed as though there was more to be done, which is why we are so pleased to have received funding from the National Science Foundation (NSF) to convene this conference.

As reflected in the points listed here, what we are trying to do is think ahead about how we can use these new technologies in interesting

HCI+ISE Co-Chairs: Kathleen McLean and Jim Spadaccini

Why Are We Here?
From the NSF Proposal for HCI+ISE

The HCI+ISE conference will:

1. Examine existing exhibits that use HCI technology;

2. Bring people together with diverse expertise to explore issues in common, and engage in design activities to better identify effective practices for designing HCI science exhibits;

3. Identify conditions under which HCI can be effective for enhancing museum visitor access, participation, and learning;

4. Identify strategies and mechanisms for expanding the application of HCI to exhibit practice, thereby maintaining freshness and nimbleness in exhibition development;

5. Connect to NSF research priorities, and to initiatives and strategic areas, in order to advance and strengthen the interchanges between museum practice, the learning sciences, and public understanding of science; and

6. Create a network of HCI+ISE users, and take steps to improve communication, knowledge access and leadership within and across ISE communities.

Web Design for Interactive Learning
www.wdil.org

ways, how we can better reach our audiences, and how those who are gathered here can play a key role in making those connections.

Another event that made me want to pursue this and ask Kathy McLean to join me was the Web Design on Interactive Learning (WDIL) Conference, where I first met a number of collaborators I have worked with over the years including some of you at this conference. It was another NSF-sponsored gathering, held at the Cornell Lab of Ornithology, and was about social media before it was called social media, about Web 2.0 before it was called 2.0. It was one of those meetings in which everyone knew there was something going on and while we may not have left with the answers, we succeeded in identifying the problems, challenges

and opportunities. That is what I am hoping we can do here.

There have been issues leading up to this conference regarding intellectual property [*see sidebar at left*] and I want to remind everyone that we are here to move the field forward. In the pre-conference workshops for HCI+ISE, Karen Elinich talked about the Augmented Reality for Interpretive and Experiential Learning (ARIEL) project, and explained that the goal was to make sure that field trip students from Philadelphia were engaged in experiences that were really meaningful and compelling. The shared desire to create meaningful, compelling experiences is why we are all here.

Regarding the need for a conference of this sort, the excerpts below addressing the ques-

The Need

"Of 36 sessions presented at the Museums and the Web conference in April 2011, there was only one that directly related to new forms of Human Computer Interaction, and it focused on augmented reality."

"The American Association of Museums (AAM) annual conference scheduled for May 2011 has planned 227 sessions and workshops. Thirty of these are focused on issues concerning technology in museums, but most are about the Web and social media. Only seven of the technology sessions focused directly on exhibits, and they do not have primary focus on HCI."

"At the Museum Computer Network conference in 2010, of 31 sessions (not including Case Study Showcases) none focused on HCI. Instead, like AAM and the Museums and the Web Conference, the focus was on Web development, digital collections, and mobile technologies."

"…the 2010 Association of Science-Technology Centers (ASTC) annual conference, of 116 sessions, keynotes, and breakout sessions, only 3 focused primarily on Web technologies, and not one session focused on the use of technology for public exhibits."

tion of need are drawn from the original NSF proposal. We had to make the case for why getting together was important. First, conferences that you would think would cover issues regarding HCI really aren't doing it. I went back and looked at a range of museum-related conferences, including the American Alliance of Museums (AAM) and Association of Science-Technology Centers (ASTC) sessions, and did a rough count from this year and the year before, and not much has changed. There is a lot about the web, and there is even more about mobile these days, but there is very little about how computers can change the visitor experience on the floor. That is part of the reason this gathering is so important.

For those of you who were at the last AAM conference, I don't know if this was true at other sessions, but I did one session on multitouch, multiuser design and the audience count, including people who were turned away, was 260. Just 180 attendees got in, so there is growing interest. People know something is happening and things are changing, it is just that right now there aren't the mechanisms within the standard conferences that many of us go to that are addressing these needs.

THINKING BEYOND THE "DIGITALK"

Kathleen McLean
Principal, Independent Exhibitions

When Jim asked me to be Co-Principal Investigator I was doubtful about how much I could bring to the table because I am sort of a digital Neanderthal. As we talked, I realized that my not-knowing (what Zen master Suzuki Roshi calls "beginners mind") might actually be helpful. It may allow me to bring the voice of many people out there in the world, both museum professionals and museum visitors, who are kind of clueless about this digital language, what I call "digitalk."

We have tried to mix up the makeup of this group so that not all of you here are digital geeks who understand that rarefied language. For those of you who don't, I encourage you to speak up, ask questions, and say, "What does that mean?" In your applications, many of you wrote that one of the biggest issues for you is trying to figure out how to talk about this digital technology, this HCI world, to people who aren't part of it. There is a huge gap there.

What excites me about this gathering is that we have talented and curious people with a diversity of experiences. We have brought you all here to Albuquerque for the next few days to engage in this cross-disciplinary talk. Jim Spadaccini and his crew at Ideum have done an enormous amount of work above and beyond

About Attendee Selection and Mix

We had twice as many applicants as we had spaces for this conference and spent days with our advisors reading all of the applications and trying to decide who would be invited. This means for every one of you who is here, there is another person out there who really wanted to come and couldn't attend. We tried to mix it up so that there is a diversity of kinds of people. We have art museum people here as well as science museum people. We have people who create exhibits but have never really been involved in the digital world. The idea was to get the kind of cross-disciplinary cross-talk going that I think is essential. • Kathleen McLean

what we promised for this conference to make this a really special event. We are also grateful for all of the knowledge and support we received from our advisors, who participated actively in helping us organize this conference.

Our intent is for this to be a participant-designed and participant-shaped conference, so if you identify something missing or want to address a topic we haven't included, make it happen and we will be here to facilitate.

Four Questions to Keep in Mind
Kathleen McLean

I want to share four questions that I hope keep coming up over the course of the conference. They have been bothering me a lot recently and I would like you to think about them.

The Digital Divide and Accessibility
I have heard a lot of people say recently that the digital divide is a thing of the past. I would argue that it is getting larger and deeper. How might cultural and informal organizations like ours take a lead in modeling a front-of-mind practice of designing for accessibility of all kinds? We tend to give a pro forma nod to accessibility, but I think it is a huge issue and one that is getting bigger. Let's keep thinking about that over the course of the next few days.

Simple, Quick, and Cheap
As we are increasingly blown away by amazing feats of digital spectacle and ingenuity, how do we reserve room in our practice for simple, humble, or as the British would say "cheap and cheerful" acts of experimentation and prototyping? We are going to see some amazing things in the next few days. I don't want to even start wondering how much some of these things cost. How can we still retain the simple, cheap, quick-and-dirty way of thinking about our work?

The Aesthetic Experience
While this conference was funded by the National Science Foundation and it is about HCI+ISE, informal science education, I am wondering if we can get beyond those notions of science information delivery, education, and explanation, and focus our attention at least a little bit on exploring the aesthetic experience, on supporting, honoring, and igniting an aesthetic sensibility in ourselves and in our visitors. I don't think we are spending enough time taking the aesthetic experience seriously. As an illustration of what I am talking about, I would refer you to Wayne LaBar's blog (http://alchemystudio.com/category/experiences-and-museums), where he shows amazing digital experiences from around the world that are rich with aesthetic experiences.

Human-to-Human Interaction
As we talk about HCI, let's not forget about HHI, human-to-human interaction, which is arguably the most important reason why we are here today. The Indian Pueblo Cultural Center's core values [*page 2*] tie right back into HHI: love, respect, community, knowledge, and faith.

Kathleen McLean on the high-wire at Explora

PROVOCATIONS

(HCI+ISE)

Technology Showcase

During a two-round Technology Showcase, 21 conference participants demonstrated a range of touch tables, software, and hardware applications related to human-computer interaction and informal science education. A complete list of Showcase participants and projects may be found in the "Attachments" section of this document. Photographs from the session have also been used to illustrate the group discussion portions of this "Provocations" section.

Dan McCulley of Intel (right) gives each "Provocations" speaker an Intel Ultrabook.™ Shown here, speakers Dave Patten and Erika Kiessner

Tiya Gordon of Local Projects demonstrates Gallery One

Provocations

Seb Chan notes the importance of immersive experiences and wonder and poses seven questions regarding what museums may offer visitors in the way of unique, lingering, and even exclusionary experiences. Sina Bahram offers a perspective on accessibility that addresses common assumptions and identifies opportunities. Erika Kiessner asks whether ease of use should be the key criterion when assessing usability, and questions whether making it easy is doing museum visitors any favors. Dave Patten talks about objects and discusses ways in which digital technology can help those objects tell a story.

Group Discussion

In follow-up discussions, conference participants discuss the nature and parameters of HCI and identify issues, needs, questions and opportunities.

No More Screens

Seb Chan
Director of Digital and Emerging Media
Smithsonian Cooper-Hewitt,
National Design Museum

I am at the Cooper-Hewitt, which is the National Design Museum of the Smithsonian in New York. Before that I was at the Powerhouse Museum in Australia.

formerly powerhouse museum, sydney

One of the teams that reported to my position there was the same team that ran a digital media learning center called Thinkspace, previously called the Vector Lab, and before that called the Soundhouse. When the Soundhouse was set up in 1995, well before I began at Powerhouse, media in museums was then about sound. Then it changed to Vector Lab, which was about video, and now it is Thinkspace and is about maker stuff, Arduinos, and the like.

http://www.powerhousemuseum.com/thinkspace/
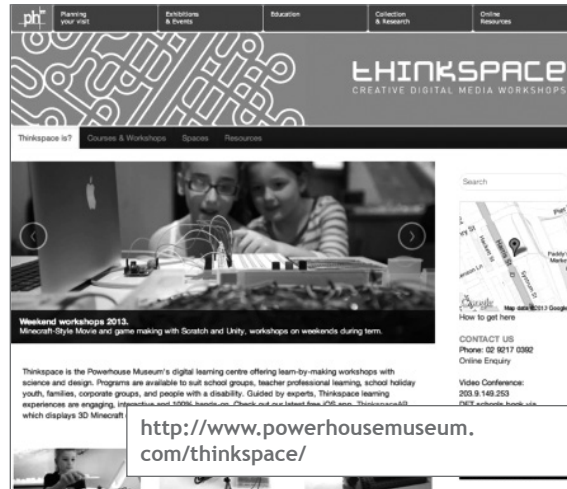
I was also engaged in visitor evaluation when I was at Powerhouse, using digital to track visitors and the things visitors do. This is a heat map of visitors, using WiFi dwell times within

@sebchan
labs.cooperhewitt.org
freshandnew.org

Time Range: 10:00 AM to 5:00 PM

how do you put a building on the internet?

technology acts as an amplifier
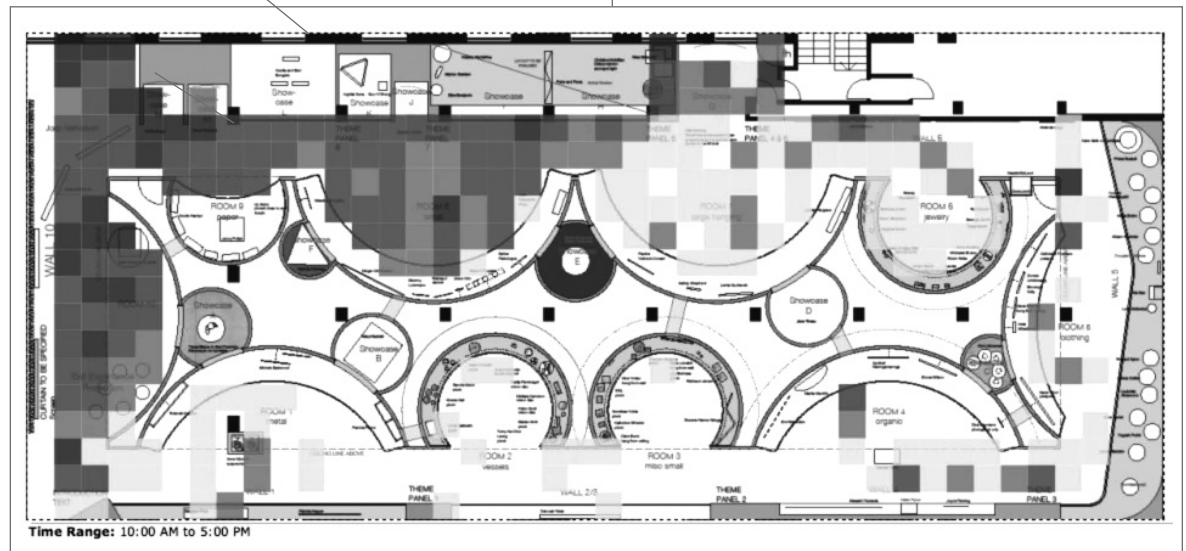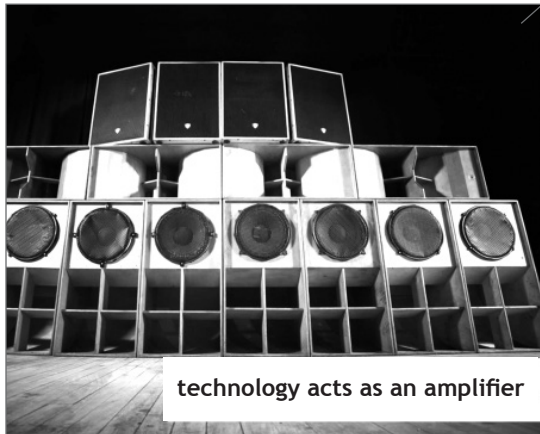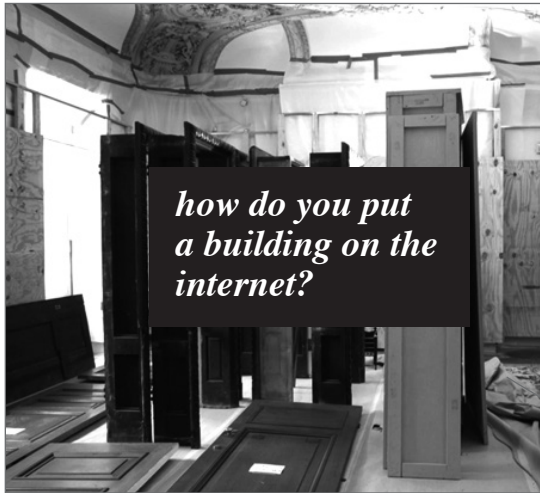
a particular gallery that at that time also used hideous QR codes. We were using this data to look at ways of redesigning the physical space, and wanted to explore the way visitors engage with labels, or whether it was the objects we put out that just did not interest them.

We found that people spent the most time around the videos. We also found, in an area shown on the upper left of the heat map, that while people weren't scanning the QR codes in that area, they were dwelling there for very long periods of time. So they were inspired by the things they saw, but didn't want to use QR codes to find out more.

Now I am at the Cooper-Hewitt, which is currently closed for renovation, and we are trying to figure out how to put a building on the Internet. What if all the showcases could talk? What if all the fittings were addressable? As we know, technology acts as an amplifier, and for museums it amplifies along three vectors: geographic reach, temporal persistence, and deepen context.

geographic reach
temporal persistence
deepen context

vectors of scale

Temporal persistence means that you can recall your visit, and the visit doesn't end. I think museums have been very bad at that. I don't think that has a lot to do with technology at all, but with the way we frame and promote visits and the whole idea of a visit.

And of course technology can also deepen the context. Of the three vectors, I think we've only solved the geographic reach bit.

While I called this presentation "Too Many Screens," when pressed to come up with a title in a few minutes prior to the conference, that isn't really the focus of this presentation. However, we know there are too many screens. We also know that screens take us away from immersive experiences.

This is a note from the Savages, a neo-punk band, which they posted before their show, and it fits with their aesthetic. Screens take us away from immersion.

A NOTE FROM SAVAGES

OUR GOAL IS TO DISCOVER BETTER WAYS OF LIVING AND EXPERIENCING MUSIC

WE BELIEVE THAT THE USE OF PHONES TO FILM AND TAKE PICTURES DURING A GIG PREVENTS ALL OF US FROM TOTALLY IMMERSING OURSELVES

LET'S MAKE THIS EVENING SPECIAL

SILENCE YOUR PHONES

screen vs immersion

Immersion may also sometimes require sensory deprivation. *Sleep No More* is an immersive theater production by a UK theater group that is in New York at the moment in a five-story warehouse. It's a retelling of *Macbeth* through contemporary dance and sound and other senses. It is amazing and scary and good. When you attend *Sleep No More* you have to wear a mask, and that is purposely to reduce peripheral vision and to focus you on particular things in that experience.

sensory deprivation for immersion

seven things.

I was asked to be provocative, so I have come up with seven things that we still have to figure out.

one.
what is still unique about the setting of a museum?

I think museums are not generally confident now about what makes them different from other physical places. Digital technology and the Web have particularly problematized this. What is special about our physical buildings? Working at the Cooper-Hewitt, which is in Carnegie's old mansion, I am always confronted by the thought, Oh my god, this is a historic house with domestic-style spaces. What the hell do we do with this to be a design museum? But we have to work with the unique setting of our museum.

I think museums bring out a particular commitment on the part of visitors to spend a particular amount of time within our spaces and do particular things within our spaces.

two.
complex ideas take time. how do we increase dwell times?

For science, art, and the world now, we need time. Complex ideas take time. Two-minute experiences in front of screens do not get to complex ideas. We need to think, perhaps, about dwell times. We also need to think about ways that complexity is explored and be excited by that rather than threatened by it.

Seb Chan

(HCI+ISE)

we have *ALL* of the birds!

In some sense celebrating the richness and the quirkiness is important to us. Instead of running away from being the nation's attic, we should say "Attics rock!" Treasures are found in attics, and adventures (as in *Goonies*) begin in attics.

three.
all the stuff is better than some of the stuff.

We are finding that all of the stuff is better than some of it. The work that curators have done in paring our collections down is not actually of much use. I would say that we should celebrate having *all* of the things. A recent Smithsonian branding campaign used the tag line, "Seriously amazing." One of the official images depicted row upon row of dead birds in collection drawers. It's not just about showing some of the birds, we have *all* the birds! If we just had some of them, we would have less value than having all of them.

new types of 'object' we need to collect, preserve, exhibit

four.
can databases ever be poetic?

Databases suck, and we need to figure out how to make poetic databases.

five.
how can we make things that are as useful to staff as to visitors?

I've been thinking about how we can make tools for our very small gallery spaces that allow our curators to curate the world and to create new forms of curatorial practice.

"emerging tools to curate the world"

"new forms of curatorial practice"
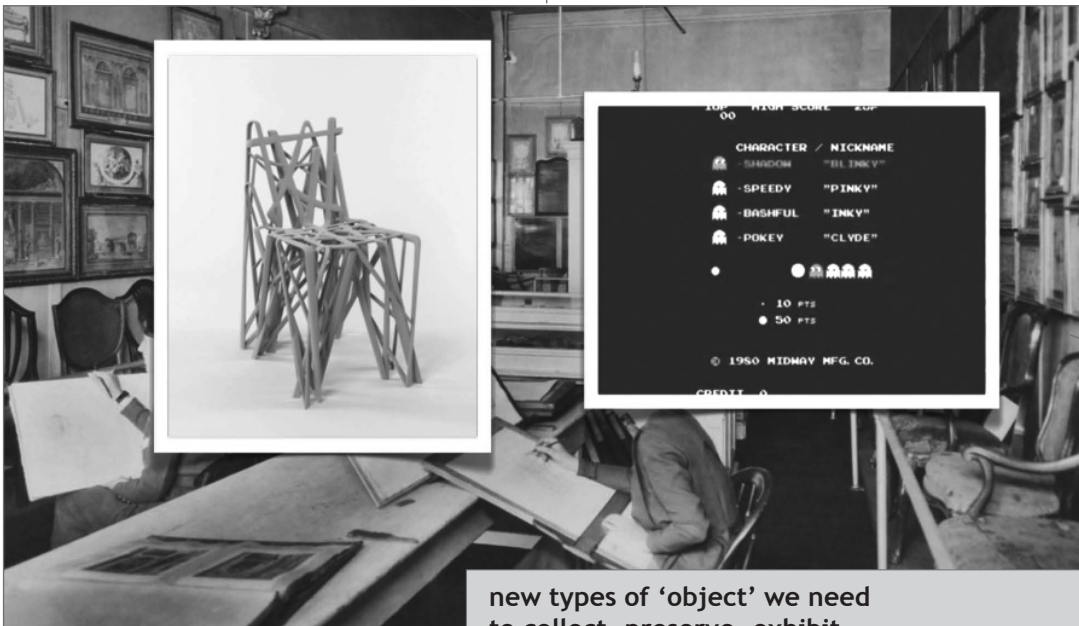
In the background here is a photo of the old Cooper-Hewitt collection, which really was about having "all of the things." We have collectively begun to change, and I know Dave Patten will be touching on that in his provocation.

We have a 3D-printed chair in our collection as most museums have now, but we didn't

collect the source code. MoMA started collecting video games, and that's great. We have a collection of telephones and other communication devices, but how do we collect the interface changes on Facebook, and how do we preserve and exhibit those in a meaningful way as a design museum to explore that? When the interface changes on Facebook, millions of people [*665 million active users in 2013 worldwide*] are affected simultaneously.

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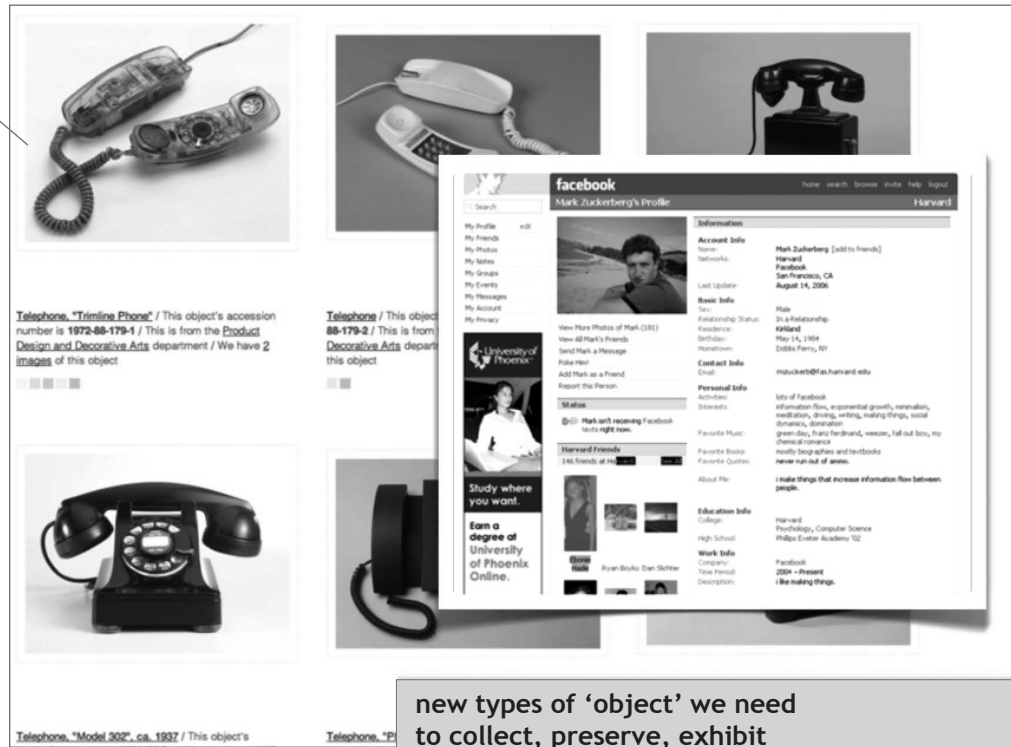
six.
what if we made 'wonder,' not 'learning' the main KPI?

What if wonder was what we really cared about, and not learning? An exhibition I really liked was this one at the Maritime Museum in the UK.

united visual artists at national maritime museum uk

for more information on the exhibit:
http://www.rmg.co.uk/about/press/sammy-ofer-wing-press-pack/high-arctic-at-the-nmm

This was about climate change, with no objects, no interpretive panels, just a UV torch

Telephone, "Trimline Phone" / This object's accession number is 1972-88-179-1 / This is from the Product Design and Decorative Arts department / We have 2 images of this object

Telephone / This object 88-179-2 / This is from Decorative Arts depar this object

Telephone, "Model 302", ca. 1937 / This object's

Telephone, "P

new types of 'object' we need to collect, preserve, exhibit

soundscape. The dwell times in this exhibition were very long. I spent 45 minutes in this space, just walking around and listening to it. It was incredible.

Also, don't forget that museums used to excite people more in the past. This is the fake Fiji Mermaid. We somehow lost that moment when magic and science became separate, and we need to restore magic back into the presentation of science because magic kind of rocks. Kevin Von Appen was showing us a bar trick with a rubber band at the opening reception at Explora. Magic is kind of awesome.
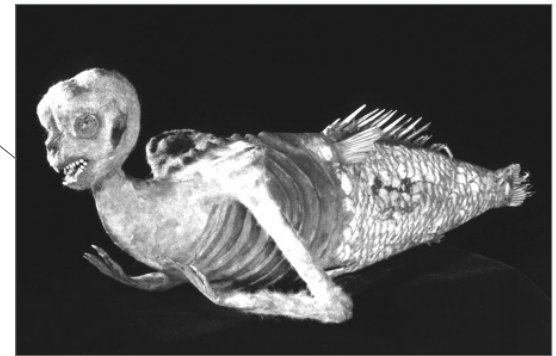
Source: Australian National Maritime Museum
http://www.flickr.com/photos/anmm/

Q = Question

A = Answer or comment from speaker

C = Participant comment

> *seven.*
> *what if we designed deliberately exclusionary experiences?*

This is a kind of interesting question: What if we designed deliberately exclusionary experiences? I think sometimes museums, particularly public museums like Powerhouse and the Smithsonian, focus too much on designing for everybody, and as we know that doesn't make good products. So what if we designed purposefully exclusionary experiences? *Sleep No More* is very exclusionary but very awesome.

QUESTIONS AND COMMENTS

Exclusionary Experiences

SLEEP NO MORE

Q: You said that *Sleep No More* is exclusionary. Could you unpack that a bit and explain why?

A: It's exclusionary because of price, because of location, and because there's no entry point to it, other than coming in, putting on a mask, and having a drink, and then you're left to run. There is no interpretation, there's no help. Some people hate it for that, but it is theater and entertainment and art, and it is not trying to be for everybody. It's accepting that some people will hate it, and that will be fine.

EXCLUSIONARY EXPERIENCES IN MUSEUMS

The Science Gallery, Dublin

Q: Working at a museum that has no entrance fee means that there's a low barrier for people coming in. If we provide the exclusionary experience, or an experience that's only for a small audience, do we need to prepare people and say, "This is not for you"? Or do we just let some people come in and say, "I don't get it, I don't like this place," or "I don't like this particular thing"?

A: I think people will do that in any case. I saw an amazing presentation at Museum Next by the Science Gallery in Dublin. Dave Patten and I were both so impressed we were thinking we should leave our jobs and go work there. They exclude anyone under the age of 16. It's a science museum for adults and they make people sign a waiver as they come in the door. Thus they can do amazing things like have a public program where they take your blood and your blood cells fight against another visitor's blood cells in a death match.

So it allows you to do things you couldn't do, and it allows you to present complexity in a way that requires visitors to buy in more than a ticket does. The Science Gallery is awesome [sciencegallery.com]. They have an exhibition on risk at the moment, and coming up they've got one on DNA modification, and I think they'll

probably be taking visitors' DNA and mutating them. These are the sorts of things that we should be exploring.

The Museum of Old and New Art (MONA)

C: MONA had a naked tour in which you'd take off all your clothes.

A: MONA is a museum in Tasmania that offers amazing experiences and is much loved because it is different.

Museums for Everyone?

C: Regarding the word "exclusionary," I think when we say "museums for everyone," implicit in that is the idea that we are thinking about the same museum experience for everyone. Perhaps if we think about it in terms of a customized experience, we can eliminate this exclusionary concept and think about this more from an inclusive standpoint.

Beyond Single Visits: Ongoing Relationships and Seasonal Subscriptions

C: When you were talking about visits to a museum, I realized everybody was talking about visits and pre-visits and post-visits. Later you mentioned time and impact and so on. Maybe museums should not be defined by visits, but by building relationships that last as long as they last.

A: One of the things we've been thinking about at Cooper-Hewitt is rebuilding our ticketing system. In fact, we've been looking at ticketing systems used in the performing arts world, in the sense of buying a subscription, and that sense of a relationship through time, where the commitment is not a single visit but a consistent series of visits. So you would subscribe to a season rather than a visit-by-visit model. I can see that the performing arts are taking a lot of good ideas from the museum world, and the museum world needs to be pulling more from the performing arts world.

Temporal Persistence, Pre- and Post-Engagement, and Lessons from PRISM

Q: I'd like to ask about the temporal persistence factor you talked about because it seems like the pre-visit/visit, model is something like ten years old and really tired. And the studies have shown us that it doesn't really work and that's not how people use things.

A: It's about how we figure out this relationship stuff. How do we track and make visible those relationships we've previously had with you when you return and keep you engaged around the topic? No one has the solution for this, but I think part of it is having a more consistently tracked relationship, which isn't just about you joining us. We send members stuff all the time and that's not really the answer.

C: Typically museums put the burden on visitors to deal with the pre- and the post- stuff. We placed all the burden on them and we didn't follow through on it because we didn't make it worthwhile and we didn't make it attractive. The thing about PRISM is that it is doing it all on the server side, it's not relying on the client to provide the information. I would actually argue that museums should put themselves in the position of doing the pre- and post-engagement and have that be part of their responsibility. That fundamentally shifts the focus and does begin to make the stuff Seb was talking about a lot more possible.

Archiving and Exhibiting Software

C: Archiving software for public exhibition and interaction is probably the most boring thing I've ever heard of. I know that you're thinking deeper than that, and I want to know what that is. Yes, Facebook changed its interface and that affects hundreds of millions of people. Six months from now, who cares?

C: But ten or twenty years from now will people care?

C: Why should people care? Because if you go back in the history of graphic interface, you can understand how to create the future of graphic interfaces. The lifetime of a graphic interface in digital media is very short, but I think we have to keep track of the history of the work the designers have done during the last 20 or 30 years. This is a big chal-

From left: Seb Chan, Bill Meyer, Olivia Jackson, and Dan McCulley

lenge and there is one question I would ask you. If you have to present the visitor with a digitized version of a very cool object, it is simple in a way because it is visible, but if you want to communicate interaction design, how do you communicate something that is ethereal and intangible, but in my view, really important for the future generation of designers?

A: Museums of art have been collecting conceptual art, and this has lessons for us. My team has just acquired for a piece of software for the collection. The registrar, who manages the warehouse and has to put things on shelves, asked, "Well how big is it Seb?" I said it didn't have a size because it's not a thing. The registrar said, "What shelf is it going to sit on then?" The cataloging system does not have the capacity to deal with things that are not things.

I've been trying to figure this out, and this is a bigger problem for the Smithsonian at large: How do we start to bring the systems that manage the physical world into accepting things that are not of the physical world? I've been looking a bit at the way patents are collected, and ideas. Do museums become catalogs of ideas? And in our case these are catalogs in process, so you could explore chairs not through their physical form, but through the process of making chairs and the economics of chairs and that sort of thing.

Think That's Useless
If You Can't See? Think Again.

Sina Bahram
Accessibility Researcher and Ph.D. Candidate
North Carolina State University
Knowledge Discovery Lab

sinabahram.com
sina@sinabahram.com
blog.sinabahram.com

OVERVIEW

Interfaces that at first seem only suited for sighted users have amazing potential for all.

There is a lot of opportunity in classically visual interfaces, or interfaces that are thought to be highly visual, for audiences that aren't able to see. This is true of other interfaces as well; I am just taking the easy way out and will talk about the one in which I happen to be a domain expert (whether I want to be or not). I would like to talk about those interfaces and some of the classical misconceptions, and then what I am calling "the real story."

The first is touch. We have all seen iPhones, iPads, Ideum touch tables, etc. The misconception is that if it doesn't have any buttons it is hard for blind people to use. The reality is that there are a lot of inherent advantages. The way I use an iPhone is a little bit different than the way some of you might. That is because it talks. It intercepts my gestures and reads what is under my fingers. I would be happy to

demonstrate that during this conference to any of you who are interested: how to swipe, how to activate various applications, how to do this and that. It is very straightforward and is usually called an "access overlay."

If you accept my word for it that I use an iPhone, and I do, as well as an iPad and other touch technologies, then it opens up the discussion. What are some of the things that implies? For example, the classical way of using an interface with a screen reader is that you are tapping and arrowing around a lot. It is an interface that is very linear. Because it is linear, as a blind person you are using the interface in a very different way than any sighted colleague, or than your parents if you are young, or than any of your friends. This is a problem because it is, by its very nature, exclusionary. Also most of the time, though there are a few exceptions, it is not as efficient.

These interfaces are also designed for mouse input. We have the classic WIMP paradigm (widows, icons, menus, pointers). What happens, if you open up the world of touch to somebody who can't see, is that they use the interface in almost the same way that someone who can see uses that interface. If somebody tells me it's the button in the left-hand corner on a regular computer, that is useless. That

TOUCH

Misconceptions

- Blind people can't use things without buttons

The Real Story

- Access overlays facilitate rich touch interaction
- Actually advantageous in that it provides an understanding of 2D interface layout
- Promotes collaboration with sighted colleagues
- Facilitates inclusion – same experience as everyone else (Universal Design)

doesn't do me any good because I don't think about things positionally, whereas on a touch interface I'll take my hand over to the left hand corner.

This promotes inclusion because you can discuss interfaces in the same terms. You can go online and listen to the audio of a YouTube video when someone is explaining how to do something and follow along. At a museum, if you are discussing an exhibit you have just experienced with some friends and the exhibit had an accessible touch interface, you can say things like, "Remember when you dragged stuff over to the right and this happened?" It allows for that level of collaboration.

Another thing it does is allow you to start thinking about interfaces in the same way across different user groups. What that really facilitates, at least for me, is this ability to concentrate more on the core principles of universal design in the interface itself for all users. It's not just thinking about blind users and making sure everything is available up front, and making sure that things aren't hidden at the bottom, and so on. It eliminates the separate aspects of that.

The next thing is augmented reality. I was going to borrow a pair of sunglasses to use as a prop for this particular slide. Some of the misconceptions here are that augmented reality involves a purely visual interface, and that the only glasses blind people wear are sunglasses. When you think of Google Glass or superior technologies to that, you may think of traffic

overlay when you are driving, or weather, or any number of overlay-based augmented reality solutions. I wish you luck with all of those, but I am not interested in them because they don't do anything for me.

However, those kinds of interfaces have to live and breathe and understand all of the things, by the very nature that I can't see, I can't receive as input. Their input involves all of the things that I don't get, as such. Because of that, it is then a matter of expression and proper interface and proper usability—just HCI at its core here—to transfer those concepts to a blind user.

AUGMENTED REALITY

The Real Story

- Such devices by definition have to understand all the things a blind user can't see
- Can assist with object recognition, orientation, mobility, and social situations

For example, think in terms of social situations. I will share with you a blind trick, and I am giving something away here. How do blind people know when to shake hands? The trick is, you always reach your hand out first because

AUGMENTED REALITY

Misconceptions
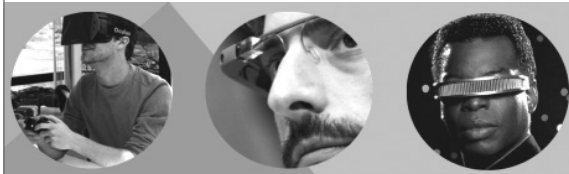
- Purely visual interface
- I thought blind people only wear sunglasses

human instinct is for the other person to reach for yours, so you don't have that awkward moment. What is really awkward is when two blind people try to shake hands. It's a subtle little thing and most people accommodate for it.

The big thing for me would be at a conference like this, where I might know some of you from different collaborations. There is a visual way people connect: "Oh, there is so-and-so down the hall," and you go over and talk to them. Obviously I don't get that kind of ubiquitous or immersive information. I don't have the ability to be aware that someone I've known for several years is three feet away from me. Something augmented reality could do is provide a whisper in my ear, "Jim Spadaccini, three meters northeast."

There are some privacy issues here and perhaps I'm a little biased, but I think they are rather ludicrous. The issue is the violation of someone's expectations with respect to something that couldn't be known otherwise. But if I give a particular application, such as a pair of smart glasses, my Facebook, my LinkedIn, my Twitter feed, my personal image gallery, and my email contact book and say, "For me, when I am wearing you, it is okay for you to identify other people," I don't see that as a privacy violation. Frankly, you know what other people look like and there is no privacy violation there. That is the argument I would make, so when Google decided not to support facial

recognition I was a little disappointed because it presents a really big opportunity in the accessibility area.

The next point, orientation and mobility, is fairly straightforward: "The door is three meters to your right." Talking GPS only gets you so much of the way there. The idea here is that if you can do the fine grain, what the telecom guys call "the last mile problems," then you can have someone who has talking GPS, but also has a pair of smart, wearable computing glasses that get them the rest of the way there. Again, this is something that sighted people may take for granted. You can just glance up and know where the restrooms are, it's not an ordeal to go and actively find them.

For purposes of brevity I'm lumping 3D and natural user interfaces and considering them in the same context, though I recognize there's a difference between Kinect and Leap, and so on. In terms of misconceptions, there is the idea that it is very visual with all of these 3D, *Minority Report* type of interfaces. What is the point, and is the effort even worth it for someone who can't see?

There really are some innate advantages to these kinds of interfaces. The first story, of course, is how you make it accessible. That is not too hard at all if you convert it back into what is basically a closed loop. If you are using something like Kinect, some of the major problems with it are not related to the input. If you're blind, that doesn't mean you have mobility restrictions, you can raise your hand and

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3D and NATURAL USER INTERFACES

Misconceptions

- Way too visual
- Doesn't offer any benefits
- Not worth the effort
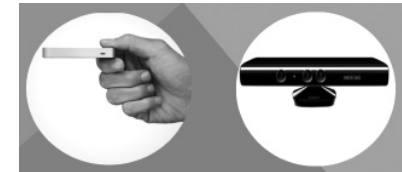
The Real Story

- Can be made usable by replacing or augmenting visual feedback with audio feedback
- Can be made highly efficient through proprioceptive feedback and muscle memory
- Can offer novel, non-linear access to data

Sina Bahram

so forth. However, you obviously don't know the feedback from the screen, so you need audio to provide you with information that the sensor is understanding your input. Once you solve that, and it is a trivial, straightforward thing to solve from a technical point of view and from an interface point of view, this offers a lot of advantages.

I mentioned earlier that when someone who is blind uses a screen reader, it is very linear and doesn't offer the same experience. Here it is the same experience. If you want to make something larger, you move your hands. It is proprioceptive feedback. You can use physical gestures and don't need to be able to see to make sure that none of your fingers touch each other. That's not collision detection, that is just your body knowing the position of its limbs, and you can convey a lot of concepts this way.

If you again make it a closed loop by using something like audio, you can talk about the relative sizes of the planets, for example. So you've got an exhibit where you want people to open their hands proportional to how big the Sun is versus how big Earth would be, or how big Jupiter would be. There are a lot of innate accessibility and universal design implications that you get for free, but the misconception is that it's highly visual and not worth doing.

Another thing I would say about 3D interfaces within an accessibility context, because I'm interested in it from a research point of view, is that they present a huge opportunity to offer

nonlinear access to data. If I'm in something like Excel and have to go through columns and rows, it's tough. You have to move to the end, you have to move to the bottom, it's tough to do. There are some shortcut keys, but it is really annoying. With a 3D interface you can map the data in front of you and then manipulate it just by using your hand. You have the audio and accessibility solutions figured out already, so that's easy. Now you can start making the input just as accessible, even though the old way of input, using the mouse, would not be. So there are a lot of opportunities there.

I will leave you with the following thoughts. To me, the important part here is that if you gather input from both users and the environment, and you weave them together, then you have a greater opportunity to make these rich, interactive interfaces.

MY THOUGHTS

The more input we can gather and weave together from users and the environment, the more possible it becomes to create rich, interactive, engaging, and efficient computing interfaces.

QUESTIONS AND COMMENTS

Blind Orienteering in a Museum

Q: In a museum, we want to make all of our exhibits and experiences accessible. How do we let blind and low-sight visitors know where those experiences are in a sea of non-accessible experiences?

A: I would say a major problem with entering a museum, from a blindness point of view, is knowing where something is, as you alluded to, and then getting to something. You could break this down into target acquisition and then going to the target, to continue the PRISM theme. There are several ways you can do that if you have indoor wayfinding solutions, which is an up and coming thing in spaces. Ben Wilson has been talking about ByteLight for example [bytelight.com], which offers foot-level resolution depending on whether the LEDs are available. If you have solutions like that available, then you can start facilitating self-directed experiences for individuals who would otherwise have to rely on somebody else, and therefore somebody else's preferences, in their journey through the museum.

Conveying Rich Information Before and During a Visit

PRE-VISIT PREPPING

A: Another thing we do is try to front-load or make a lot of these things real-time. There is nothing wrong with asking blind users to flip out their iPhone and go to an accessible version of a website that lets them know all of the things they can study. They could get that ahead of time, for example. I think this may sometimes be frowned upon because it may be asking that visitor to do something extra, but if you are facilitating really rich and useful information for them, it is a valid thing. It shouldn't be the only way of conveying that information, but it is something that should be considered, so they can come better prepared for the museum even before stepping in the door.

DURING THE VISIT/AT THE EXHIBIT

Q: How do you get a web address to a blind person? Do you speak that out character by character?

A: Let's say they are at the exhibit and you have a lot of great information in accessible digital form, in HTML or a wiki-like format so they can fly through headings. How do you get that information to them from the exhibit? There are a couple of things you could explore. There is NFC, there are QR codes and there are plenty of accessible QR scanners. So, for example, you could have a Braille label that lets them know the location of the QR code. They put their phone in one hand, they obviously know where the camera is, they know where the page comes up, they've got an accessible user agent.

Q = Question

A = Answer or comment from speaker

C = Participant comment

Of course, this is assuming they have a smartphone, but you've got to make certain assumptions at some period in time.

The problem with speaking out all of that information in an audio, push-to-talk mode is that they are in human speech. I am used to listening to my technology reasonably fast. For example, this is slow presentation mode because I want to listen and talk at the same time. [*Bahram plays a snippet from his tape recorder of speeded-up, compressed speech that to the sighted sounds like gibberish or a foreign language.*] My usual speed is 900-950 words a minute.

You have multiple ways of conveying that information, whether it is QR or NFC or just having someone tell them. This is blasphemy and I shouldn't say this as a computer scientist, but it doesn't always have to be a technical solution, though those kinds of things are really useful. There could also be handouts at the beginning when they come in that have the URL in Braille or big print, whatever the case may be.

Prioritizing Accessibility and Universal Design from the Beginning

Q: We've been talking about accessibility in museums for 30 years, and for 20 years pretty intensively. It was a hot topic for a while and then dropped off. In every project I've worked on we always say that of course we want to make it accessible. Then when it gets right down to it, accessibility is the last thing people think about and then the money is gone, so all of the good intentions go down the tubes. How can we reprogram our brains so that we are not thinking in that sort of cyclical way that stops us from making much progress?

The Segue from Pre-Visit to Visit; Advantages of Using Visitors' Smartphones

C: Assuming that you do have an iPhone or smartphone that is going to give you advance information regarding what is going to be available to you at the museum, then what is the segue that you would recommend? Do you continue to use the iPhone as you move through the galleries, or is there a bridge between that and the instantiated technology in the room?

A: I would say yes, you do continue using that device. I know that this is sometimes a controversial topic. There are a lot of technical and conceptual challenges that go along with the bring-your-own-device approach, but I think it's a movement that's useful. What it does is place the onus of making the information universally accessible, and also consumable in a lot of different, generalizable ways, on the content creators and on the technologists behind the content creators. That's helpful not only to disabled users but to other user groups, and offers other means of archiving and all of these other advantages.

The downside of that is that you sometimes don't have as much fine-grain control over the user experience because its not going to be something you've written from scratch, and the hardware you assume that they're using, etc. But I think there are ways of doing that. I wrote a little about this on a blog post about seven principles of universal design for museums. It's something I'm really passionate about. I would prefer, as someone who has various tech gadgets, to bring my own device, get some content, and go through it myself. And then: Oh yeah! You've got this cool NFC thing I can wear around my neck that communicates with my phone, and every time I go up to an exhibit it talks to me automatically in my speed, in my language.

There are deaf people who may not be literate, but they know sign. It would be great to have the computer sign that information when they come up to an exhibit. Once you do that hard work up front of getting that info in an electronic, generic way in a reusable format, you can do a heck of a lot with it.

***7 Principles of
Accessible Inclusive Exhibits***

http://blog.sinabahram.com/7-principles-
of-accessible-inclusive-exhibits/

A: I encounter this a lot when I'm doing consulting work because clients will say, "We need to make this thing accessible," and I'll get all excited and say, "That's excellent." Then it turns out they designed it five years ago and there are about a million lines of code that need to be remediated. Doing it at the end is always harder. It's harder not only for the obvious engineering reasons. All of the software concepts and those who talk about them are borrowing from architecture. It's always harder to add something later on than to do it at the beginning. It's the same thing with software.

Obviously, my preference would be do it correctly from the beginning. But if you can't get that in at the beginning, you want accessibility that will consider universal design and have all of that be reusable. At least put in the abilities to get at and control and dynamically change things rather than hard-code them. This is simple, it is basic computing, but we all fall into this trap where it is easier to just statically assign something. For example, I am going to assume this image is *always* 100 pixels wide. Then if someone with low vision comes along you say, "Here's a magnifying glass." That doesn't work. If you can at least build a level of dynamism or generality into the application up front, that helps a little bit.

But moving on, from a policy level it should not just be sold as an accessibility augmentation. Let's say we want to help blind

people. Well, that's great, but how many people coming to the museum are blind? Okay, maybe it's a legal thing. But you can look at it from a universal design point of view in terms of different user groups, and also as a selling point because it opens the door to other things. A lot of developers will tell you that after doing things in a universal design-centric way from the beginning, it actually makes the rest of the product easier to manage. It makes certain things bubble up to the beginning.

I think Jim ran into this with the Ideum framework for Open Exhibits. The accessibility solutions illustrated things in the framework that you wish you knew beforehand, right? I think there are ways you can sell it, both at a policy level as well as a technical level to try to promote doing it the right way.

Designing Multisensory Experiences

Q: Let's say you have a van Gogh painting that is absolutely beautiful to the eye. It seems like there are so many other ways it could be translated into beauty through audio signals and sensory signals, maybe temperature. It would be beautiful not just to people who can't see it, but also to anybody because that complexity is translated into different senses. Are people doing that?

A: I've seen some, but I'd have to look up the references. The kernel that I got out of your

**Ideum
Accessibility Lessons
with Open Exhibits**

• One of the things we tried to do with the Open Exhibits software framework was build in a descriptive audio layer. We found that in an object-based framework that wasn't really sufficient. You didn't know when you were near a digital object, you only knew when you were on an object or touching an object. The proximity part of this made us think about other ways of modifying the framework, including adding agents who might go in and do things to objects. For example, one of the things Sina and I discussed was maybe having an agent that would go through all of the digital objects in an exhibit and find the ones the visitor was interested in. We have the problem of these exploratory exhibits in which it is very hard to identify or find the things you are looking for. So this did really change the way we wound up looking at the framework. • **Jim Spadaccini, Creative Director, Ideum; Principal Investigator, Open Exhibits**

Design Methodologies for Addressing All of the Senses

Q: I'm really interested in your world and design methodology. It seems like a lot of design is done now by pushing it through the eyeballs. Every sense has a different memory, every sense has a different advantage. Olfactory is the only one connected to emotions, haptic is the only two-way memory, audio is the only 360-degree experience. It would seem like we have dumbed-down experiences by only focusing on the visual. How can we find this methodology for all of these other senses?

A: Vision is big in terms of neurological processing space. It's not only about the amount of information that you can convey, because you can convey less in tactile than you can in vision. But there is the emphasis and significance that you place on it in terms of smell going directly to emotion and to memory. That presents a lot of opportunities to be exploited, and we don't. Part of the reason I think is that when I talk to these designers, a lot of the creation of these things is visual. The artifact usually, though not always, represents the tools that were used to make it. One way of addressing that might be to introduce other sensory inputs and outputs into the design process systems and into the creation process and into the inspiration aspect. The input will influence the output.

question is that regardless of the fact that it would be great for somebody who can't see, it has a lot of advantages for other people. That to me is key, if you can actually do something where you can convey the aesthetics—sonification, thermal, tactile, wind jets, vibration, haptic feedback, etc.—then what you've ended up doing is making it a multisensory exhibit in the first place. If you've done that, then someone who can't take advantage of the visual domain or someone with nerve damage who can't take advantage of the tactile domain can have access to other sensory experiences that make up for it. It then becomes a really

creative challenge for a content designer. For example, let's say you have five different dimensions of conveying that particular exhibit. If you have access to three or less of those domains, you still get a certain level of aesthetics out of it. It moves the challenge point from it being a technical problem back to it being a creative, very cool, and very open-ended point of view, which I think is fun to work on.

C: And then if you compose in one of those you could translate to the other senses.

Sina Bahram at the HCI+ISE pre-conference (see "Attachments")

Feeling Conflicted About Usability

(HCI+ISE)

Erika Kiessner
Interaction Designer, Aesthetec Studio, Toronto

My background in museums is mainly in prototyping, so the entire process of prototyping and interactive design and thinking about usability is something that comes up for me a lot. I am passionate about interfaces. I love looking at them, thinking about them, and thinking about what they mean. Lately, some of the rhetoric about designing exhibits and devices has started to move from interaction into experience, and I think experience is a fundamentally emotional thing.

Usability is a Process

Usability focuses on traits and responses. But it does not only affect intellectual responses. Interfaces make us feel something too.

Usability tends to focus mostly on the traits of the device and the responses that those traits elicit from the users. But that isn't really the complete picture of usability because interfaces don't only communicate how the thing functions, they also say something to you on an emotional level. So as we start to consider what the experience of a device or an exhibit is, we have to think as well about what emotions your interface is evoking and consequently, what impact usability is having on that.

I gave this some thought, and let's forget bad usability for the moment, let's start with the premise that we've got a device with an excellent, easy-to-use interface. I find that those devices leave me with three different feelings. First, they make me feel comfortable (which sounds really nice). They make me feel not-dumb. I have "smart" in parentheses here because I don't think they actually make you feel smart. This is more the absence of frustration with struggling over something. It is the opposite of that dumb feeling you get when something you're trying should work but doesn't. You're thinking, is it the object or is it me? Maybe I should have read the manual. Finally, really great objects and devices are ones that also give you a feeling of control. You have a sense of how you can use it and the knowledge that you can use it to do something.

I want to expand on these briefly. "Comfortable" covers three areas. The first is physical comfort and ergonomics, so it's not too short or too tall, it's not pointy or sharp or any of those things. It doesn't cause you anxiety. The device is robust enough so that you don't feel like you're going to break it at any second and

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Usability and Emotion

Good usability leads to feeling

- Comfortable

- Not dumb (smart?)

- In control

Erika Kiessner demonstrating
Exploring Sensors *during the Technology Showcase*

Photo: Ideum

Comfortable

The device is physically comfortable.

It does not cause anxiety.

Its design is appropriate for its users.

Not Dumb

But not quite smart either.

This is about communication:

- How well the device tells the user what it is and what it does.
- How well it tells the user how to act upon it.

In Control

The device gives you freedom and a sense of open-endedness.

Its functions and abilities do not have obvious limits.

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you don't have to feel uncomfortable using it. Finally, its design is appropriate, so if you're a high-end camera for real photographers you don't make it in primary colors like a Fisher-Price toy. Similarly, if you're designing an exhibit for a family audience you don't put scantily clad women on it. For me, this feeling of appropriateness is the final piece that is the trefoil that is "comfort" in usability.

"Not dumb" is really about communication, so this is how well the device tells you what it is and what it's for. It tells you how you can communicate back to it and how you can make it do the things that you want it to do. This is pretty fundamental interface stuff, and this is where interface gets a lot of attention.

The final one, "in control," is the most abstract and therefore often the most difficult to reach for. This is about a feeling of freedom when you are using an object, that it is not just for one thing, that if you have an idea about how to use the device you can do that, you don't knock up against the limitations of the device itself. I will show you some examples of this a little later. It is that the device itself does not have obvious limits, you are not constrained by it, and it enables you in that way.

Museums and Education

"Comfortable" is something we do really well.

"Not dumb" is where we spend a lot of our time.

"In control" has a bad history of being sacrificed.

From a museums and education point of view, comfort is something we do really, really well. We have plenty of experience making people feel comfortable in our spaces and comfortable using our devices. My experience as a prototyper has led me to believe that we spend most of our time in the "not dumb" area of usability, tweaking our design and focusing our design and making our designs work in that way, making sure they are communicating what we want, making sure people know how to use them. Because of that, I think "control" has a bad habit of getting lost. It is being sacrificed on the altar of simplicity.

Simplicity

One thing we do a lot of as prototypers is that we tend to strip things out. We start with a great idea and we want to show something in all of its splendor, so we create a device for this idea and we show it to people, and maybe they get stuck. We decide to reword a part so it's a bit clearer, and tidy that part up. Or a user may get caught up on part of the interface and we think, do we really need that function? Is this clear? Is this too many buttons? Do they know where the restart is? What if they get confused? Let's pull a little bit more out. If we can simplify this it will be more clear.

In that simplification process, as we are reediting and removing and taking the concept or principle we want to show and presenting it in the most perfect, clear, and beautiful light, we

are taking the burden of exploration and the burden of discovery away from our visitors. I'm not sure that they asked us to do that.

Moving away from that idea for a moment, I went online and looked at the attendee list for this conference and all of the museum-style institutions represented (so educational institutions and independents are off the hook). I went to the websites to see if I could find the mission statements. Below are some of the catch-phrases in the mission statements of the various institutions represented here. I pulled out what I thought were some of the most important words, so we've got things like inquiry, exploration, creativity, excitement, inspiration, passion, and critical thinking. There is one that I love that I think is from the

Museum of Science in Boston: "active citizenship." These are ostensibly the goals of our institutions, to make visitors feel this way. As museums, this is the emotional experience we want people to have when they come to our institutions and try out our stuff.

And these are the goals of usability: comfortable, not dumb, and in control, the worst represented of the emotional goals of usability. As I look at these two lists, and hopefully as you look at these two lists, we see that there is not very good alignment here. The question I pose to you is, are we letting usability get in the way of what we are really trying to do? As we simplify and make it easier for people to understand and make it easier for people to not get bogged down by all of those controls

How Do These Goals Line Up?

- Inquiry
- Explore
- Creativity
- Excitement
- Inspiration and passion
- Critical thinking
- Active citizenship

- Comfortable
- Not dumb

- In control

Our Goals

- spirit of inquiry
- passion for learning
- change lives through science and wonder
- promote active citizenship informed by the world of science
- appreciation of the importance and
- impact of science
- explore and develop their interests
- show richness and complexity
- spark scientific inquiry and creativity
- ignite a passion for lifelong learning
- advance the public understanding
- advancing knowledge and understanding
- advance the deep scientific understanding

- inspirational discovery
- inspire people to think creatively and critically
- convey excitement and understanding
- become an active explorer
- engage and inspire, entertain and inform
- dedicated to connecting people with nature
- encourage fresh ways of seeing, thinking, and engaging with the world delights, informs, and challenges
- improving the public's understanding of science and technology
- entertaining and participatory
- inspires a lifelong interest in science, math and technology

and buttons, as we take that type of freedom and control away from them, are we also taking all of these museum-related goals away from them?

But all is not lost. I want to show you some examples of exhibits that I think are successful. This is from the McWane Science Museum in Alabama. The turntable is a popular exhibit that we see in many museums. I think this is a great example of not having the interface get in the way and not having to strip too much out in order for it to work. It doesn't even have that many instructions. You can go and play with it in any way.

The process of experimentation with this turntable device is what makes the experience compelling, but one thing that's great about it is that you can fail constantly. Your disk can roll over or you can throw the ball too far or too fast and it just skitters off the table and nothing happens. We allow that to occur and I think it is great for that reason.

Another one that shows "in control" really well is an exhibit at the Science Museum of Minnesota. This is a shadow exhibit that lets you play with proportion. There are several different sizes of shadow dudes and a couple of different sizes of foxes that you can move around the space and try to act things out. It

Source: James Emery

McWane Science Center, Birmingham, Alabama

Source: Ryan Somma

Science Museum of Minnesota

doesn't constrain you to exploring ratios. If you wanted, you could make a stop motion shadow animation with your phone. There's nothing to prevent you from doing that because your interaction with it is totally unlimited.

I think these two exhibits offer great opportunities for exploration, inspiration, and passion in science.

One thing that I wasn't able to get a good example of, and because this is an HCI conference I think it is pretty relevant, was a digital experience in a museum. I haven't been to every museum and I am sure that they are out there, but I wasn't able to get one for this slideshow. Instead I want to talk a little bit

about *Minecraft*, which you have probably all heard of. It is a game, sort of, but it is so free-form as to be almost not a game anymore. I think it's open for debate whether it is educational. Aside from that, it has exploded in the last few years and schools are using it as well as extracurricular learning camps and parents. It is a game in which you collect resources and then make stuff out of those resources.

This is the starting screen. Down at the bottom right-hand corner is your fist. You start the game by punching the ground. That's how you get dirt and that's the first thing you can use to make stuff.

Then there is the crafting screen [*see sidebar*]. There is one thing the *Minecraft* designer did very differently than what happens in museums. He looked at the balance between making the users feel dumb and giving the users hints and an opportunity to explore. What he said was, "Well let's let them feel dumb for the first 20 minutes or so." What you see here is all you get. You've got your inventory down at the bottom and then you've got nine empty squares that you just stick stuff into and hope that it turns into something, and it might turn into something or it might not (I have played this game, and lots of stuff turns into nothing).

I think that if this were in a museum it would be full of instructions: Put the dirt here; try this many numbers there. There would be arrows and constraints and then concern that maybe there are too many materials and it will be confusing for visitors. In the interest of

Minecraft

making the user comfortable and making the device communicate well, that opportunity for exploration gets lost. Here is a designer who said, "Okay, let them feel dumb at first, but they'll thank me for it in the end." And I think that we do.

That brings us back to my real question: How much are we doing to let usability stand in our way?

QUESTIONS AND COMMENTS

Changing Expectations of Easiness in a Museum Setting

C: Regarding this question about games and usability and making things easy in a museum, one of the things we did at the Koshland was put a game in the museum. It's not a really complicated game, but it's a lot better if you play it for a while. Nobody reads

Minecraft
Crafting Screen
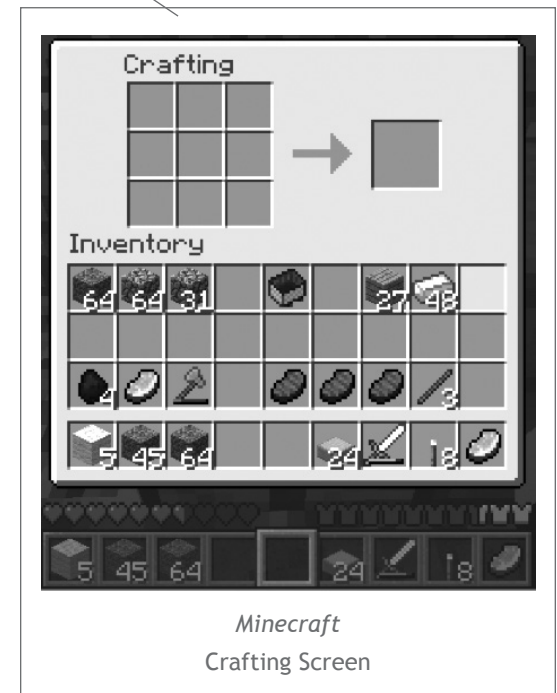
Q = Question

A = Answer or comment from speaker

C = Participant comment

Frustration and Ambiguity as Part of the Learning Experience

C: I appreciate what you had to say, especially around this concept of frustration. I had a fortune cookie once that said, "If you know what you're doing you're not learning anything." I started looking at my own life and at moments I was frustrated when I was learning something. The *Learning Science in Informal Environments* "bible" has six strands that we look at and say, "If people are experiencing excitement they are learning science." Frustration isn't on that list and may be worth thinking about in terms of what we create.

C: It's not about usability it's about ease of use being of no use, where frustration and ambiguity serve as learning tools. I think what is really important is to make frustration and ambiguity fun and intuitive. I think it goes back to senses. The more senses we use, the higher bandwidth our working memory is going, in that we make complexity intuitive instead of simple. I think that's the direction that we have to start defining.

the rules, and then people play it and some people kind of get it, and if you play it twice you get a lot more of the lessons, but people get really frustrated. I've found that when visitors see a digital screen in a museum there is an expectation that it is going to be pretty easy. When you have a game that has a learning curve in a museum, I've found from very early feedback that this is a setting in which they do not expect to be challenged digitally.

A: This is something I could talk about for hours. I think that museums make things too easy for visitors, so visitors come in with an expectation of what their experience is supposed to be like. I think we see average dwell times of 15 seconds at exhibits because we've taught people that it only takes 15 seconds to get it. It's not that you did something wrong by making it hard and giving a learning curve, it's that we've set this context that isn't forgiving of that. If we as institutions start moving towards the idea that you've got to learn something, you've got to figure something out before you can get anything back, then we can change the attitudes that people have when they come in.

Learning from Failure and Feedback

C: This makes me think about something I learned from trying to incorporate game play into exhibits, working with a group of people who were really inexperienced with

gaming. I realized that exhibit developers and designers and game designers approach user feedback very differently. Typically, when you are playing a game you are getting a lot more feedback as you go, and there is value in that feedback even if you are failing. That's something that you don't often see in exhibits.

Dwell Time, Fairness, Throughput

C: I'll answer a provocation with a provocation. I love complicated, open-ended, emerging experiences, but they take longer. How do we feel as an industry about allowing for longer dwell time, and one visitor or group of visitors monopolizing the experience? When you have this type of experience it is just going to take more time, and there is the throughput and the fairness side of that as well. They may be great experiences, but how do you balance that?

A: Fairness? Are we being fair to our visitors if we don't give them these kinds of great experiences? I've noticed that one of the ways we tend to measure the success of an exhibit is by how long people stay at that exhibit. We say, "People spend two minutes standing there playing with this, isn't that great?" As an industry I think we are ready for the longer experiences. If you're worried about throughput, that just means you need to design your space better.

C: If I sit at my computer I'm willing to spend

20 minutes to learn a new game or something like that. When I go to a museum, and I do this even though I'm in the industry, I want to see the whole museum. If I can't figure something out in two minutes I've got to go because I still have four more galleries to look at. I see people at the zoo going through the zoo almost like it's a checklist: saw the tiger, saw the leopard. Then they complain that the animals aren't doing anything, when they're only there for something like two seconds. I don't have coherent thoughts about this other than that I think you need to figure out a way to make it okay that you spend half your time in one room at the museum.

A: I think people accept that already. My first museum job was as on the floor at the Ontario Science Centre as a host. Sometimes I would get to talking with people about an exhibit for 45 minutes or an hour at a time. I would meet visitors who said, "Your museum is so great, but I spent most of my time doing X." I would see that as a success. If they are willing to spend two hours at one thing or even in one hall, I think that's great for us. Not only would the margin do better because they will come back more often to see the rest, but also it would mean that we are touching them in this deeper way. And they will remember those two hours much better than if they saw everything really quickly for ten seconds.

C: But they want to see "all the birds" Seb Chan was talking about.

A Museum Director's Perspective: Making it Easy to Come Visit

C: As a museum director, it has got to be "and." It's that, *and* this, *and* more people through the door. I like what you're saying because to me it's about respecting visitors and trusting their intelligence and their intuition and their smarts. I do worry about putting folks off at the door or before the door. For me, that part of the easiness and comfort is more interesting to worry about. Why won't they walk through our doors, why don't they know about us?

At each user interface, each exhibit, each exhibition, I say, yeah, make it hard, make it tough, plus a few easy, wonderful, beautiful things that someone wants to run to. But let's figure out how to get them to our place and how to get to where they are.

Learning: It's a Good Thing

C: Another comment that goes back to an earlier provocation relates to how we use the term "learning." I think we set up false divisions about learning and wonder and fun, and put the term "learning" in a box as if it's a bad thing. I would just point that out as something important to think about.

The Trouble with Objects

http://www.sciencemuseum.org.uk
dave.patten@sciencemuseum.org.uk

Dave Patten

Dave Patten
Head of New Media
Science Museum, London

When I was asked to give a presentation I looked at the challenges we are facing as a museum and my personal challenges around objects. I have spent the last fourteen years developing and building contemporary science exhibitions, and we have done a whole lot of work on contemporary science at The Science Museum in London.

We are now about to start work on a whole range of object-rich historical galleries. We want to think differently about our objects and this presents some challenges. We hope, ten years from now, to be able to provide some of

the answers to that challenge. We have been collecting stuff, as lots of museums have, for a long time. We have all sorts of random objects and you could make the argument that we have gotten better at explaining things over time. We make more attractive displays.

But we still have lots of these—vitrines full of objects with not very much interpretation. In

this case, there are some books and a minimal amount of interpretation in the showcases. And then there are things like this [*photo below*] where there is no interpretation at all. The interpretation is basically on a very small label that might tell you what something is, when it was made, and the inventory number, and that is all that we tell you about the object.

But every object has a story to tell, and we must find ways of telling more than one story

An object has stories to tell

in ways that are really difficult with traditional printed graphic panels. This is something I came across in Paris a couple of years ago. From a distance I could see there was some kind of weird stuff on the side of a bridge. It turns out they were padlocks and I went up to have a closer look. It's obvious that these are love tokens on which people write their names and then padlock onto the side of the bridge. I walked away from this wanting to learn more about the objects that I was seeing. Who were Lukas and Ines, and Daniela and Mario? Do they love each other? Do they love Italy? What is their story? There's nothing there and that's the problem we face with our objects.

We have lots of objects, too many to display. We have an airfield in the west of England where we have probably 92% or 93% of our collection in storage.

Too many objects?

We have loads of big stuff including airplanes, radio transmitters, nuclear missiles, submarines, and big printing presses.

Not enough objects

And we have lots of small stuff, including lots of prosthetic hands. This is just a small selection of them.

We have thousands of syringes, thousands of hands, and we never stop collecting, which is why we get to keep on building storage in which to keep all of these things. And the public never get to see these things, they never get to hear the stories that are embodied within these things. It is only when we do an exhibition that we go down and pick a few objects out and put them on public display.

We then have another interesting challenge: not enough objects. We cover subjects where there sometimes aren't any objects, particularly in contemporary science. This is a case in point, an exhibition about future energy scenarios where we looked at how we actually transition between a carbon-based and a hydrogen-based energy economy. We worked with artists to create a set of future-looking

objects that were designed around living in a hydrogen-based economy. Those objects don't exist because they're from the future, so we have to make objects.

Or there are exhibitions like this, which is an exhibition on climate change, where our collections aren't strong. This is about concepts, so it is a very interactive gallery and there aren't a lot of objects. We haven't really had to do a lot of object interpretation around these contemporary collections.

But we do have some fantastic historical objects and they can tell fascinating stories. This [below] is Stephenson's Rocket. This engine heralded the dawn of the railway age and it is full of stories. There are stories about the technical innovation, about Robert Stephenson, the man who invented and made this, about the social changes that the spread of the railways made happen, about the design, about the life of this, about why it looks so grubby

and old and worn. Traditional museum labels can tell just one story, so we have a small label that maybe has a hundred words on it that only tells you what it is, when it was made, when we acquired it, and the inventory number. If you want to find out any more about it you have to read a book or go to *Wikipedia*. We'd like to find ways of telling or bringing those stories alive.

What stories could I tell?

And we have some things that are really beautiful and not necessarily obvious.

What am I?
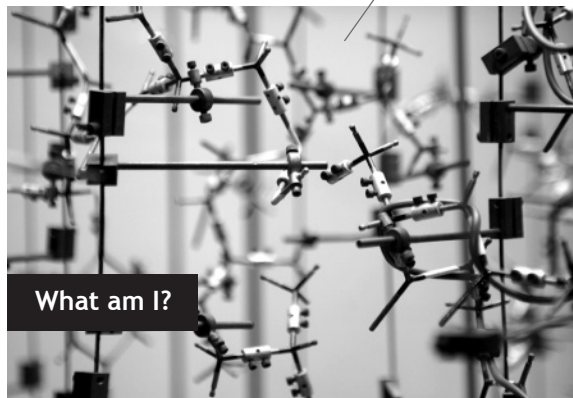
This is the original model that Crick and Watson made to show the structure of DNA. Again, it is not necessarily obvious when you walk into the museum how important this object is. It looks quite attractive, but for every one of these we have thousands of objects that are really dull and boring and not interesting to look at. They are grey computers, or engines where you can't actually see the mechanisms, so they're just cast iron cases. How do we bring those things to life?

We sometimes have fake things as well. Occasionally they slip through and we don't like to have this happen. This is the capsule that brought out the Chilean miners who were trapped underground a few years ago. We were really pleased when the Chilean government agreed to ship this over to put on display for about six weeks. We put it on display with some interpretation around it and not until the press launch, when the Chilean ambassador announced it, did we realize it was actually a fake. Lots of museums asked for this after the mine accident, so they made five and shipped them to museums around the world.

The fact that we didn't find out until it was already on the floor posed a challenge because the interpretation here, by and large, was all printed and had to be reprinted because we needed to tell people it was not the real capsule. We would have interpreted this in a really different way if we had known. We probably would have let people get inside it if we had known this wasn't the real object. The object

Is it real?

can still have real power to communicate but we must be truthful about it's status.

And then you have objects that are really personal and might not appeal to larger crowds. This isn't an object from our collection, this is one of my favorite objects in any museum, anywhere in the world. This is a sandwich board. Somebody physically put this on and advertised. This was worn by a man named Stanley Green, who walked up and down Oxford Street in the 1970s (when I was a teenager), the main shopping street in London. He did this for 27 years wearing this sandwich board, encouraging people to eat less protein because he thought that protein made you passionate and that we ought to be slightly less passionate. Every time you went to London there was Stanley Green, trying to sell his little pamphlet on why you shouldn't eat lots of protein.

I went to the Museum of London a couple of years ago after a major revamp and this appeared in the Museum of London. I was almost in tears because somebody had thought to collect this thing and it hadn't just been thrown in the skip when Stanley died, which was astonishing.

Audiences

All of our audiences want different things from our collections. We have lots of school children who visit, we have lots of families who visit with young children, we have lots of independent adults who visit, and we have experts in particular fields who want to visit and use our collections. How can we use digital technolo-

gies to unlock the stories in objects for all of those different groups of people?

We also want to tell some really different stories. This is the Apollo 10 space capsule, the capsule that went around the moon on a final reconnaissance before the moon landing. It's at the end of an exhibition space that looks at the iconic science and technology changes from the Industrial Revolution to the year 2000. This object is obviously really important in terms of engineering and technology, but what you are seeing in front of this is something different.
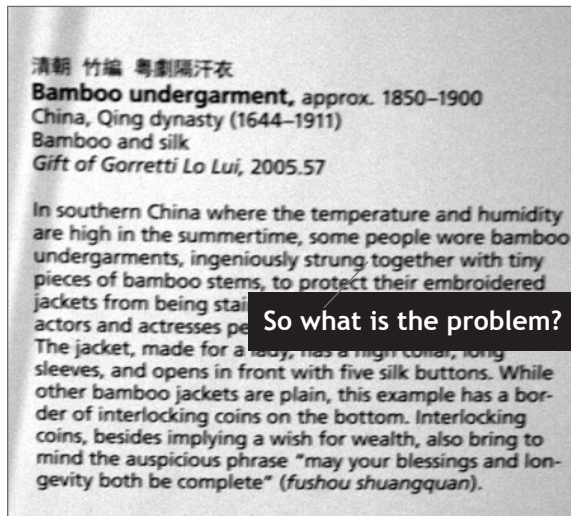

Different stories

It is part of a series of programs that we are doing around climate change. Our museum is built of things that led to the climate being where it is now. It is full of those big power

engines and gas guzzlers. We built an exhibition on climate change but knew that lots of people wouldn't go there, so we wanted to create interventions across the museum. Some are physical interventions and some, like this, are artistic interventions.

In this, you get to dress up as a cockroach and wander around the museum, looking at our collections through the eyes of a cockroach. They were here on the planet before people, and when we've killed ourselves and are no longer on the planet the cockroaches are still going to be there. Dressed as a cockroach, you take this trip through the museum looking at these mad human beings from the point of view of the cockroach. It's a great tour to participate in and a great bit of theater for other people visiting the museum that aren't part of this tour.

清朝 竹編 粵劇隔汗衣
Bamboo undergarment, approx. 1850–1900
China, Qing dynasty (1644–1911)
Bamboo and silk
Gift of Gorretti Lo Lui, 2005.57

In southern China where the temperature and humidity are high in the summertime, some people wore bamboo undergarments, ingeniously strung together with tiny pieces of bamboo stems, to protect their embroidered jackets from being stai_ **So what is the problem?** actors and actresses pe
The jacket, made for a lady, has a high collar, long sleeves, and opens in front with five silk buttons. While other bamboo jackets are plain, this example has a border of interlocking coins on the bottom. Interlocking coins, besides implying a wish for wealth, also bring to mind the auspicious phrase "may your blessings and longevity both be complete" (*fushou shuangquan*).

I guess the problem really isn't the objects, the objects are great. The problem may be

around how we label the objects and how we tell stories. We spent a long time refining the art of label writing. It is interesting to look back at a history of The Science Museum, written in the 1920s. They were having the exact same discussions we are having about labels now. How do you keep them short? How do write them in a language that is appropriate for the ordinary visitor, not for the expert? What do you say on a label? How do you not overload people with content?

We have done various things over the last years looking at how we can augment or use digital technologies to supplement or replace some of those labels. We have done things like embed screens in traditional graphic panels. This is a large old pumping engine in our main hall. There is some traditional printed graphic material, and then there is a screen that allows you to find out how the engine works. There are animations actually showing how the engine works, and there is more information on how the engine was used, where it was made, who the inventor was, why it is in the collection, why it is significant, and why we picked this one and not another engine.

Other museums have also done work looking at how you inter-

science museum | Welcome to the Energy Hall

Atmospheric engine by Francis Thompson, 1791

the screen to find out more
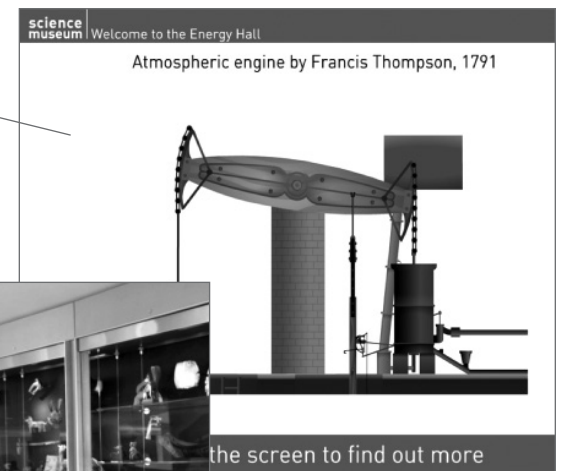
pret dense object collections. This is from the Smithsonian's National Museum of the American Indian. Again you see large vitrines of objects, and there are some touchscreens in front of them that let you visually identify the object and then mine down and get some more information about it. There is probably the information you would get on a traditional label, but the technology allows you to say more than you could on a small caption you would have on an object in a display this densely packed.

We looked at things like this and thought we'd try our own experiment, so we built a small exhibition where we did exactly the same. We had a graphic representation of everything that was in a large vitrine, situated right in front of the vitrine. We didn't put any traditional labeling inside the vitrine because we wanted to encourage people to use the electronic interpretation to see whether we could deliver more content.

The results were really interesting. People would go to the exhibition and either look at the screen and not at the things in the showcases at all, or they would look at the showcases and find no interpretation and then moan like mad because they couldn't find out anything about the stuff that's in there. Even if you put prompts on the object saying, "The interpretation is on the screen that is behind you," and you put prompts on the screen that say, "Please look up, the thing we are talking about is right in front of you," most people don't do it. It is a real challenge.

We looked at QR-coding exhibits and for us that is still not the way to go. Most people don't have QR-code applications on their phones, so we are not really doing more of that at the present time.

We are looking at more innovative ways of bringing objects to life. We've looked at things like this, where projected shadows are used to tell stories around an object. This is a kind

of nonvocal interpretation and might show you how something worked or how something was used. We've done a little bit of this as have some other people.

We are doing work at the moment on transparent touchscreens, partly to get around this problem of people either looking at the screen or looking at the object. We are building showcases where the front of the showcases are a transparent touchscreen, so you are looking through that layer of content at the object.

It lets you do some quite interesting things [*lower left*]. You always see the object, but if we choose to let you, we can shutter that down so that we can hide the object from you and just let you have the interpretation. If we are talking about a particular aspect of the object, we can close down the view through the window so that you just see the particular thing we are talking about. We have also played with a level of gamification of those objects, so for some audiences you can do, "Can you guess what this object is?" Then you can do a gradual reveal to draw people into the objects and draw people into the content that way.

We have also looked at projection mapping onto large objects. This is a test we are doing for a large radio transmitter from the early to mid 1940s. We projection-map what is inside and how it works and the flow of information through the object. It is not that difficult to do, but as with the transparent touchscreens there are some major issues. Our conservation people had some qualms in the past about throwing high levels of light on delicate objects. The key to making the transparent touchscreens work is really tight control of lighting, and again we have to be quite careful about what objects we light and what light sources we use to comply with the conservation regulations we have in the museum.

This [*below*] might worry them even more. We have started work that involves making the object part of the interpretation, so we are

Sound

using a combination of a working real object and a projection overlay on that object. We are using the object itself to enable visitors to understand how it works. We are building some prototypes at the moment for an exhibition we are opening at the end of next year.

There are a few other things we have been looking at. One is the use of sound. We have steered away from the use of sound at our museum because we are a big, very open, very echoey museum, and the use of sound is very challenging. We have begun to look at it less to interpret individual objects and more in terms of bringing an exhibition space as a whole to life.

This was a small exhibition we did on the technology that came out of the Formula 1® industry that has found its way into unusual applications. We used an audio sound track to weave a story around that exhibition and weave that "Formula 1-ness" into that exhibition. That was very popular and actually made people think very differently about that content.

We are also very interested in the use of smell in museums. It is really evocative. A couple

Smell

of years ago we brought a ton of coal into the museum for an exhibition and for about four days after we brought it into the museum, the museum smelt of coal dust. You can absolutely tell people's ages by whether they recognize the smell and find it kind of homey, or whether they walk around holding their noses. It really made people emotionally connect with the museum in a way that is hard to achieve using traditional media.

We are also increasingly thinking about what we actually collect as we look at how we push this interpretation that isn't traditional media. It isn't sufficient to just collect the objects any more. We have an exhibition on communication which opens next year, and we sent a small curatorial team out to Cameroon to collect artifacts around mobile phones in Africa.

What should we collect?


Photos ©Sjoerd Epe Sijsma

Photo ©Sjoerd Epe Siisma

We bought a mobile phone shop, the little shack shown here. We did loads of interviewing with the people, so we generated lots of film, lots of audio clips, and lots of interviews. We also bought a lot of other artifacts, including the tools they use and examples of the mobile phones, so it was not just that shack but a range of other things. When we put it all on display in the museum, it allowed us to bring that to life.

The last thing I want to touch on is a project I have spent the last couple of years working on.
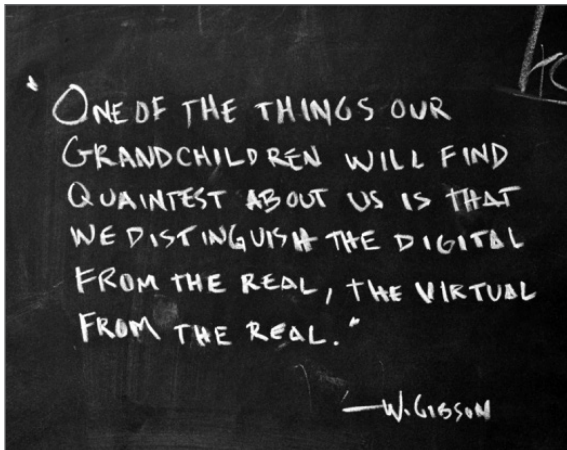
I spent the last two years working with Google on an exhibition called *Google Web Lab*, an exhibition which is physically in the museum but available from anywhere online. When you access the exhibition online it's not like a traditional website. You physically interact with the devices that are in the museum. For example, you play musical instruments that are located in the museum, and we live-stream everything out from the exhibition space.

It has been very successful and it works because it is interactive, but what we are thinking about and looking at now is how to take what we have learned about opening an exhibition up to a global audience and apply that to more object-based exhibitions. What can we do that goes beyond websites? Is it having curatorial tours someone to actually direct a curator with a video camera around an exhibition space and have a virtual exploration with a real guide, true to giving people some more physical, tactile experience with things that are in that exhibition space?

> **The future is always just around the corner**
> We could wait for the next big thing,
> - but that will probably mean waiting forever,
> - so experiment, play, implement and learn.

I want to leave you with my provocations regarding this. We could always wait around for the technology to sort itself out, and wait

for the next big thing, and we often say that's what we are doing internally in this field. If we do that we could wait forever. We try and play and experiment and learn all the time. We accept that the technology is not ready all the time, but in a sense it is never ready, so we test and build things often and the things that work we put into practice. We don't wait around for the major technological changes, that doesn't work for us.

My challenge to you are outlined here. How do we stop the overuse of screens in museums? It would be really easy, particularly for us as a science museum, to fill the museum up with touchscreens. It would be an awful experience for the visitor. So what other technologies can we use?

How can everyone who wants one have a personalized curatorial experience in the museum? The best experience you can probably get from a museum is to walk around with a really knowledgeable curator who can tell you all of those stories that don't make it into the exhibitions, stories that are usually funny and also slightly bizarre. How can we give people an approximation of that, and how can we use digital media to do that?

How do we structure all of this content? If we start to tell lots of different stories about objects, how do we structure all of that content, and how do we give people ways to navigate around that content and find the elements of content they might be interested in? At the same time, how do we not destroy that seren-

dipity that you have in a museum, where you think you've gone to look at one thing and you see something across the room and go to look at something else?

I also have a list of provocations for you.

Some Provocations

What should we collect?

Are multiple narratives worth the effort?

Are museums best placed to write these?

Make other peoples stories available.

Visitor challenges of allowing the above.

What should we collect going into the future as we want to tell these diverse stories? What do we need to collect beyond the objects? If we build these multiple narratives, is it really worth the effort and are museum professionals the best people to write these narratives, or do we need to open up and allow other people into our museums to write those stories? Do they need to live on museum real estate and be on museum servers?

If we do that, there is a challenge for the visitors. If we are writing stories about those objects, and other people are as well, how do you know which ones you can trust? Do you trust them all? Are they all the same? I could go into a natural history museum and turn it into a museum of creationism. Would I be comfort-

My challenges to you are:

How do we stop the overuse of screens?

What other technologies could we use?

How can everyone (who wants one) have a personal curated experience?

How do we structure the content?

How do we gather and share stories?

How do we help visitors find and navigate the stories they want to hear?

able with that if I worked in a natural history museum? Probably not, but we can't stop that, it is going to get more and more common. As we open our museums up to multiple voices and multiple narratives, there are some things we need to be aware of and think about regarding how we are going to deal with this in the future.

QUESTIONS AND COMMENTS

Sorting Through Other Voices
(e.g., a creationist tour of the museum)

C: Regarding your last example, the speculation regarding a creationist tour of a natural history museum, I've actually daydreamed about that a lot as a means of understanding something that, frankly, I don't understand. That is like one of the golden eggs of audio tours. The challenge is whether the visitor understands that there are lots of different kinds of expertise, and you have to trust your own intelligence and your own intuition and understand what you're getting into. Which may be where the challenge is, more so than trying to get a creationist to come in and discuss what these dinosaur bones really are.

C: A quick search reveals that there are a number of creationist tours of natural history museums online. They are independent of the website of the institution.

C: Does anybody know if there's an evolution tour of the Creation Museum?

C: The Creation Museum is building a theme park because their attendance keeps dropping. They need a new model—theirs is a losing model in Darwinian terms (it's survival of the fittest).

## Being Alert to Implications and Effects of Technology We Introduce

A: For me it is more about the idea that technology is opening up all sorts of possibilities to us, and sometimes we sleepwalk towards that future without really considering the things we might be doing. In a conversation last night I expressed some concerns about how the use of mobile phones in an exhibit might make the museum a more insular experience. You're visiting with your mobile phone and not with the people accompanying you. That may or may not happen, but if we are not talking about that and thinking about the consequences if that did happen, and designing things to make it less likely that it will happen, we could suddenly wake up in five years' time and find that the social aspect of a museum visit has disappeared. And it has disappeared because we weren't thinking about this thing that we are introducing.

C: If we could stop that problem here this week, that would be an amazing thing.

Q = Question
A = Answer or comment from speaker
C = Participant comment

What About Alone Time in the Museum?

C: Speaking as a devil's advocate, the museum is a place where you can be alone, and if there is going to be a backlash to what we are moving into it is going to be when people realize they are losing the ability to be alone. It is not a loss of loneliness but a loss of aloneness, there is a distinction there. We also want the museum to be a place where you can go to be alone.

A: We are really fortunate in that we are a massive museum. If we could get everybody spread out evenly around the museum it would be great, but actually everybody who visits wants to be in the same place, so there are lots of places you can go and be quiet and alone and contemplate bits of the collection.

To see a video of the Cockroach Tour:
**www.sciencemuseum.org.uk/
cockroachtour**
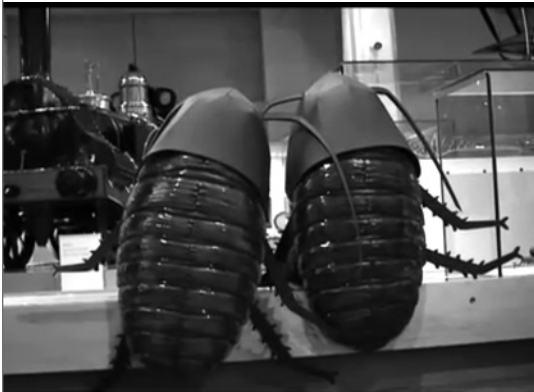
Dressed as a cockroach, you look at the madness of human beings. Why are they doing things that are so inefficient? Why are they digging up fossil fuels and burning fossil fuels? Why are they doing these things that are changing the planet? It seems completely mad and it's taking that really sideways kind of view to look at the content in the museum. An actor leads the tour and there are 12 people dressed as cockroaches going through the museum. Other visitors just stop and can't believe it's happening. • **Dave Patten**

More About the Cockroach Tour

Q: Speaking of custom and insular tours, I am curious about the Cockroach Tour. Was there custom content delivered to the person in the cockroach suit, or was it just the experience of being in a cockroach suit?

A: It is custom content. As part of that climate change program, we put a call out to performance artists to develop a performance across the ground floor of the museum and engage with the collections and the impact they have had on our climate. We got a number of proposals back, and that was certainly the maddest. We thought it was great but weren't sure that anyone at our directorial level would buy this, but when we showed it to them they said, "Yes, we've got to do this." We got funding to do it for a year. It is sold out every time we run it, and we have the funding now for another couple of years.

C: I like it. It's not as diametrically opposed as creation versus natural history, but it's very subversive.

Augmented Reality

Q: Can you talk a little about the augmented reality project you did with Mr. James May?

A: This is a commercial product. A commercial company approached the museum to build an augmented reality application, which pops up a well-known television presenter, BBC host James May, when you are looking at an object and he tells you about the object. It's not a bad app, my frustration with it is that it only deals with ten objects in the museum, so it only has a very small amount of content.

When the company approached the museum, which was done through our commercial wing, they said, "We can use the camera on the phone to recognize the objects. You don't need to do anything in the space." About a month before it was due to launch they decided they really couldn't recognize the objects. These are big, three-dimensional objects with lots of people around them. They needed to put some kind of QR coding in, so we then had to do a last-minute graphic intervention in the exhibition. There are no high structures, so the QR codes are pretty low and you have to hold your phone down to read the code and it's a pretty uncomfortable experience.

It's not in itself bad, it's just the implementation wasn't great on it. It doesn't use QR codes well either. It's a single QR code, so it's using the QR code as a marker to pop up a video on your phone. It really confused me the first time I was using it. I looked at one object and James May told me a story. Then I walked to the next object and James May told me a story about the object that I'd just seen previously because I didn't press the button to say I wanted this object, not that one. So it was a mixed experience.

Projection Mapping onto Objects

Q: Of the many intriguing things you showed, one of the more intriguing ones for me was the projection onto the object. Can you say a little more about that, about why you decided to do that with that object, what other objects you're thinking about, and what technology you use to do that?

A: It's a fairly common technique using projection-mapping software. It allows us to do all sorts of things. You can show how an object works and reveal the internals of an object. The first thing I did a few years ago when we were experimenting with this was an exhibition on RJ Mitchell, who was the designer of the Spitfire. We got a deconstructed Spitfire and tried some experiments with projection-mapping onto the wings to show fuel flow from the tanks in the wings and the gun mechanisms, and how they are fired on the wings. It looked pretty good, but our conservation people had a real freak and wouldn't let us do it because they were worried about us projecting onto an object. It was done last-minute and we did it as a test, it didn't make it onto the floor.

For the Communications Gallery next year we are looking at some big objects that are interesting to look at, but it's not at all obvious what they do, what's inside them, or how they work. Overlaying content directly on that object allows you to interpret without having the visitor look through a screen. And again, these objects are big. The radio

transmitter is probably 3.5 x 3 meters, by a couple of meters deep. They are not tiny things, so you can't put a screen in front of them and stand back. You've got to do something else if you want to cover the whole object.

C: That was an airplane that the conservators wouldn't allow you to project on? There's something wrong with that picture.

A: Absolutely, and we didn't have the argument that we should have had at that point. We've been through it with them on lots of levels, and they are much more comfortable with that now.

Combining Projection Mapping with Working Objects

Q: You also talked about a hybrid approach using projection mapping.

A: That is projection mapping with working objects. The example I used was this, which is a crystal radio.

We can make this work and you can tune the radio and hear something. This is from what we call the "handling collection," so it is not part of the core collection and visitors are allowed to manipulate it, but it's not obvious what is happening. So it is a combination of being able to play with how it works (and because it is audio it is delivering messaging to you) and projection mapping over the top of that to show what is actually happening: What is the electrical circuit, what is the cat's whisker that's at the top, and how does that actually work? It allows you to do that, so you can play and get a deeper understanding of what the mechanism is that makes this work.

Q: That's a little like the ARIEL work [*see "Attachments" section of this document*].

A: Absolutely. I was really excited by the ARIEL work.

Provoked:
Responses, Reflections, Discussion
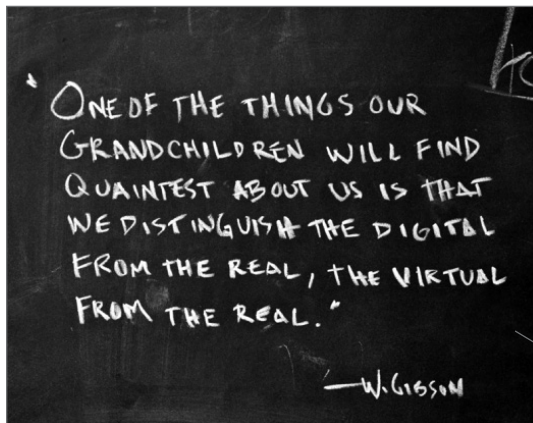
THOUGHTS ABOUT HCI

A Focus on the "Why"

• What I like is that everyone is talking about why we are interfacing human beings with computers as opposed to how, and the fact that each perspective is different.
   • **Christopher Stapleton,** Creative Venture Catalyst, Simiosys

It's Really HDI
Human-Database Interaction

• I know "database" sounds like a bad word, but a lot of this is human-database interaction. Maybe we ought to get over the idea that "database" is a bad word. Museums are, in fact, a kind of manifestation of a database, or a manifestation of our knowledge base. We are saying "computer interaction," but the computer is really the medium by which we interact with the database.
   • **Jason Stevens,** Principal and Exhibit Designer, Flutter & Wow Museum Projects

The Inseparability of
the Digital from the Real

• Something I hadn't thought about and found interesting was the quote Dave Patten

shared in his presentation, which highlighted the fact that the quaintest thing our grandchildren will think about us is that we considered these things separate.   • **Beck Tench,** Director for Innovation and Digital Engagement, Museum of Life and Science

• Internally in my institution, talking about the digital is the thing that holds us back the most when we separate the digital into something separate. That is now a really big drawback for us.   • **Dave Patten,** Head of New Media, Science Museum, London

• Building on that, Dave made the point that using mobile devices separates us from the social. I just wondered whether your definition of "social" marked you as someone of a certain age, when actually a younger generation couldn't imagine social interaction without those devices.   • **Wayne LaBar,** Principal, ALCHEMY studio

Human-Information Interaction

• The question was, is it good to call it "human-computer interaction"? It seems the main struggles here are about human-information interaction, with the computer just being the venue for that. The tension I see is

that if the information and interpretation is changeable, then what is the museum providing? Is it just a warehouse where people can go and see things? Is everyone seeing a different reality? What is the museum's role in the light of that new ability that everyone has, which is to see this information in new and radical ways and add to that information? That is becoming important in a way that it never was before. Maybe in the future the human-computer interaction will encompass artificial intelligence. "Human-computer interaction" is a way to state it, but it seems that in this case, with a conference in 2013, the struggle is getting the right information to the right person in the right place at the right time with this stuff.
• **Robert Ketner**, Curator, Independent

It's About New User Interfaces

• I would like to throw out the idea that, with the palette of choices that we looked at today, it's more about natural user interfaces than human-computer interaction. It's about how we are interacting with these digital environments or the new devices and opportunities that we have. I'm also finding it fascinating that with you science people here, it is a science fiction author that you are quoting. • **Mike Mouw**, Media and Technology Consultant, Gamut Interactions

The Virtual Pushing Back Out at Us

• Regarding this question about what HCI is, I'd like to summarize it differently. The first 40 to 50 years of computing was about us trying to push into a virtual world that's on the other side of the piece of glass in front of us. When we look at HCI, and probably at the next 30 or 40 years, it's the reverse of that. To me, HCI is the virtual world pushing back out at this real world, and whatever things that give that virtual world the ability to sense the physical world and experience and allow us to interact with it in our space, rather than go into the virtual space.

So at the end of the day it's not necessarily the individual techniques I use or how I do it. I think in terms of the verbs relating to the interactions I want to have. Let's say I want to share something with Seb. That may be a physical thing that I want to give. Then I need to make sure that physical thing allows the sorts of intersections with the virtual world that represent the real world. That is the foundation and basis of how I think about HCI. • **Bruce Wyman**, Principal, USD Design | Mach Consulting

• I think you've highlighted something that is the underlying premise of this entire conference, and something I'm not sure we all get. Could somebody else say it in a different way? This is an important issue. • **Kathleen McLean**, Principal, Independent Exhibitions

Museum Focus on the Humanistic Side

• I think everything we saw today was definitely HCI. Touchscreens are HCI. I think the big challenge for museums is that we are one of the places that helps society keep its culture. It's the humanistic side, not where technology is used for much more utilitarian or promotional or marketing purposes, and that is often what drives a lot of these technologies. I think the onus is on us, and I don't think it's an easy task, to figure out whether these technologies are isolating or not and to play with them creatively and thoughtfully so that what comes out are things that actually do help people have more interesting and deeper cultural and educational experiences. We should be asking whether our work is going in that direction or not and keep retuning to that. • **Bill Meyer**, Director of New Media, Exploratorium

Perceptual Computing

• We haven't talked about perceptual computing. The Xbox One includes facial recognition. Perceptual computing can recognize anger and smiles. How will exhibits be changed dynamically based on the reaction of the person in front of them? That interface is going to be in our living rooms by the end of the year.
 • **Dan McCulley,** Business Analyst, Intel

• It will also read fingers, like Leap Motion, so it will be a pretty amazing toy.
 • **Participant**

Future Thinking

• I was talking to Peter Samis about what it is going to be like for SFMOMA when they reopen in three years. We talked about the fact that probably much larger displays and display walls will be far cheaper. In terms of this idea of waiting on conversation until things move from drawing boards into reality, that's a little bit of a trap. Obviously when we're making stuff now, we have to deal with current affordances and what the technology is today, but I think in this type of group it is really important to think forward to what this is going to look like five years from now, about interactions in a world where there are big displays on walls everywhere and your mobile devices know who you are, precisely where you are indoors or out, and what you've been doing. Walls and exhibits will communicate seamlessly with those devices, and interact based on that information. That is the world we are moving into. • **Bill Meyer,** Director of New Media, Exploratorium

• What I think Bruce captured, which I got excited about during these first sessions, was that the preliminary stages and development of HCI kind of went internal and focused on what the digital world looked like. Now we are looking at how that digital world can roll back out and reconnect with the real world so that it begins to transform and influence and engage and become a part of our reality.
 • **Suzanne Pierce**, Research Assistant Professor, Assistant Director, The University of Texas at Austin

• The last few years we were reaching into the incubator and playing with the baby, and now the baby has emerged from the incubator and is walking around our space. • **Bruce Wyman**, Principal, USD Design | Mach Consulting

• It reminds me of that Gibson quote Dave Patten introduced in his presentation—the idea that there is still this separation in the way we think about the real and the digital, the virtual. • **Jim Spadaccini**, Creative Director, Ideum; Principal Investigator, Open Exhibits

• I think we did spend a lot of time dealing with how to improve things in computing, whether it was usability, including different groups of users, connectivity, or whatever the case may be. What is interesting about the late 1990s into this millennium would be that you actually start realizing that computers can help you in the real world. It's a virtual construct, but it has a lot of ability to help you in the real world, whether it's as simple as a GPS device that talks to you or a more complicated piece of assistive technology, like hearing aids or what have you.
 • **Sina Bahram**, Accessibility Researcher and Ph.D. candidate, North Carolina State University Knowledge Discovery Lab

Two Vectors, Fundamentally Different Experiences

• I feel like there are two vectors, two directions going on here. One is the intimate and personal, the very granular, the invisible, and the ubiquitous, which is what Bruce Wyman was evoking. Then there is the other, larger dimension, working at scale in a spatial environment, and what happens when you have a bunch of people looking at a mass of data, whether it's the *Collection Wall* at Cleveland or some other large-scale interactive social environment. I think these are the two arrows we want to be following in some way. We don't know enough about either of these or have enough examples of either of these to know how people behave. It's not the same working in mobile, working with a kiosk, working with a website, and working with a collection wall. They are fundamentally different experiences.

What I would like to hear is five different scenarios of what that kind of spatialization and socialization of mass data is good for. What makes the technology worth the candle, in a sense? What kind of stories and

scenarios can we create that are actually compelling cases that can then get disseminated out into the more granular intimacy of our own personal ubiquitous relations? And how do we then take these group interactions produced at large scale, and integrate them into our more intimate, personal interactions—into the world where computing becomes invisible, subliminal, and ever-present? • **Peter Samis,** Associate Curator of Interpretive Media, San Francisco Museum of Modern Art

ISSUES AND QUESTIONS

Visitors and Their Devices

• Whether the devices visitors bring really are a barrier, or whether they are something that is going to enhance the experience is a question that is really irrelevant. It is what the visitor is going to bring unless we are willing to say, "Check those devices at the door." That's what comes with the visitor, and that is just the first wave of all of the new technology that visitors are going to come with, whether it's Google Glass, or if Apple ever releases a watch, or whatever. This is just the beginning of that.

However, it does bring up that question. Looking at a place like Explora, which has very low-tech experiences, do those devices enhance that or would it be better to have

visitors check their devices in a cubbyhole before entering a tech-free zone? Maybe that wouldn't be so bad. • **Jim Spadaccini,** Creative Director, Ideum; Principal Investigator, Open Exhibits

Interactive versus Reactive

• This might sound a bit pedantic, though I hope not. Having been an interaction designer for the past twelve years or so working with museums, quite often I feel what I am being asked to design is a reactive system versus something that is actually interactive. It's worth making a distinction between those things. When I say "reactive" I mean that there is some content to push, and the reactive experience is one where you push a button and something happens as a response, and you get it back. Whereas an interactive experience is one that is actually listening to me and is processing what I am doing and is modulating the response in accord with how I respond to it. So an interactive system to me feels like something that actually evolves as I engage with it over time. It is something more generative than simple push buttons. • **Graham Plumb,** Creative Director, Snibbe Interactive

• I have heard more than one person change the semantics there, making "interactive" what you are calling "reactive," and calling "participatory" what you are calling "inter-

Digital Layers:
A mobile phone snaps a shot of Paul Marty demonstrating Habitat Tracker

active." I have adopted that because other professionals have. It's all semantics, but the point stands. • **Jason Stevens,** Principal and Exhibit Designer, Flutter & Wow Museum Projects

Abdicating Control

• Something that has been a through-line in a lot of the conversations that I am having is abdicating control and breaking down who is the authority and who is the voice. I don't know if that is because a lot of us are interested in exploring education and learning in connection to our collections, so we are willing to give up control and let other people tell stories about our objects and do citizen science and participate in meaning making, or whether we are assuming that technology is going in that direction.

I'm not really sure if a lot of the conversations about abdicating control and abdicating a single, didactic voice in the museum are because we are talking about technology, or we see technology as a way to do something that we are already trying to do.
• **Allison Price,** Director of Education, Lincoln Park Zoo

• One thing that is interesting is that it is social media that paved the way for

that. I think in a lot of museums it was easy to say, "We'll create a web department and they can deal with all of the visitor voices." Now the chickens are coming home to roost and you have to figure out how you are going to deal with that on the museum floor. For a lot of museum practitioners that is a very troubling development. Where it was easier to deal with that and push it off to the side, now it is something that is sort of inherent in visitor expectations as they are coming through the door. They are expecting that level of participation. • **Jim Spadaccini**, Creative Director, Ideum; Principal Investigator, Open Exhibits

How Sophisticated Is an Average User?

• Regarding expectations, for the past several years I have started all of my classes with the same exercise. I pass out slips of paper to all of my students and ask them to write their name and the name of their favorite web browser. I collect all of the slips of paper and sort them by value and say, "You are the Chrome group and you are the Firefox group," and everybody has a big laugh over this.

Then I show them the video that Google produced about three years ago (http://www.youtube.com/watch?v=o4MwTvtyrUQ) called *What Is a Browser?* It is introducing Chrome, and the video has a man on the street in Times Square. Nine out of ten people they stopped on the streets of New York could

Graham Plumb demonstrates two apps for Leap to Peter Samis and Paul Marty

not name a web browser, let alone tell them which one they were using. I show this to the students as a way of showing them the great diversity between their university class, where it is second nature to them to know what a browser is, and users who can't tell you what a browser is. However, this doesn't stop those users from going online, working with the content, having very strong expectations about what they want, and being very upset if it's not there.

I think one of the challenges we have is how we live this double life, where behind the scenes we have to be very sophisticated about the technology we use and at the same time we have to make things as seamless and transparent as possible for end users who really have no idea what a web browser is. • **Paul Marty,** Associate Professor, Florida State University

• That maps with an experience this morning in the van taking us to this conference. The driver asked what the conference was about and I told him human-computer interaction. He burst out laughing and said, "I have no idea what that is about." He told us how he never used a computer and then started talking about what he really loves, which is music, and all of the digital equipment that he bought to collect and sort his music. He thought he was clueless but in fact he was a major user, though he didn't articulate it in the way we would. • **Kathleen McLean**, Principal, Independent Exhibitions

• A lot of our discussion is really about the more traditional version of the computer and the technology. It would be interesting for us to have a discussion starting from the point of view of the man on the street and see if we wouldn't explore the subjects differently from a different viewpoint. • **Wayne LaBar,** Principal, ALCHEMY studio

• I always get very uncomfortable with the man-on-the-street thing. Something that museum professionals have a problem with is thinking that our visitors are dumber than they actually are. That Google video really set them up to look much stupider than they are. They don't know which web browser they're using or what one is, which may sound absurd, but if they know how to use it they have a sophisticated understanding, they just aren't using the same language we are.

I think about usability a lot and one of the problems with assessing usability is that we speak a different language than our visitors do. It makes them seem dumber to us, and it makes us give them less credit than they deserve. • **Erika Kiessner**, Interaction Designer, Aesthetec Studio, Toronto

• I didn't mean it that way, but instead of us thinking about it from a sophistication level of touch tables, etc., we could start a whole discussion about Xbox One and how we're going to use that. Millions of people are

Joe Hastings and Karen Elinich trying the Open Exhibits Collection Viewer

about to buy these things off the shelves.
• **Wayne LaBar**

Avoiding Technolust

• This is not a new challenge. You have a lot of tools in your toolbox and you see things and ideas that are cool and sexy and you want to try them. But we need to remain agnostic about what we are going to use. We want to really focus on what we want to do or what kind of experience we want to create for the visitors. It's hard to do—I fall in love with things too. We need to stay focused on the experience that we want to produce and not fall in love too much with the technology. • **Daniel Davis**, Media Producer, Smithsonian National Museum of the American Indian

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Postable Take-Away Ideas and Thoughts on Provoking Visitors

• When I am thinking about exhibits and designing new things, I keep a list in front of me to make sure I'm thinking about certain key things. So whenever I go to a conference or a meeting like this, I capture key ideas. I'm going to read some of these ideas that will probably go onto my wall at least temporarily, and some of them will stay up for a while.

- Having all the birds is great, and it's up to us to explain to our visitors why that's great, or the great things about "all the birds."

- Databases do suck, but giving our visitors control over databases somehow (and over the science that they're perusing) doesn't suck.

- Designing exhibits for people who are vision impaired or deaf isn't the way we want to design exhibits. We want to design exhibits for all the senses when possible because that makes better exhibits for everybody, not just for smaller groups of visitors.

- Regarding the tension between simplicity and challenging our visitors that Erika Kiessner

was talking about, there's a fine line between frustrating our visitors and challenging them. Prototyping is how we make sure we're not on the wrong side of that line.

Then there is something I ran across the other day, Tilden's principles of interpretation. Some of the more academic people probably know what that is. One of the lines in there is about the idea that interpretation is not about disseminating facts to our visitors, it's about provocation. What everybody was talking about during the presentations was provocations, including what we collect and whose stories we are telling. I think when we provoke our visitors we help them understand that the story we're telling as a museum has other interpretations, and the visitor has control over those interpretations. That's what provocation is and what interpretation is. • **Erik Lizee**, Director of Exhibit Design and Development, McWane Science Center & Aquarium

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INTRIGUING/PROMISING HCI

HCI with Antique Objects

• I think the last thing Dave Patten showed, the working object with the projection overlay, is a really interesting example of HCI because it's not intuitive, and it mixes the analog, the digital, and the manual in a very interesting way. The idea that there are too many screens came up, and yet we know that multitouch surfaces are made of glass. This notion that HCI can be an antique object that also triggers and has contextual augmentation is an interesting twist.
• **Peter Samis,** Associate Curator of Interpretive Media, San Francisco Museum of Modern Art

The Magic of Gestural Interfaces

• Seb talked about magicians and I have been thinking about magic as well. The technology is just a way to create an experience. If

it doesn't get in the way of that experience, you have this kind of magical experience that creates something really indelible. I have seen that more with gestural interfaces. One thing I find interesting is that I'm moving my hand and I'm manipulating something, but I'm not necessarily seeing my hands move. I don't have to see that, I just see the object move virtually. Maybe one next step is that I can now manipulate a physical object with a gestural interface.
• **Daniel Davis**, Media Producer, Smithsonian National Museum of the American Indian

REMEMBERING THE ISE

The Point of HCI: Getting at the ISE

• We're talking about what HCI is, and I think we also need to be talking about what ISE is. It relates to the idea of wanting new tools because they're cool and sexy. There's that touch table that you fall in love with, but what's at the other end of it? Peter Samis and I were talking about *Gallery One*. When I experienced that in Cleveland I felt that if I had that in a museum I'd have a better relationship with the art. That's why they use the technology, to get at that. It's thinking about art implementations of HCI, so it gets at this ISE that is the reason we are involved in this conference. • **Beck Tench**, Director for Innovation and Digital Engagement, Museum of Life and Science

Balancing the HCI+ISE Equation

• I found it interesting that at the beginning of this discussion we were asked, "What is HCI?" I kept waiting for this group to be asked, "What is ISE?" For me, the most provocative part of the premise for this conference was the fact that you presented an equation, that it's balanced. I think it is really our task to sum it up. What is the value of HCI when you put it in balance with ISE?

Exploring the Equation

HCI + ISE = ?

• What is the equal sign? It's not a balanced equation, it's just this plus this. What does it equal? I'd love to have some things on the other side of that equal sign by the end of the conference. • **Charlie Walter**, Executive Director, New Mexico Museum of Natural History & Science

Beyond the Parentheses

• One thing I was thinking about was the parentheses in the equation, which mean there is something else outside because you don't put parentheses unless there are other factors and other vectors actually affecting that first addition. It would be interesting for us to think about what other things we are talking about that have major implications to the merger of human-computer interface.
• **Wayne LaBar**, Principal, ALCHEMY studio

**Markers of Success
on the Other Side of the Equal Sign**

• I think the question of what is at the other end of the equal sign is a compelling way to look at it. How do you know when you've got a product at the other end and what does that look like? I would invite us to think about the visitor behaviors we see, the things people say to each other, and the meaning and the memories they create together as a result of that equation. You kind of know you've got it right when you hear "Oh my god, come and look at this!" more than "Come on, let's go." When we get it right you get ineffable experience, you get memory making, and you get expressions of joy.

I don't mean that to sound too abstract, but I know that I've seen examples over the last couple of days where I've thought, yes, that works. And there are other examples, including things that I'm doing right now, where I think, that's not really going to work. I think our conversations regarding HCI+ISE should focus on what kind of results we want at the end of that equal sign. • **Kevin Von Appen**, Director of Science Communication, Ontario Science Centre

Sharing How Science is Done via HCI

• Continuing this HCI+ISE thread, one thing that is important to remember is that so much science today is done with computers and trolling through data looking for patterns. Computers are a very natural part of the process, and that alone is something to think about. How do we give visitors engaging, authentic experiences of how scientific research is, in fact, largely performed today? • **Bill Meyer,** Director of New Media, Exploratorium

Digital Technology as the Medium and the Message

• Regarding relevance, the science museum field has been going for about 40 years. What has happened in that 40 years is the digital revolution itself. Is there a way to get the visitor inside that tech itself? Can the digital be the phenomenon being explored through itself? I feel like there is this missing topic there. As far as science education, the cry we hear the most is that there are not enough computer scientists. Is there a way, by focusing on this technology, that you can get students into the technology itself? • **Robert Ketner**, Curator, Independent

To me, it's about what the ultimate purpose is. What is the "So what?" What is happening through the HCI? That's provocative and something I am still thinking a lot about and looking for as this conference continues.
• **Karen Elinich,** Ed.D., Director, Educational Technology, The Franklin Institute

Transcending Museum Walls; the Wider Scope of HCI+ISE

• The equation is not HCI+Museums, it's HCI+ISE. I think it's so easy in museums to get caught up in the physicality or the spaces and the needs of our collections. One of the real strengths of bringing the computer in is that it gives us the ability to transcend space and geographic location and deal with things at a very small scale and things at a very large scale. One of the challenges for us is to think beyond our institutions to the larger goal of science education, wherever that may occur and however we may bring people in. There was Dave Patten's example of the *Google Web Lab* exhibition tied to the Web. That is really transcending that space and moving beyond those walls. I think we need to think about what is so special that we want to do with technology that we can't do elsewhere, and not just all of those things that tie us down to the space that we're in and the containers, the walls, in which we have all of our information. • **Erika Shugart, Ph.D.,** Principal, Erika Shugart Consulting, LLC

Tangiality: the Importance of Play and a Connection to Physical Experience

• I would like to dissect this a bit. Informal science education is about learning, and as a neuroscientist I know that most of the learning occurs in the early stages of life, and it occurs mostly through play, through playful activity. What I think is an important point to make here is that we promote these kinds of interactions. About ten years ago I coined a term that brings together these two worlds, both the virtual and the tangible. The term is "tangiality," so it would be "tangible virtuality." If you have virtual, digital information that you can manipulate in a way similar to the way you discover things around you in the real world, that is when learning can happen, that's when exploration can happen. I see this happening in different interactives. Those that are good ones always have some component that can relate what is going on in an abstract virtual domain to physical experience.

Just as a reminder, all of the great concepts in philosophy and mathematics and geometry and all other disciplines are deeply rooted in our early physical experience, including complex concepts like gravity or balance.
• **Slavko Milekic**, M.D., Ph.D., Professor & Chair, Department of Art + Design Education, University of the Arts, Philadelphia

• I would second Slavko's point. I was thinking about my kids, who are nine and four, and

watching them interact with technology. I think a lot of things we are saying about HCI would be foreign to them because we are talking about boundaries between the virtual and the real. These are conversations that have been going on for decades and they are rooted in a world where we see a boundary. We talk about transcending boundaries and blurring boundaries and crossing boundaries, but I don't think my kids know that a boundary exists. I don't think they view the world that way, and it is going to be very interesting to see what that generation does with technology. • **Paul Marty,** Associate Professor, Florida State University

How Informal and Entertaining Can a Learning Experience Be?

• The word "informal" in the right half of the equation intrigues me. I'm a little new to the museum world. I've been doing interactives in other areas for quite some time, some for pure entertainment value and some for learning. To me, museums actually feel very formal. It's not a classroom, but when you are used to doing stuff that is learning for CD-ROM, TV shows, or Epcot Theme Park in Florida, museums are a very different beast. So how informal can you go and still have a learning experience?

I recently worked on my first museum experience in a long time, a traveling exhibit called *MathAlive*. I brought a lot of my entertainment sensibilities into that exhibit,

so what we have are 12 or 13 highly interactive experiences. The premise of the exhibit was that there is math in the things kids in middle school already do, so let's let you see the math while you're doing it. We have all kinds of different interfaces, like jump on a snowboard and snowboard down, and design a skateboard. Then there are the "glam cams" they have at a red carpet event. You can do that yourself, and all of these cameras take your picture and you learn about angles and other things. So it's really informal, but it's really fun and playful and the learning is there. My question to this group is, how informal can we be and still be a learning experience? • **Susan Kirch**, Creative Director, Right Brainiacs, Los Angeles

RESEARCH AND EVALUATION

Need for Research and Evaluation

• I think the baby is still in the incubator, and I think that's what we're still talking about. We have spent a lot of time discussing new technologies and new interfaces so far at this conference, but nobody has researched them and we don't have any evaluation data. I think as you mature an idea you do more research and more evaluation on it, and I don't think we've talked about that here yet. • **Charlie Walter,** Executive Director, New Mexico Museum of Natural History & Science

Erik Lizee demonstrating the Bug Scope

Paul Orselli and Wayne LaBar play with Erika Kiessner's Exploring Sensors, *which incorporate unintimidating Altoid tins*

Comparing Virtual and Physical Routes to Reaching Learning Goals

• After the conference at Cornell [Web Design for Informal Learning, www.wdil.org/conference/proceedings] I submitted a grant. I'm very biased and love physical exhibitry, but because of that conference we submitted a grant that said we were going to create a physical exhibit and a virtual exhibit using the same learning goals, and then we were going to research it. I though the physical exhibit was going to blow the virtual away, and it did not. The learning was equal across both experiences, and if you did both the Web and the exhibit there was no increase in learning, which was probably a flaw in our design since we had the same learning goals across both. The exhibit is in storage now, but the Web is still out there and we have thousands of people coming and saying things like, "I always wanted to be a forensic scientist and after going through this web adventure and doing it, I feel like I can do this and may take that next step." So I'm biased in favor of exhibitry because that's what I know, but I'm learning just how powerful the Web is. • **Charlie Walter,** Executive Director, New Mexico Museum of Natural History & Science

Touch Tables and What We Do Know

• When we talk about multitouch tables, we think of multitouch tables as tabletop exhibits rather than thinking about them as kiosks because we think that in a lot of ways they have much more in common with the types of behaviors that you'll see at tabletop exhibits. Charlie Walter said we don't have a lot of research. Actually, there are probably a half-dozen or a dozen good papers done recently that are about museum installations with multitouch tables. Also, as a field we have 40 years of experience in developing tabletop exhibits and we understand how people behave within those types of environments. It's something to think about. • **Jim Spadaccini**, Creative Director, Ideum; Principal Investigator, Open Exhibits

SOCIAL INTERACTION

A Shift to Social Experiences and Learning

• I think it's a lot about the social experience. That's something we know from studies on visitor behavior, that people visit in pairs or in social groups of friends and family. That is what is really interesting about this group. We are looking at media that is not isolating people and talking about experiences that really bring people together and let them socialize and learn together. That's a big shift over the past decade, where so much focus has been on mobile and then online experiences, to have the focus now come back to the galleries and the spaces that we all work in, and it's important. • **Mike Mouw**, Media and Technology Consultant, Gamut Interactions

• There is this idea that these interactions now are more social and more physical. If you think about how technology has been used in museums for the past 40 years, the audio tour and the kiosk are probably the two dominant uses. You really can't think of anything more isolating to experience within a museum setting. In some ways those were never really a great fit, although I know there are varying opinions about audio tours. But certainly these are not the kinds of things that encourage social interaction within our museum spaces, and we know that social interaction is important. • **Jim Spadaccini**, Creative Director, Ideum; Principal Investigator, Open Exhibits

The Kiosk Experience: Pro and Con

• Regarding the comments that technology can be isolating and kiosks and the like can be isolating, I have never in my life in museums seen a kiosk that has prevented anyone from saying, "Oh my god, come here, look at this!" • **Erika Kiessner**, Interaction Designer, Aesthetec Studio, Toronto

• But the most common social behavior is someone pulling on the person at the kiosk saying, "Let's go." • **Jim Spadaccini**, Creative Director, Ideum; Principal Investigator, Open Exhibits

• But what is telling about what you are saying is that there is also something powerful about having something all to yourself and being in complete control over that thing, with nobody sticking their fingers in and messing with it. • **Erika Kiessner**

• But it's also an ATM-like experience. It's not fundamentally different from what you experience at home or at school, and I worry about that. • **Jim Spadaccini**

• We went to Explora during the opening reception for this conference, and Explora is so different from the Exploratorium. When I worked at the Exploratorium, if we tried to put up walls there would be mutinies because there was a belief that walls interfere, divide people, are controlling, and so on. Then Explora started up, and Explora is like walls on steroids. There are walls everywhere, and the whole notion is that walls help you focus and go deeper and not get distracted. So what is the difference? What is the difference between putting a wall around a really compelling exhibit where the visitors go in on their own and get deeply into it, and what you are talking about as a kiosk experience? What's wrong with that? • **Kathleen McLean**, Principal, Independent Exhibitions

Accessibility and Social Interaction

• I have a little different tack on this social inclusion issue. I agree that people should not be isolated when interacting with an

Allison Price listening to birds on Olivia Jackson's OMCA Soundstation

Darold Ross, Erika Kiessner and Kathy McLean play around with Markus Seidl's Playing Valcamonica

exhibit. If you have a screen and just have everybody looking at the screen, this is obviously bad because they're not interacting with each other. I don't draw the line as strictly, though, at the exhibit. I would view a completely universally designed and accessible exhibit as something really fantastic, not only because I can't use it otherwise, but because of the fact that I can use it and it actually allows me to talk to others about it.

So even though the act of interacting with it might not be socially inclusive, the before and after is. The before might include talking about it (e.g., "I remember stuff on planets"), and then you go in and access a planetary exhibit, and then you talk about it afterwards (e.g., "That was really neat about the size differences"). That is a lot more inclusive and actually something I care a lot more about than whether, at that unit of time when I'm interacting with the exhibit, I'm also interacting with others as well. But obviously I have a little bit of a bias in terms of priorities there. • **Sina Bahram**, Accessibility Researcher and Ph.D. candidate, North Carolina State University Knowledge Discovery Lab

Thinking in Terms of the Feast Rather than Individual Ingredients

• I find this discussion of an individual kiosk or an individual table a bit bewildering because I've never seen these things in isolation in our environments. We are not designing a kiosk that encompasses all of our learning goals and we are not designing it for everyone who is in this room. Visitors don't all stick together like glue when they move through an exhibit. They come together and they come apart, and there are moments of solitude and moments when you want to be with your group. It is a long and varied experience for a wide range of people. While I may find the kiosk the most rewarding, someone else may not.

It is not our job to make sure that those things appeal to everyone, but that the experience overall balances out and there are elements within that meal that will appeal to others. You are not preparing one dish. I don't worry as much about social exclusion within kiosks if the balance in the rest of the exhibits is right. I don't necessarily believe that kiosks are socially including or excluding, but they may be in that exhibit for a very good reason because that's the element that you're trying to add. I'm finding this a conversation about ingredients when I want to talk about the feast. • **Kate Haley Goldman**, Principal, Audience Viewpoints Consulting

MOVING THE FIELD
FORWARD: INTEREST GROUPS
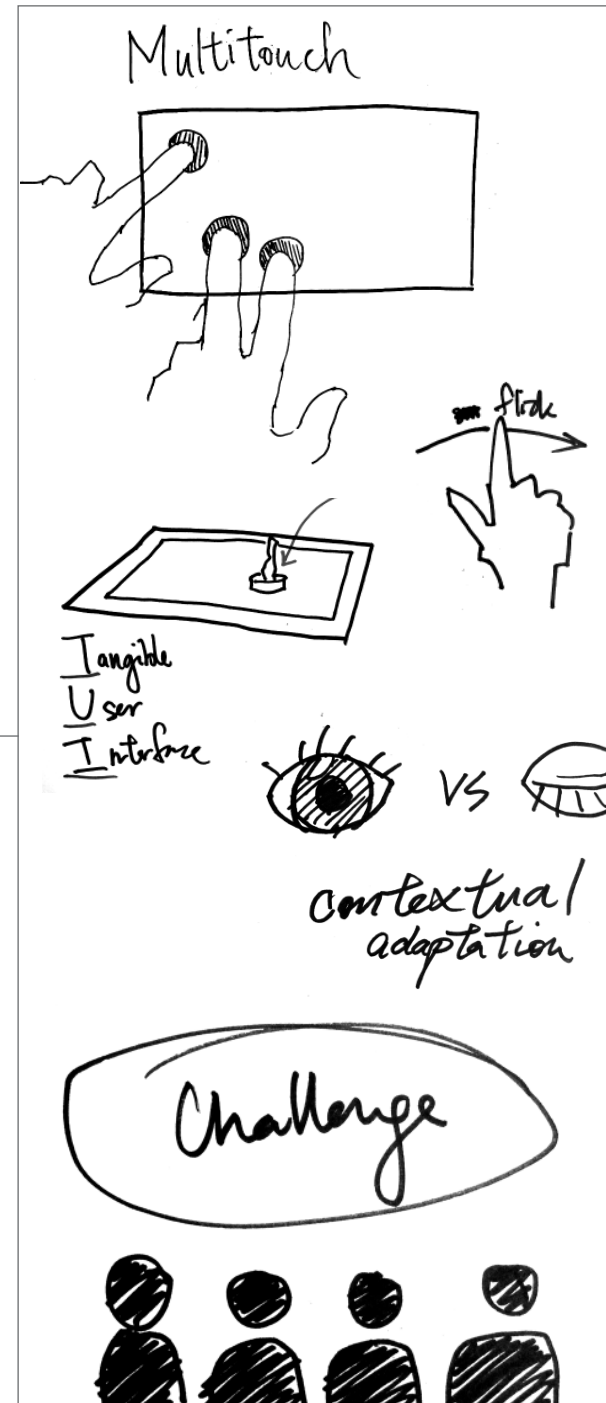
About the Interest Groups

*A highly social learning experience with a
prototype touch table at Ideum*

The Task: Interest Group Instructions

The topics in this section were generated by participants and posted to an online board to elicit preliminary feedback and discussion prior to the conference. They became the focal point for two rounds of breakout groups with participants free to sign up for an interest group of choice. Each group was encouraged to think of itself as an ad hoc think tank for the field. In the course of exploring the topic and reaching common ground, the groups were asked to address the following questions as a means of focussing discussion:

- Why is this topic of interest? What is the need or issues(s) for the field?

- What questions or hypotheses is the group exploring?

- What problems or constraints is the field facing?

- What are the opportunities going forward?

- What references, resources, and tools might we use to address the issues and constraints?

- What are your recommendations for future research, experimentation, development?

Introduction to Interest Groups

Jim Spadaccini
Creative Director, Ideum
Principal Investigator, Open Exhibits

In thinking about the interest groups there have been sideline discussions regarding how they should function and what the focus should be. First, they are not about individual exhibits or experiences, but about large-scale environments. Peter Samis and Bruce Wyman talked about this during the follow-up discussion to the provocation presentations [*see "Provocations" section of this document*]. What are the ubiquitous computing environments that we will see in the future?

It is also not about the iPad, it's not about your phone, and it may not be about Google Glass either, although I imagine museums will be using some or all of those things as well. The personal devices are going to set expectations, we know that, and they represent technology that people are going to bring with them, so we have to keep them in mind. The visitors are going to do this regardless, but the question is, what are museums going to do?

> **Think big**
>
> **Not about personal devices**
>
> **Social • Physical • Immersive**

Kathleen McLean
Principal, Independent Exhibitions

We said early on that these interest groups are self-selecting and participants are to come up with what you want to talk about. The idea is to really look at the field and identify the issues and opportunities going forward.

Some people, and Jim is one, think it is not about personal devices, it should focus on the big and immersive. I disagree a little with that, but I don't think it is either his or my issue. What we want you to do is get together in the interest groups you signed up for and decide this for yourselves.

However, what we are asking you to do is address the big ideas. Take the themes that you have come up with, look at the questions we have posed [*see previous page*]. In your report-outs we want you to articulate what the issues are, what the interests are, the opportunities, the constraints, and your recommendations going forward so that we may share your think-

Why the Distinction About the Devices Used?
A discussion between a participant (Q) and Jim Spadaccini (A)

Q: Why are you making the distinction about personal devices? If part of the thinking is that the physical space doesn't really matter and whatever you do and whatever you bring to it is part of that experience, and this division between virtual and real isn't there, why are you making this distinction about the devices we are considering?

A: The distinction is this: things in consumer space move at a very different clip than things in museum space.

Q: That is so wrong. Museums should be moving at a different pace.

A: I'm not saying they shouldn't, I'm saying that's the reality that we're in. That's why NSF funded us.

Outside of Museums

• What if it is not in a museum? What if this is actually outside of the exhibit space in the environment abroad? I would like to make a plea that the interest groups spend at least a few minutes considering that question. I go out in the field and work with people. I'm not at an exhibit, but that doesn't mean that I can't succeed in driving people back to the museum because I've piqued their interest. So just take a brief moment to think about this. We are talking about the ISE field, not just museums.
• Participant

What About ISE?

• The goal is informal learning of science, and that's what I feel is missing from the discussion. • Participant

Conference participants in discussion during a break

ing with others in the field who are not at this conference. The hope is to outline an agenda for the field.

Jim and I are not setting the agenda or the focus. We are trying to be responsive to participants, some of whom argued that it should all be about big, immersive environments. Should it? You tell us. That's what these interest groups are for. It is not about the particular or the nitty-gritty bits, and it's not just opinions. It is about why we are here. Why did you take the time to come here and identify issues that you want to talk about, and what are the implications for the field going forward?

Jim Spadaccini
Creative Director, Ideum
Principal Investigator, Open Exhibits

The way to reframe this one more time may be that it is thinking about all of these things in concert. These are all things that are going to happen together. However, there are still things that we don't really know about. We know much more about kiosks and personal devices than we know about large-scale immersive environments. We don't know as much as we would like to about things like full-room motion tracking or giant multitouch walls and the like, so that is what we are pushing a bit. We just want to make sure that's clear going into the interest groups. Part of the back-channel discussion resulted from the fact that we couldn't really bring those large-scale things to this conference's Technology Showcase. Even if we saw a slideshow about a big exhibit, we still wind up feeling like we are talking about iPads and laptops.

Is This Tech Necessary?

Presenting: Paul Orselli,
President and Chief Instigator, POW!

Our ultimate response to this question was, "It depends." However, we did cluster some points that kept bobbing up in the conversation and they are outlined below under the operative terms.

Appropriateness

Digital and high-tech tools are just one category of many tools available to us, and the question of appropriateness was a major takeaway.

Motivation

What is the motivation for using the tool, both for us and for our visitors? There is often the inherent "cool factor" that we butt up against, so understanding motivation was important to us. A particular technology may seem like a cool thing, but what are the learning goals? Who is the audience? How do we choose the tools that address both our and our visitors' motivations?

The Content-Tools Dichotomy

What is the proper order in this content-tools dichotomy? Are we picking content first or picking the tools first? We of course talked about "content *über alles*," but we liked the

- **Interest in/need for this topic:**
  Who chooses the technology and why?

- **Questions or hypotheses being explored:**
  Appropriateness of technology, and using technology as a tool.

- **Problems or constraints:**
  The "shiny new toy" syndrome is the biggest.

- **Opportunities going forward?**
  Co-creation with visitors, hacking the museum, and learning from groups outside museums (Unisys, Intel, makers, artists, SIGGRAPH, etc.).

- **Recommendations for future:**
  Work with visitors and "outsiders" to determine the best use of technology in service to content.

Group Members

Group Leader: Paul Orselli

- Joe Hastings
- Ron Eppes
- Steve Snyder
- Monica Smith

- Erika Kiessner
- Allison Price
- Erika Shugart
- Eric Welch

Is This Tech Necessary? group in session

notion of deliberately going against the grain and choosing the tool first to see what all of the possibilities are with that tool, and somebody actually did an exhibit like that recently.

Looking Outside of Museums

We talked about not being so insular and looking outside of museums at universities and artists and other institutions.

Sharing Failures

We like the idea of a Hall of Failure. We are not very good about talking about our failures and could learn a lot from that.

Sharing Information and Strategies

How do we identify whether there is a technology to let us do what we want to do? How do we identify what the technology has to offer? How do we choose? How do we tell each other about what's best?

Is This Tech Necessary? group in session

Scraps of Thoughts and Ideas from Notes and Butcher Paper

• How does tech help me do informal science education (ISE)?

• Digital tools are "content agnostic." Is there a technology that enables me to do what I want to do? What does digital technology have to offer?

• Digital Possibilities:

  - Tools and technology that allow you to see things that can't be seen

  - Digital tools that allow a more personal experience

  - Digital technology as information provider/ database

  - Technology that allows/enables visitor sharing

  - Intriguing tools: AR, Kinect fingertip tracking

Inspiration: Hacking the Tech

• A civic day of hacking, opening up databases

• Hacking your museums

• Hack the Polar Bear exhibit

Social/Contextual

• How good digital media can be at context

• Context awareness

• Behaviors catching up to technologies

Tablets, Smartphones:
Bridge or Barrier for Interaction?

Presenting: Kevin Von Appen, Director of Science Communication, Ontario Science Centre

I wanted to go right after the previous group because they asked the question of whether the tech is necessary and their response was, "It depends." In this case we say the tech *is* necessary. We reframed the question of whether tablets and smartphones are a bridge or barrier for interaction. Instead we asked, how are we going to make them a bridge for interaction? This is the raw material that we can and should be working with in terms of our visitors and the people we are trying to reach.

Why Care?

Why care about tablets or smartphones as platforms? Because the people we are trying to reach care, as indicated by some statistics I collected and shared with the group:

- Earlier this year at the Digital Marketing Conference in Salt Lake City (3/17/13), Adobe released a study showing that global websites are now receiving more traffic from tablets than smartphones for the first time.

- Here is where it gets really interesting: 70% more pages are viewed in an average session by someone using a tablet than a smartphone, so tablet users are staying longer and looking at more stuff. That spells out content opportunity, and that is interesting.

- Not surprisingly, people using tablets spend about 54% more online per buying session than those using smartphones. If people are using that behavior for buying, they could also be using that behavior for informal science education.

- Finally, there is an interesting statistic about apps. The shelf life for apps, which is one of the main routes for reaching content through tablets, is really high: 70% of tablet users are keeping and regularly using at least 50% of the tablet apps that they have ever downloaded.

All of this addresses the question of why we should care, and this spells opportunity.

Questions?

With the issue of why we should care addressed, we turned to the core question: How do we make tablets and smartphones into a bridge? We were sharing anecdotes about the peculiar aspects of modern life in which there

Group Members

Group Leader: Kevin Von Appen

- Markus Seidl
- Daniel Davis
- Jason Stevens
- Dave Patten
- Erik Lizee

- Catherine Baudoin
- Kristen Nesbitt
- Tamara Schwarz
- Olivia Jackson

Tackling smartphones and tablets

Constraints

Welcome to the (__fill in the blank__) Science Center

Do you have (__fill in the blank with personal device required to experience exhibit__)?

Do you have (__fill in the blank with application/reader required to experience exhibit__)?

Is there WiFi in this area? (__indicate yes or no, though you'll find it is mostly no__)

WiFi without capacity is useless, and unless it is free is useless. The Shedd Aquarium still doesn't have free WiFi and neither does the Ontario Science Centre.

Kevin Von Appen rallies his troops
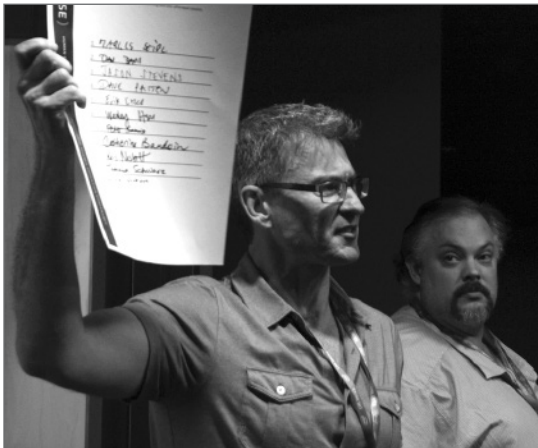
Ideum photo

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are too many screens and too many people looking at screens. How do these things become bridges rather than barriers?

Constraints

Notwithstanding the fact that people have these applications and museums have these devices and infrastructures and so on, the experience is often still like this [*see sidebar*]. There are a lot of these kinds of constraints and what are just practical barriers to use. While, as Dave Patten pointed out, many of these constraints will probably go away in five years, there will probably be new ones. We simply have to realize that constraints are part of the palette we need to work with.

We didn't spend a lot of time on constraints, though there is one interesting constraint that isn't technologically based, it is culturally based. The example that Dave Patten shared was at the Imperial War Museum, where they had an exhibition absolutely dependent on QR codes, and those codes were hanging next to signs forbidding photography. There was a very real barrier there, which made it difficult for people to do what they wanted to do.

Opportunities

Opportunities are where we focused a lot of our energy. People are now at the point with their devices where signatures on emails sent from tablets say things like, "Sent from my handbrain." Given the fact that the devices are becoming an extension of the person using

the device, what can we ask them to do?

The approach taken by one consortium, 21-Tech.org, basically says: We have a group of experiences on our floor, we have 300,000 apps to choose from, what apps provide good extensions? They are thinking about it fundamentally from a point of experience as opposed to a point of technology. That seemed a very useful opportunity for us to pursue.

One theme that emerged was the notion of using this technology to extend a museum beyond its boundaries. There was the example given of a science museum in the UK being a temple filled with stuff, but most of the contents of the temple were actually invented in your backyard or down at the end of your street. There is an opportunity for tablets to make those bridges and make those connections, enabling people who are inside the museum having an experience to share that with people who are outside.

There is the notion of gathering and sharing data. Citizen science applications are readily enabled by these devices, and that is of particular interest for informal science education.

Resources/References

A couple of cool examples came up:

• Sonnenwelt
English-language info and links: www.xpedeo.de/en/Sonnenwelt_-_interactive_exhibition.html
Link to German-language site for Sonnenwelt: www.sonnenwelt.at

Using Samsung devices, visitors can construct a sustainable house based on the information that they get ("part of Sonnenplatz Großschönau, a Europe-wide unique demonstration project of 'trying to live' in a passive house"). They can take the house they create and put it into a village with others to see how their house performs in a larger community, bringing the experience into the social realm.

- 21-Tech.org

21-Tech.org

This consortium, which we mentioned earlier, is conducting powerful review of applications that work well with various kinds of exhibits.

- *Heist*

openexhibits.org/research/heist/

Another great example from the touch table to the tablet is *Heist*, at the Maxwell Museum of Anthropology, part of the *Look Close See Far: A Cultural Portrait of the Maya* exhibit. Visitors can literally swipe resources off the table onto their tablet.

Recommendations for Next Steps

Finally there are recommendations for the future. What would we want to hear about, what would we like to do?

- Experiments that continue to explore extending the museum to the outside world was a strong recommendation.

- Evidence that we are getting more accurate recognition of geographic location from the devices, which would enable us to do more.

- A desire for small-group discussion that is cross-disciplinary around this kind of subject.

- The need for some kind of forum where we could continue to have these conversations was key as well.

Excerpts from Group Notes

Observations

- Native apps vs HTML5? Either way users will engage, so the distinction is not so important.
- Internet maturity is 'a long way off.'
- Uses for non-smartphone devices: look for inspiration in places in the developing world that are joining the Web.
- When we develop these experiences, we are developing for an exclusive audience.
- Do we want to build off what people are doing (taking pictures), or suggest new things?
- We need to facilitate what people will do anyway.
- How can we use tablets to get people to look more deeply at the real?
- Visitors could do meaningful work.
- Use the tablet to document what you have seen with your eyes.

More Opportunities and Ideas

- 'Radical trust' is an enabler (e.g., visitor-based moderation of comments; a "like" function).
- Museums could leverage visitor social media practice as well as their devices.
- Send the iPad out to a teacher pre-visit and have students create and input data.
- There are significant opportunities for smaller museums: low cost of entry and existing app resources don't have to be developed in-house.

Other Examples/Resources

- *Ethogram*
  Allison Price's work at Lincoln Park Zoo: Is the animal eating? Drinking? Time it. Observations from different visitors are combined to make a picture of the animal's activity.

- We have the big, immersive experiences already. What we can't provide easily is the customization and personalization that tablets enable.
- Consultation with docents is key.
- There is an opportunity to reveal the hidden, the non-moving (if it's an animal, say).
- Collaboration opportunity from inside to those on the outside the museum via "video calling," webcasts (weblab music collaboration example).
- Experiment: ongoing smartphone-/tablet-based participation that builds data, and participation is visible.
- Experiments that extend the museum to the outside world using these devices.

Sharing Practices, Tools, Resources

- Can we work better to create/share best practices and resources? This would be particularly valuable for smaller museums. Examples include the ARIEL toolkit; Wikimedia Foundation toolkits for content development is another resource; AAM partner for future resource sharing/NAME. For example, facilitated use of the devices can be immediately successful— further work and sharing here is an immediate opportunity.

Interactive Computer Games for Informal Environments

Group Members

Group Leader: Eve Wurtele

- Francesca Samsel
- Suzanne Pierce
- Karen Elinich
- Wesley Hsu
- Charles Compton
- Dan McCulley

Graphics: Wesley Hsu, Web and Touchscreen Developer, Balboa Park Online Collaborative

Notes: Suzanne Pierce, Research Assistant Professor, Assistant Director, The University of Texas at Austin

Interactive Computer Games group

Presenting: Eve Wurtele, Ph.D. in Biology, Professor, Iowa State University

Informal science education happens everywhere, and games already play a significant role in the lives of many people and have the potential to enhance learning. As has been pointed out, if learning in the virtual world can mimic learning in the real world, then that is sort of a natural form of learning. There are broad groups of people working to develop games and tools across a spectrum of environments.

Challenges

"Game" is a very open and ambiguous term that means many things to many people.

- Games in general have not met expectations for providing substantive experiences, particularly in museum settings. Webified games are also not fulfilling and frequently perpetuate scientific misconceptions.

- There is a risk of misinformation because sometimes the designers of the games are not those who know anything about the scientific content they are trying to represent. We need to improve the integration of design with content in compelling game formats.

- Games can cross learning styles, but we don't know how to do this. There is much work remaining to evaluate and assess how to develop games that fit a broad range of learning styles.

- Bad games do exist.

- Funding for game development, design, and implementation is always a challenge. Funding is limited, and simultaneously there is a stigma to commercializing educational games, which is a barrier to people who want to create good games for money.

- Barriers to entry need to be addressed so that people feel comfortable with games and gaming is accessible.

- We need the ability to iterate and collect good information about what is working and what is not from the people who are using the games. We need to build a data collection capability into each game that is out there, so both the public using the game and the group that maintains the game have access to that data to assess learning and how the game is being used. This can also enable interaction back into the game.

- Good games come from strong interdisciplinary teams, which requires funding, time, and patience.

Opportunities

- Games can serve as a bridging mechanism between museums and the public, particularly for visitors who can't actually make it to a museum facility.

- Games allow us to explore ideas and environments that we cannot explore in the real world, such as those at very small and very large scale, and subjects like astronomy and technology. MetaBlast (metablast.org) is a good example of exploring cell and metabolic biology.

- Games provide exposure to content knowledge and environments that may help anchor learning in complex topics like mathematics.

- Games also allow us to iterate, both in content and design, and through experimentation. This is a process both developers and players can use to learn.

- Games enable the players to fail without penalty and learn from those failures.

- Cooperative gaming online can harness the knowledge of groups to solve big science and social problems. *Foldit* [http://fold.it/portal/] is a good example of that. It allows the public to participate in learning more about protein structures.

- Gaming and game building may help engage future scientists and build skills for future HCI and ISE professionals.

- Developing games provides developers with a deeper understanding of the core sciences involved, as well as the interconnections to adjoining fields.

- Museums may provide a significant testing ground for deep engagement with games on the part of kids and visitors, enabling identification of which games work best.

Graphic map of discussion by Wesley Hsu
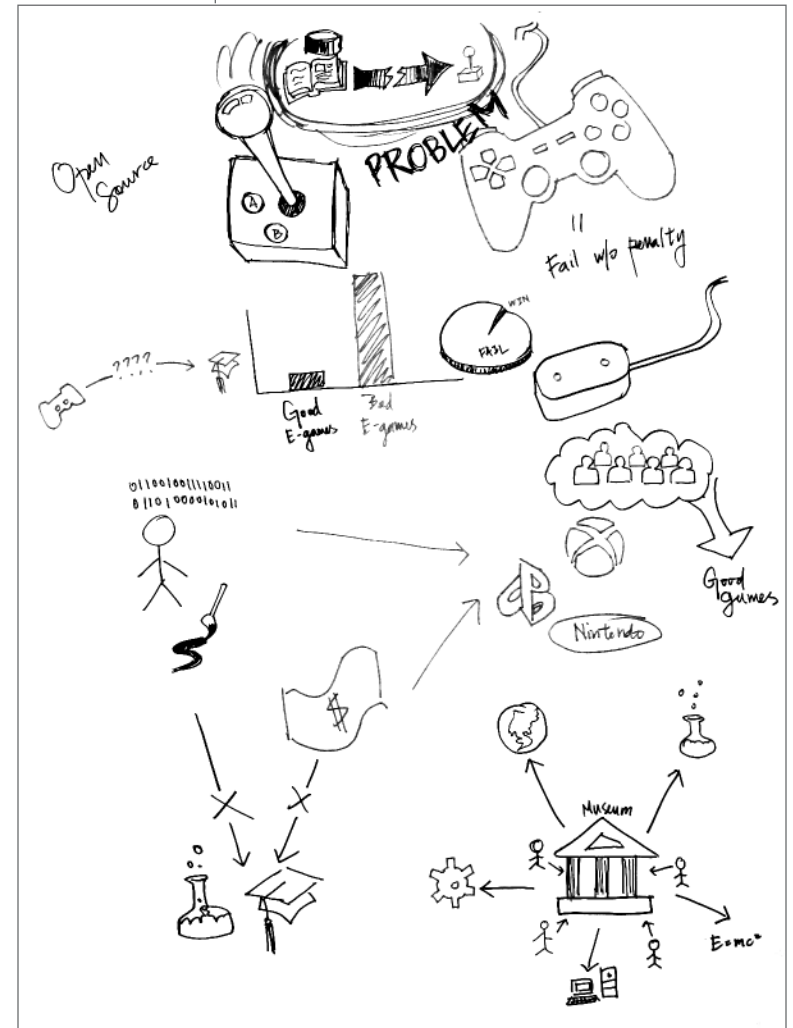
References

• There are a myriad of resources and references available for gaming, yet every resource has limitations. More resources are needed to focus on flexibility, accessibility, stability, etc.

• Programming languages are also wide-ranging (e.g., Java, JSP, Python, C++, etc.).

Tools

There are already a broad number of tools, including:

• Kodu
  fuse.microsoft.com/projects/kodu

• Unity 3D
  unity3d.com/unity/

• Scratch
  scratch.mit.edu/

• GameSalad
  gamesalad.com/

Future

• Adapting games to the rapid advances of hardware and software technology is going to be a significant challenge.

• Incorporating emotional detection into the experience of interaction designs will occur, and that will provide feedback to the game environment.

• Something almost everyone so far has said is that this isn't just for museums, it's about making good science content accessible in grocery stores, and in Kenya, and hinterlands beyond.

• Interactivity on many levels, including museum-to-museum, player-to-player, and hinterland-to-hinterland, is going to be important.

• We will be moving to inclusions of informal collaboration and integrating more open

source, so people from all over can participate in development of the games.

• There will be large environments (e.g., in museums) for highly visual, complex games.
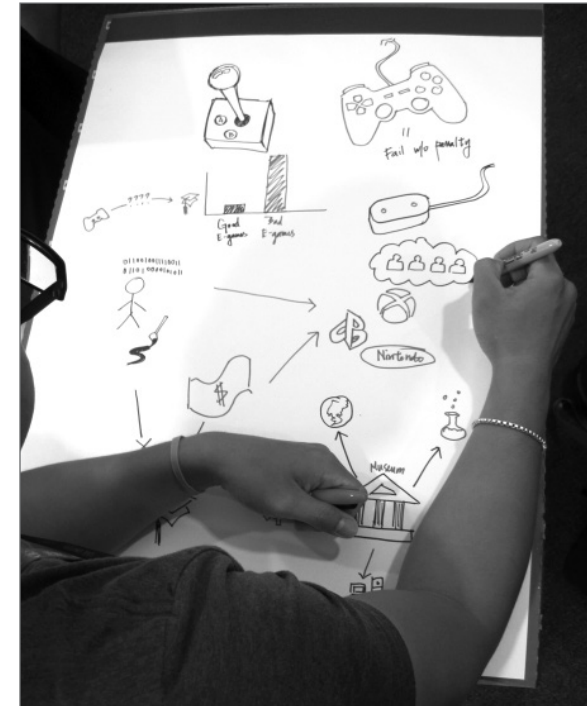
Wesley Hsu taking graphic notes

Interactive Computer Games discussion

Immersive Environments

Presenting: Graham Plumb,
Creative Director, Snibbe Interactive

What Is Immersion?

The interest in this topic in the group was broad, and that was interesting in itself. I think this is partly because the definition of "immersion" is constantly shifting like moving sands. It's a bit like the word "design" was in the '80s. It's not something that you necessarily can put a pin on and define.

> **Types of Immersion**
>
> intellectual + emotional + spatial
>
> ⌄
>
> aided by HCI

We came up with three groups or categories of immersion: intellectual immersion, emotional immersion, and spatial immersion. Spatial immersion is the type most aided by HCI. Immersion is also about creating a suspension of disbelief in order to pass this threshold where you can begin to lean in and take in a new message and a new story.

One comment was that reality already works well, so therefore let's keep it.

Questions/Hypothesis

One question we pursued was, "What are the different kinds of immersive experience?" We had a discussion about kiosks versus tables, and the interchange was interesting because there are a lot of hidden truths in both perspectives.

> **individual** — **shared** — **interactive hybrid**
>
> only me/her/him/you | we are all having the same experience | a combination offering options of individual and/or shared

> **Group Members**
>
> Group Leader: Graham Plumb
>
> - Jennifer Elliott
> - Beck Tench
> - Susan Kirch
> - Bruce Wyman
> - Wayne LaBar
> - Sina Bahram
> - Matt Celeskey
> - Bill Meyer
> - Olivia Castellini
> - Mike Mouw
> - Ben Wilson
> - Libbey White
> - Charles Xie
> - Brian Kelly

Immersive Environments group

Resource:
Social Immersive Media: Pursuing best practices for multi-user interactive camera/projector exhibits. Snibbe, S. and H. Raffle. Proceedings of Association of Computer Machinery Computer-Human Interface 2009 (ACM CHI 2009).

Download at:
www.snibbe.com/pubs/

Immersed in discussion

What we came up with is that there can be individually immersive experiences in which you are honed into a space and are able to focus in that way, and then there are shared immersive experiences around tables. You can shift between the two, so you can shift your focus from one space to the other. The successful immersive experience affords that kind of movement, which leads to the third definition, this sort of interactive hybrid in which we are interacting with each other, with multiple people, but can also move back to that individual space.

Scott Snibbe wrote a great paper about socially immersive experiences for an HCI conference in 2009, and a lot of ideas in that paper guided us in our discussion about what creates a socially immersive experience. One of those qualities is that as more people enter the experience it should get better and not worse. That is a good test as to whether your exhibit is actually being immersive or not.

Also, there is something that designers shy away from for some reason and I think it has a lot to do with design education. That is, a multisensory experience is inherently more immersive. When I design visual experiences (and I am more trained as a visual designer), I am usually the one who has to remind the client that you can use sound as well. And using sound is quite cheap to produce and it is remarkably effective. Yet I am not really trained in sound design and sound is subjective, so it is not an easy thing to do. The point is that we don't create experiences that are multisensory enough.

Problems and Constraints

There was a feeling amongst many in the group that we should be doing more prototyping and we should be more iterative in our prototyping. We also talked about different types of prototyping. You could be very literal in your prototyping, using your client's actual content, or you could be more metaphorical where you are trying to create an adjunct to the experience that gives you a sense of what it's like without using the content. It is also not prototyping for prototyping's sake, but prototyping to get it out in the real world. "Release more often" was the catchphrase, which is also about being prepared to make more mistakes.

Two phrases here require additional explanation by a group member:

An Explanation of Terms
Ben Wilson
Manager, Interactive Media, Museum of Science

"Fault Tolerant Group Dynamics"
In talking about the potential for shared social experiences, there was concern that the dynamics can be broken by people who don't know the rules. They aren't particularly well-versed in whatever is going on if they haven't accepted the social contract or the rule set implied by whatever the shared experience is going to be. You would use adaptive systems to be able to modify the experience and correct for that. Some of the technologies that we have been talking about throughout this conference are going to help us build some of that fault tolerance.

"Adaptive Magic Circle"
In an adaptive magic circle you are engaging in a contract to play by the rules of that social experience.

One of the problems or constraints is the pre-programmed behaviors that we come to the museum with. By that I mean that they've learned to engage with electronic devices in a certain way, and therefore they expect things to behave in the same way. In a museum you expect people to do things differently in a more physically social way than a virtually social way. Getting people up that curve is a real challenge.

There are limitations of imagination on both ends, affecting both the visitor/user/client and the designer. Finally, there is the problem of using old paradigms of content delivery. For example, there is the idea that classrooms have to be designed a certain way and that is the way they have to be.

Opportunities

There seem to be so many opportunities that it is getting easier, or perhaps it is getting more confusing. There are opportunities to get it wrong as well, and maybe we need to run with that and take pride in that.

One of the great things is that because there are so many more tech opportunities, there is more of an opportunity to match the means of conveying a message with the actual quality and content of the message itself. Additional

opportunities include user-generated content and rich consumer space.

Recommendations

Recommendations include the need to iterate more, to prototype. Another is to start with the actual content (the story, the goals, the experience), which seems obvious, but I can say as a museum designer that often I don't actually get the content until three-quarters of the way through the design process (and then let's hope it fits).

A final recommendation is to attend conferences outside your field. We generated a list of suggestions.

Conferences

- Ars Electronica
  www.aec.at/news/
  Because artists have been doing this for ten years before we've become aware of this, and doing it really well.• IAPPA (International Association of Amusement Parks and Attractions) www.iaapa.org/

- CES
  (Consumer Electronics Show)
  www.cesweb.org/

- CHI
  (ACM Conference on Human Factors in Computing Systems)
  chi2014.acm.org/

- SIGGRAPH
  (Special Interest Group on GRAPHics and Interactive Techniques)
  www.siggraph.org/

- UIST
  (ACM Symposium on User Interface Software and Technology)
  www.acm.org/uist/

- UbiComp
  (ACM International Joint Conference on Pervasive and Ubiquitous Computing)
  www.ubicomp.org/

Freewheeling
Social Immersive Experiences

- There was also the idea that when you are creating a socially immersive experience it doesn't necessarily have to be designed. In fact, designed social experiences might seem forced and artificial. You can design the conditions in which an experience might occur, conditions which spark a socially immersive experience, and you can inspire social sharing and learning before and after the experience. • Participant

- We also talked about the fact that some of the most successful ones are divergent group experiences. You supply a space for that without applying any rules regarding what goes on. • Participant

(HCI+ISE)

Immersive Examples

Presenting: Mike Mouw, Media and Technology Consultant, Gamut Interactions

We started our presentation with "suspension of disbelief," which we thought was the most important thing. It is the idea of the story, and everyone being involved with that story and forgetting who they were when they walked into the museum. This is *Funky Forest* from the design group IO, a very talented group. They are currently doing an installation at the New York Hall of Science you will all want to check out.

Suspension of Disbelief

Thoughts from Butcher Paper Notes:

Use tech sparingly—or even not at all. Start with the story. Use multiple modalities to convey any given goal.

We looked at the museum as an immersive space and discussed the City Museum in St. Louis, which we all enjoyed. Here, the point is that it doesn't have to be technology, it can also be an environment that allows us to play and suspend disbelief in a different way.

Open House Prototype
[A short video on Mike Mouw doing rapid prototyping while working on Open House: If These Walls Could Talk *at the Minnesota History Center.]*

Something Kathy McLean made me do a while back was record rapid prototyping processes. As Graham talked about, rapid prototyping and testing is so important when we are doing any sort of immersive work. We discussed the range of immersion from highly interactive, where you don't need any detail because you are caught up in the story and the interaction in an organic way, to the other end, which involves a very detailed environment like the *Backdraft* show at Universal Studios, with live flames and other things affecting you in a very powerful way.

Then there is the idea that it can be individual as well as social, and the example is Oculus Rift coming out with what will be every person's VR device next year. Phones can also


Immersive Museum

Individual and Social

be social if you are using social apps like those developed by Oblong Industries that allow you to collaborate in a museum space through their g-speak™ technology. They are former MIT Media Lab people, now working out of LA, and you've seen their work in *The Matrix* films, that's how they did all of that stuff.

Then just for fun, this is *3D Pacman* created by Keita Takahashi, game director of Katamari Damacy [*see more at* www.psfk.com/2012/09/ *3d-pac-man-museum-exhibit.html*]. You can take game environments and turn your entire gallery space into a digital environment.

There are some of the examples that help to illustrate the ideas we included in our talk.
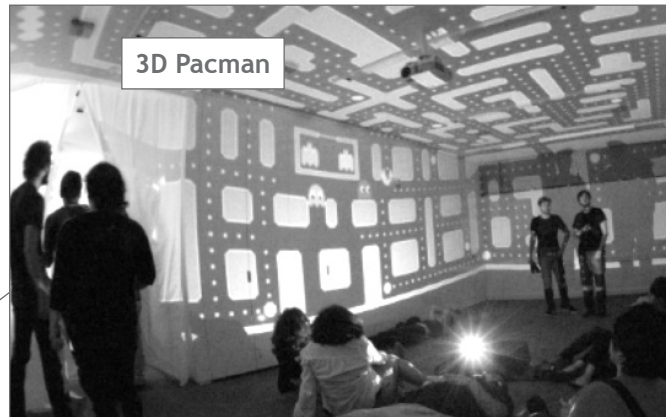
3D Pacman

Immersed in discussion

Design Research & ISE Projects

Presenting: Marti Louw, Research Faculty and Designer, University of Pittsburgh Center for Learning in Out-of-School Contexts

Our group had a very loose title, "Design Research & ISE," and we spent the first 15-20 minutes getting to know each other and figuring out what it was we wanted to talk about and what we meant by "design research." We had designers who have designed research, we had museum professionals, we had academics, and we had evaluators, so we had a wide range of people who think about both making and studying these kinds of informal science learning experiences with technology.

We broke into three separate groups, each focusing on a different area of discussion.

Design Research group

Those three areas are outlined below, and each of the subgroup leaders will talk about their sections.

1. **What new things/designs are there to study/evaluate?**
   - What do we want to study/evaluate
   - What are the exemplars?

2. **What methodologies are best-suited to the process?**
   - What is considered research?
   - What logistical/ethical constraints exist?

3. **How do we communicate what we learn?**
   - Where/to whom?
   - What reward structures influence this?
   - What barriers exist?
   - What is the value in sharing? How does it change the field?

What Should We Study?

Presenting: Peter Samis,
Associate Curator of Interpretive Media,
San Francisco Museum of Modern Art

We talked about some way of identifying what the spectrum between ubiquity and the big wall is right now, and this was somewhat discussed earlier in the conference. We set up some dynamics between those things that enable creation, like Arduino/Tinkering Studio

kinds of things, moving on the continuum from working with small parts into information consumption, and from the interactive to the passive or reactive.

1. What should we study?		
Continuum(s) of HCI		
• Creation	to	Consumption
• Personal	to	Social
• Format: Visible	to	Invisible/Ubiquitous
• Scale: Mobile	to	Environmental
• Location/Place-based	to	Universal

The continuum moves from the personal to the social, format goes from visible to invisible/ubiquitous, and scale goes from mobile to environmental. Regarding location, is it inside the building or is it universal outside? Earlier, there was a call for informal science education outside the box or container of the museum.

We can situate different projects in different places at each of these dynamics, and we can then see what the issues are that come up. What works and what doesn't in each of these? What remains to be done? At what scale do problems emerge when we look at different examples?

Here is a *Collection Wall* at the Cleveland Museum of Art. It is consumption-based on a certain level, it is not about tinkering with little modules. It still allows you to do something personal because you are able to download those images onto your own personal device. It is social. It is definitely very visible,


Collection Wall – Cleveland Museum of Art

it is not ubiquitous in that sense. It is environmental. And it is situated in a museum, so it is place-based. There are issues that come up as you start examining that wall and how it interacts with the environment around it, and those need to be taken apart and shared with the field, so we can understand how to move beyond the shortcomings of that particular space.

Then we have inaturalist.org, which involves citizen science. You sign up and can get into an informal science experience by contributing data to any of these projects that are already online. It doesn't depend on the building at all.

One more example is the Tinkering Studio at the Exploratorium. It is place-based, but it is really about making things and about putting things together. These offer some beginning ways to get a handle on the field and the range of examples that we are evoking here.
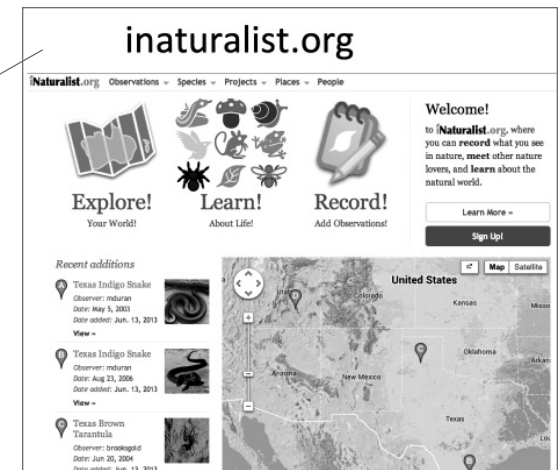
Tinkering Studio - Exploratorium

How Do We Study It?

Presenting: Leilah Lyons, Director of Digital Learning, Assistant Professor, New York Hall of Science / University of Illinois at Chicago

Peter did a great job of setting the stage for exactly how divisive our area is. Even though we are all ostensibly doing the same thing, we are all coming from so many different disciplines, representing different kinds of institutions with different kinds of goals. On top of that, the questions we are interested in are very different, the settings are very different, as Peter illustrated, and Chris will talk about the fact that the dissemination models are very different. So there is a huge scope of methods that could be applied to any given interesting HCI+ISE opportunity.

> ### 2. How do we study it?
>
> - **Challenge:** Different fields/different perspective—figure out how to share them in collaborative way
>
> - **Solution:** Professional Development workshop for people from different backgrounds to produce examples (e.g., Rosetta Stone)

In our group, after talking circles around each other for a while, we realized there is a real need in our community to have some way of understanding the scope and breadth of the work being done. What we propose is what we started calling "the Rosetta Stone," selecting

a couple of these key examples, different form factors for these kinds of interactive experiences. We would then have those of us who come from these different backgrounds say, "These are the kinds of questions I would be interested in looking at in this particular installation. These are the ways I would do it, and this is the kind of outcome we would get."

This would be used as an information sharing focal point, literally a Rosetta Stone. You have the Aramaic linguists and the hieroglyphic university researchers, and you could see how each group takes on the same task.

How Do We Share?

Presenting: Christopher Stapleton, Creative Venture Catalyst, Simiosys

> ### 3. How do we share?
>
> - **Challenge:** Going from dissemination to adoption
>
> - **Solution:** Accessible, mineable data
>
>

I am going to use the metaphor of a beach with all of these different grains of sand. Where do we go for value? We see some grains and don't see other grains. Some data, reports, design,

and research is hidden, and some of that is valuable. How do we share it? The key here is: How does it transform advancing the field? We need a way to incentivize the contribution of data, information, and reports, and the sharing them in an automatic way.

We also need a way of mediating those reports, understanding where they are coming from, where they are going, and how they are developed, and we want to be able to cross-source the relationships. What is growing on one? What is advancing on another? The intent is to follow the different threads and ideas to form our own sandcastles from all of these different grains or different structures.

We also need to find out where the gaps are. Are we collecting data from the users and validating the information we are collecting?

And finally, how does all of this contribute to advancing the field? How are our insights moving us forward? Does this information sharing give us tools to incentivize more reports and more data to advance the field, while avoiding replication or dissemination of research without using the results?

Actionable Ideas

Presenting: Marti Louw, Research Faculty and Designer, University of Pittsburgh Center for Learning in Out-of-School Contexts

In many talks people give references or exemplars of projects they like. We all go to conferences, we all like to present our own

work, but we don't come around and pick out three or four excellent examples, make a worked example out of them, and talk about how we study them, how we can understand them, what some of the problems are, and how we can remix and reuse some of the solutions.

Wouldn't it be nice to virtually, or more ideally face-to-face, go to Cleveland, have a working example, and sit there and interrogate those exhibits across a range of questions and disciplinary lenses? If we can't do that in person, we could virtually support that kind of thing and work that out in an online setting.

There is also the possibility, when we go to a conference like this, of having small working groups of people the day before or the day after do these kinds of worked examples, looking at these interactive, immersive experiences.

Dissemination Recommendation: CAISE
caise.insci.org/
beta.informalscience.org/

I also want to put a plug in for the Center for the Advancement of Informal Science Education (CAISE), which is an umbrella organization to help support the field. Ideum has been working on a website that has been bringing together a lot of the research and evaluation reports. It's not comprehensive and it probably doesn't touch all of your fields yet, but it is a resource we could continue to build on and grow. I put that out there as one part of addressing the dissemination and sharing goals. • **Marti Louw**

Design Research group

Intermission: Open Conversation

IMMERSION

A Fine Grain of Interaction Required (*3D Pacman* Isn't It)

• I would question whether the last example the Immersive Experience group gave of immersion (*3D Pacman*) is an immersive experience. Maybe we need another name for it. It's a 360-degree experience, but it's not necessarily immersive because I don't know what the grain of interaction is. Maybe to be truly immersive there needs to be a fine grain of interaction.

I've done a lot of peephole video that becomes very immersive, and that's because it reduces your perspective. You have to focus yourself and you're looking through a little peephole at something moving on the other side. I would argue that could be more immersive than the *3D Pacman* example.
• **Jason Stevens,** Principal and Exhibit Designer, Flutter & Wow Museum Projects

Defining Immersion

• We spent a lot of time defining what immersion is. Actually, about three-quarters of our session was spent on that. We came to a kind of generic conclusion that it was really just transportation to a content or domain space.

We weren't saying that it is necessarily big, wrap-around spaces that are immersive. We spent a lot of time talking about how individual experiences could be immersive as well. • **Ben Wilson,** Manager, Interactive Media, Museum of Science

The Responsive Loop

• I agree with the sentiment behind what Jason is saying. You're talking about granular, and that totally is not an immersive experience in a way. It goes back to this idea of experiencing something, and it responding to you in the way that you already have engaged with it. I can get myself into a loop describing that loop. • **Graham Plumb,** Creative Director, Snibbe Interactive

Is Learning Occurring?

• As we define that experience, we have to define it as it relates to the educational pedagogy or theory or strategies, take what is experience and what is experiential learning, and ask how they are relating and dialoguing and advancing each other. It is really important to look at that learning before we go defining each one. • **Christopher Stapleton,** Creative Venture Catalyst, Simiosys

Marti Louw and Jason Stevens in conversation

STRUCTURING THE NEXT HCI+ISE CONFERENCE

The Value of this Kind of Multidisciplinary Exchange

• In our group there was a strong feeling, and it's something I heard from other groups, that conferences like this that are by definition multidisciplinary are very important. Getting the time to talk to each other in a way that we don't get to do at a big conference is also important. I would recommend that Jim and Kathy do this again, and that NSF sponsor it. • **Erik Lizee**, Director of Exhibit Design and Development, McWane Science Center & Aquarium

Multidisciplinary Groups and Actual Nearby Examples

• All the better (as Marti Louw pointed out in her final remarks) if we have examples nearby, so we can actually go and look at something and take all of our lenses, and then create a common vocabulary around it and build something so that we are not just forced to look at slides or representations of exhibits. Then we can start to build some understandings and working criteria. • **Peter Samis,** Associate Curator of Interpretive Media, San Francisco Museum of Modern Art

Moving from Questions to Answers

• It seems like all of our conversations are questions. We're developing the questions, but we're not getting to the answers. That seems to be our next step. What are these answers? How do we do these things? • **Erik Lizee**

• Just getting together for the first time to find out what people's questions are is a big step. • **Kathleen McLean**, Principal, Independent Exhibitions

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Upcoming Conferences, Workshops, and Professional Associations.

Pre-Conference Workshops at ASTC

• We are hosting the ASTC conference in Albuquerque this October (www.astc.org/), and I know the 21-Tech group that was mentioned earlier is hosting a full-day, pre-conference workshop regarding what they've learned. Then there workshops on makers' spaces and Arduino boards. Those are the small opportunities, but they will be full-day workshops if you want to come back. • **Charlie Walter,** Executive Director, New Mexico Museum of Natural History & Science

HCI+ISE at ASTC

• We are also going to have a meet-up at ASTC in October. That is part of what we wrote in the HCI+ISE grant. I know that not everybody here makes it to ASTC, but I would encourage those of you who do to meet up, and those of you who normally don't to consider coming. We're going to have both an evening event as well as some kind of get-together. • **Jim Spadaccini**, Creative Director, Ideum; Principal Investigator, Open Exhibits

NAME

• I'll take this opportunity to plug NAME, the National Association for Museum Exhibition (name-aam.org/), which is a professional network inside AAM. If you're already an AAM member, joining NAME is free, and we publish a journal twice a year. That is another community. • **Jason Stevens,** Principal and Exhibit Designer, Flutter & Wow Museum Projects

Augmented Reality in ISE Environments

Presenting: Karen Elinich, Ed.D., Director, Educational Technology, The Franklin Institute

We started with issues and definitions and went right to the why question: Why use augmented reality? We came up with eight bullets. Augmented reality can be used to show scale. It has the ability to transcend time and space and show changes over time. It can offer revelation of energy source, the energy in a system. There is the ability to look inside and see something bloody,

Why?

- Scale
- Time
- Energy
- Inside
- Information Overlay
- Multimodal/Multisensory
- Creative Interaction and Social Constructionism
- Hinting

something that might be inside the body, or it might be something inside the magic box. It could be something inside the machinery: the gears, the mechanisms.

"Information overlay" is the ability to augment something through the addition of an overlay. AR can also be multimodal/multisensory, which means we can have many levels of learning engaged simultaneously through the senses. "Creative interaction and social constructionism" is the idea that augmented reality gives you the capacity to capture play and have other learners build upon the artifacts of previous learners' play.

Finally there is hinting, the idea that there could be a little bit of agency in your learning environment, where the augmented reality would recognize the need to suggest that the learner do something a little differently. This might involve something like the projection of footsteps on the carpet as a way to indicate

Group Members

Group leaders: Steve Snyder and Karen Elinich

- Susan Kirch
- Kevin Von Appen
- Erik Lizee
- Jason Stevens
- Charles Compton
- Libbey White
- Charlie Walter
- Charles Xie
- Dan McCulley
- Tom Aageson
- Jennifer Elliott

Augmented Reality group

that perhaps they might try over there instead of where they are currently standing.

We discussed hypotheses and generated the following questions.

Hypotheses

- Can AR bring virtual and experiential and interpretive together?
- Can AR be experiential in and of itself?
- How does the physical interaction with the technology affect the experience?

Can augmented reality bring the virtual and experiential and interpretive aspects of learning closer together in an informal environment? Can AR be experiential in and of itself? And how does the physical interaction with the technology affect the experience at hand? These are questions we might want to pursue in search of answers.

We also identified what works well with AR. It allows us to replicate historical content, and gives us the ability recreate a place that no longer exists. That might involve something like bringing a ruin back to life through AR though visualization.

AR also offers the ability to show assembly and disassembly, how to take something apart and how to put it back together.

There are medical applications as well. Instead of practicing on human subjects we might want to practice medical techniques on cadavers,

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What Works Well?

- Replicating historical content in context
- Assembly and disassembly
- Medical application
- Avoiding wear and tear on actual objects
- Multimodal & multisensory
- No physical device (sometimes): e.g., (ARIEL) representing abstract

---

using MRIs and adding augmentation that would help people know where to cut and where to insert a PICC line or an IV.

Because AR helps to avoid wear and tear on actual objects, this might offer a way to conserve, preserve, and protect our designed environments.

The multimodal and multi-sensory benefits of AR were talked about earlier. And finally, sometimes AR enables you to work without the need for visitors to use a physical device. For example, with ARIEL (www.fi.edu/ariel) there is no iPad being held up and the projection doesn't get in the way of the user experience.

There are also some issues and technical constraints, things like registration systems and GPS. Lighting and glare are big problems.

Relevant to the Context

There is an addition to the list of what works well. AR really works when it is relevant and specific to the space I am in. Don't use AR to provide a tag that brings me to a virtual world that has nothing to do with the space I'm in. Use it to offer something that is relevant in terms of my physical context. • **Dan McCulley,** Business Analyst, Intel

Augmented Reality group

What Issues Do We Face?

- Technology issues with registration, GPS, other technical quality
- Visual overlay
- Physical overlay and varying lighting
- Device intervening between visitor and content
- Public attitudes driven by marketing experiences
- Expensive
- High maintenance

Lack of Concise Definition

Another issue is that we really lack a definition of AR that is concise and helps us talk about augmented reality in a way that is meaningful.

- **Jennifer Elliott**, Cognitive Research Scientist/Senior Consultant TiER1 Performance Solutions

The device being between the visitor and the content is a kind of learning problem. We also have some issues with the fact that "AR" as a term has entered the consumer space, and in some ways can cause skepticism and turn some people off from the get-go when they hear "augmented reality" because of the ways it has been used for marketing purposes. It can still be expensive in some cases, and high maintenance issues may arise from any kind of large-scale implementations.

There are a couple of good implementations that we've seen and are familiar with.

References
combined from slideshow and group notes

- ARIEL
  www.fi.edu/ariel

- Simtable
  www.simtable.com/

- Professor Bruce H. Thomas
  www.unisanet.unisa.edu.au/staff/
  homepage.asp?name=bruce.thomas

  ARQuake
  About: en.wikipedia.org/wiki/ARQuake

  Wearable Computer Lab
  wearables.unisa.edu.au/
  [Ed note: next door to Bruce Thomas's Wearable Computer Lab is the Magic Vision Lab: www.magicvisionlab.com/]

- Aurasma
  Augmented reality app for iPhone: www.aurasma.com/

- Layar
  www.layar.com/

This concludes our presentation.

Visualize the invisible, or inaccessible, or abstract.

Beyond the Screen: Aesthetically Pleasing Digital Experiences

Presenting:
Wayne LaBar, Principal, ALCHEMY studio

This presentation runs you through our discussion about why we feel aesthetics and design are important, the challenges that we face in doing these things, some observations we feel are aspects of increasing the aesthetics of HCI+ISE experiences, and finally where to see some good examples.

What Are They?

A couple of words emerged when we discussed aesthetically pleasing digital experiences. Instead of describing what they are, we described how we felt when we saw them.

> ### Wonder

The first was wonder, a sense of wonder, a feeling of wonder.

> ### Magic

The second was magic, that there is something magical about them. We agreed that trying to increase the magic of an experience ten percent every time would be a good thing to strive for.

Characteristics

We also identified some of the characteristics of these experiences.

> Simplicity
> Detail
> Unity
> Timeless
> Imaginative

There tends to be a simplicity, not necessarily of interaction but a simplicity of direction, a simplicity of purpose, a singularity regarding how it is used. Second, attention to detail is really important. It might be that aspects of audio, materials, or texture, that lead up to the experience are as important as the experience itself. The wrong detail can ruin an aesthetically pleasing experience.

There is the idea of unity, that everything works together towards a singular occurrence, a singular experience. And often a really aesthetically pleasing experience is timeless, it could exist for a long period of time, and future generations will engage with it with the same sense of wonder and magic that we have.

Group Members

Group Leader: Wayne LaBar

- Seb Chan
- Francesca Samsel
- Dave Patten
- Joe Hastings
- Mike Mouw
- Kate Haley Goldman
- Tamara Schwarz
- Olivia Jackson
- Slavko Milekic
- Brian Kelly
- Eric Welch
- Marco Mason
- Eve Wurtele
- Marti Louw
- Bruce Wyman
- Beck Tench

Beyond the Screen group

Making moments where you "start knowing" without relying on knowledge

Aesthetic experiences increase impact and engagement

Wayne LaBar

Finally, these experiences are imaginative. Aesthetically pleasing experiences are not the result of just replicating something, they require an imaginative leap by the person or the group that is making the experience, and they move beyond what we have seen before.

Our group identified how you know you have found one, expressed in this statement. This tends to be another common characteristic of these experiences.

In fact, whether we know this for certain or not, we were of the opinion that these experiences increase impact on the visitor as well as increasing engagement. We will come back to this statement briefly as one of the challenges we think this area of investigation faces as well.

Challenges

Integration of aesthetics into all parts of the process

One of the challenges involves integrating the aesthetics into all parts of the process. It's not something that just gets added on after you've decided what the experience is and you say, "Now we are going to make this aesthetically pleasing." This means that experience and aesthetic objectives are part of the consideration from the very start, that experience and aesthetic objectives are part of the science research as well as the

design work, that all parties have to buy into this if we are going to make this happen. In fact, one might wonder whether the museum bureaucracy or process actually allows that to happen often in the organizations in which we work or those we work with.

Rapid prototyping of aesthetics

There is also a challenge regarding how we rapidly prototype aesthetics. This might be a difficult thing to think about. Certainly we know that part of aesthetics is not just the experience. We talked earlier about details. Often some of those things don't happen until we get a little further along in the design process and the development process. In some cases those aesthetic details may be final cost outcomes that we might add to a project, which may then make your prototyping beyond the capacity of your project budget. These are things that we have to be thinking about.

Research that shows it works

Regarding the question of the research that should be going on, it occurred to us that research is a challenge as well. All of these challenges could also be areas of research, and we have combined those thoughts.

We then discussed thinking about putting ourselves inside an NSF review panel or other review body. Is there research, or points

of research, that actually show the impact of aesthetics on the ISE experience and experiences in general? We feel this is a bit of a research hole, and there are certainly sources out there that won't fund unless they can see some more quantitative research about this. This is an opportunity for some investigative work to be done out in the field.

> Not getting caught in the cultural aesthetics of the short term

One final challenge is not getting mired in the cultural aesthetics of the short term. For example, you may design something that might be aesthetically pleasing because it's 2013, but by 2015 that aesthetic has moved a little to the wayside. This also involves entering into this process with some thoughts about an understanding of aesthetics.

References/Resources

That leads us directly into some places to look for aesthetically pleasing experiences. We have Ars Electronica; *Leonardo* (the journal); the eyeo festival; and ISEA.

> • **Ars Electronica**
>   www.aec.at/news/en/
> • **Leonardo**
>   www.leonardo.info/isast/isastinfo.html
>
> • **eyeo**
>   eyeofestival.com/
> • **ISEA**
>   www.isea-web.org/

I would have to fire myself if I didn't mention my own blog, on which we've been documenting some interesting experiences out there that might be interesting for all of you to take a look at.

Finally we have the last slide.

> This slide is deliberately left blank.

We have left this blank so that you can think of your own examples. In fact, the natural world itself is an aesthetic experience and an inspiration for us all. As our group discussed just before we wrapped up, doing this through practice and through exposure is the way all of us become more knowledgeable about these experiences, which will guide us and help us in making better ones.

> ALCHEMY studio blog
> alchemystudio.com/

Beyond the Screen group

User Testing Approaches

Group Members
Group Leaders:
Anna Lindgren-Streicher and Erika Kiessner

- Bob Ketner
- Daniel Davis
- Carrie Bruce
- Allison Price
- Leilah Lyons

- Ron Eppes
- Paul Marty
- Paul Orselli
- Joe Hastings
- Jennifer Borland

Presenting: Anna Lindgren-Streicher, Project Manager Research and Evaluation, Museum of Science, Boston

Why?

In talking about the "why" of user testing, we acknowledged that we were the choir preaching to each other on this because we all think user testing is awesome and makes everything better, while Paul Orselli served as the voice of dissent.

We all thought that having the user as part of the design process is important to making sure we have a final product that is interesting, educational, and enjoyable.

User Testing group

Why?
- User testing makes things better!
- We have bias (we are the choir, preaching to each other)
- Voice of dissent

Us

Paul

What?

Wonder

Value

Delight

If you had a magic wand...

Empowerment

Inspiration

This discussion fits in nicely with the Aesthetically Pleasing Experiences group.

There are some things that are really hard to measure that we might want to look at in user testing. The question was: If you had a magic wand and could look for or measure something in your users or visitors as they are using your prototypes, what would that be?

We started talking about things like delight and wonder, and some more long-term things that are hard to measure like empowerment and inspiration. So it is not just thinking about whether they are learning, or whether they are using it as intended, or whether the usability meet expectations, but these other qualities, including some of the aesthetic qualities Wayne LaBar was describing, and integrating those into the user testing as well.

How?

These are really hard things to measure, and there are a couple of things we talked about using. One is doing transfer tasks. For example, after a user has gone through an experience ask them to engage in a task that demonstrates whether they feel empowered to engage in a similar type of activity. Another technique would involve having videotape of visitors and bringing that back to the team or stakeholder group, looking at that, and asking, "Where do we see wonder? Where do we see delight in our visitors?" This would help those involved come to a more common understanding and a common definition, so you can look for it as you are doing your user testing.

From Group Notes: Questions About Measuring Inspiration

- There is a hierarchy from wonder to inspiration, and you are not going to inspire everyone with everything.
- The challenge of longitudinal studies: how to use those to apply to our work, to make our work better?
- Can we identify commonalities across exhibits that provide that inspiration?
- Can we use measures for happiness, depression, etc., from psychology?

Anna Lindgren-Streicher

Excerpts from Group Notes: Motives and Questions Participants Brought to the Table

- An academic perspective: trying to prove that things did or didn't happen—metrics and assessment are more important; there is an intersection of usability and research.
- User testing enhances end products, which involves trying things out, fiddling, a sandbox approach.
- In figuring out ways to successfully engage our public we have to ask the visitors. By forcing yourself to ask the visitors, you have to make a lot of decisions beyond just conceptual discussions.
- How do we know what we know? Do we know what we think we know? What are they getting out of it?
- What about diversity within users? How are people doing user testing with diverse groups

of users? What methods are they using? What is participation, what are we measuring, etc.?
- The distinction between what people are getting out of it vs. what visitors identify they are getting out of it.
- We bring assumptions into our work while testing things and looking for data.
- You can save money, time, and embarrassment by doing user testing and can learn so much from a few users.
- Difference between user and a visitor: a user is a visitor, but is a visitor necessarily a user? Politics of user testing, when & where it happens, why it happens. Institutional baggage.
- How can we use user testing to push design towards things like emotional engagement and immersion?
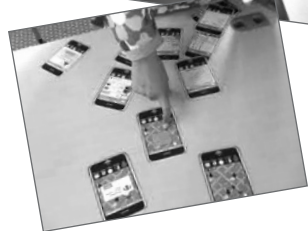
Barriers

- Lack of buy-in
- Lack of trust
- Willingness (+$) to change

21st-Century User Testing Strategy

Monitor Facebook, Twitter, Instagram to see what people are saying. - Group Notes

Strategies That Work for Doing User Testing

- Flexibility
- Using videotape of visitors
- Participatory evaluation
- Pre-evaluation: cognitive walk-throughs, use cases, personas
- Low-tech facilitated concept testing
- Make sure you are testing what you want to be measuring
- Plan to act: walk-through scenarios with potential findings

Barriers

We also talked about barriers to adopting user testing, such as lack of buy-in at the institutional level. There may also be a lack of trust. A lot of this comes down to interpersonal relationships and trust. As a developer or prototyper, you trust that those taking it out on the floor and testing it with users don't have their own agenda; that they are actually looking at what you want them to look at and will come back with actionable data.

It is also necessary to have the willingness to change and to build in sufficient funds to do so, as opposed to going out, testing, and then not doing anything with the results.

Strategies that Work

We shared some strategies that work for user testing that we have seen used. Flexibility is important in the user testing process. You might go out and test with five visitors, you might go out and test with 40 visitors. You don't necessarily have a set plan, you go out and identify problems and iterate. We talked about using videotape to illustrate what is going on to the design team if they are not on the floor.

We also talked about using participatory evaluation,

which is different from participatory design. It involves evaluators working with developers and designers to develop the tools that will be used for evaluation, and then training the people who are actually making the end product to go out and collect the data themselves. Analysis is done collaboratively so that everyone sees (and hopefully buys into) what is going on.

Before things even get out on the floor there are some user-centered things that you can do for pre-evaluation, including cognitive walk-throughs, use-cases of exhibits early in development, and user personas to think about how different kinds of users might use your exhibit and your individual interactives.

Early in development you can use low-tech, facilitated testing of concepts if you're not sure of the direction something is going to go or whether it is going to work out. Instead of doing a full build-out to test it, you can get something out on the floor that is quick and dirty, with a person there talking visitors through it.

We talked about the importance of making sure that you are testing what you want to be measuring, and figure that out before you get on the floor. You also need a shared understanding that you are going to look at a certain type of data, and if you get certain results back, this is what it means.

That leads into having a plan to act and the idea that you are collecting data that a team

will use, and the strategy of walking through scenarios with potential findings to help you learn if you are asking the right questions. If we find that this is what's happening, what will we do with it? If we find that it completely crashed and burned, what will we do with that data?

Then there are strategies that work for acting on and implementing findings. Once we do the testing, how do we make sure that the results are used?

**Strategies That Work
for Acting on/Implementing Findings**

- Synchronization within the process—asking the right questions at the right time
- Planning budget, time, and emotion for iteration
- Overcoming aversion to iteration
- Relationship/trust building
- Embedding evaluators as team members
- Having a process that tolerates/embraces challenges
- Be willing to pull the plug/cut your losses (kill criteria and desired levels of optimization)

Synchronization within the development process is really important. It's not just asking the right questions, it's asking the right questions at the right time, before you've gone too far down the road and can't act on that information anymore.

Planning for iteration within the process may include the timeline, the budget, and sometimes emotional preparation. Along with that there is overcoming an aversion to iteration that some folks have. A lot of it comes down to relationship and trust building between individuals and those interpersonal relationships.

There is the strategy of embedding evaluators as team members, so they can understand the process and make sure that the evaluation is just in time and the user testing is right where it needs to be.

Having a process that tolerates and embraces challenges is another strategy, knowing that while potentially some things are going to go just as we think they are, there might be really hard problems we are chewing on that we need to go back to. Along with that, you need to prepare yourself to pull the plug and cut your losses if things are failing, and have criteria, preferably agreed upon, for killing off a particular experience. And you need to know when things are optimized enough and right where you want them to be so that you don't need to do further evaluation.

"A culture of fail early, fail often."

• Group Notes

Resources/References

Studies of Impact on Core Museum Visitors

- Reach Advisors
  reachadvisors.com/
- Math Moves longitudinal summative
  mathmoves.org/
- Activation Lab
  www.activationlab.org/

User Testing group

Tackling Tough Topics in Science with Human-Computer Interaction

Group Members

- Matt Celeskey
- Chris Stapleton
- Olivia Castellini
- Charles Xie
- Suzanne Pierce
- Erika Shugart

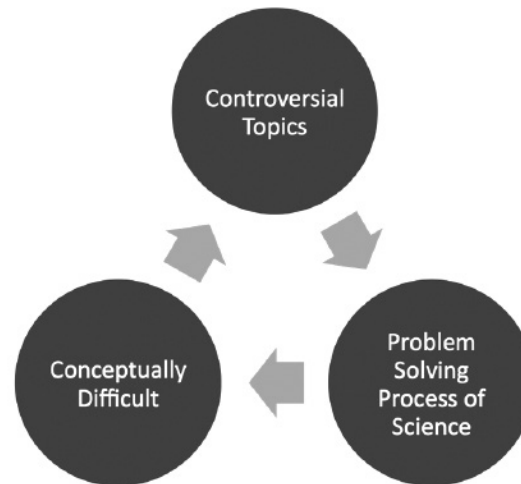*Erika Shugart and Charles Xie tackle tough topics*

What's So Tough?

Presenting: Matt Celeskey, Exhibit Design Manager, New Mexico Museum of Natural History

We had a hard time figuring out what "tough topics" meant, and all had different ideas about it.

Some topics are tough because they are controversial, they're socially awkward to deal with in an informal science setting. Some are conceptually difficult: brain surgery, rocket science, high-level science that is tough to convey. Then there is also tough implementation in the problem-solving process of science. Trying to figure out how we can convey that process can be difficult in the settings in which we operate.

Challenges and Opportunities

Presenting: Suzanne Pierce,
Research Assistant Professor, Assistant Director,
The University of Texas at Austin

One of the problems with tough science topics is that you let the scientists be in charge of things like your visual presentation. The results look something like this.

General Challenges

- Infinite story of science that we need to tell in short increments and within a finite space
- Data, information, and technology are constantly changing
- The public often believes that science can only be conducted by subject matter experts

So many things were streaming through our conversation that we just captured a few of our bullets. One is that there is this infinite story of science that we only have a few short minutes to tell people about. We felt that these scientific topics are so complex that we need for people to reconnect with them as lifelong learning topics. One challenge is imagining how to connect those short increments into a longer sequence of information.

There is also the need to deal with the constant shifts and dynamic nature of the data and our understanding and knowledge of the topics. And finally, the public often believes that it can only be conducted by a subject matter expert. We need to make it open and accessible so that they realize they are part of constructing the story of science, and that is one of the transitions that we would like to see ourselves make.

General Opportunities

- Create layered experience to generate a spark of interest in content (varying depth)
- Linking museum experience to lifelong learning opportunities
- Design and systems that leverage existing science databases to teach current science (real data)
- Create smarter exhibits to push information through layers
- Connect visitors to relevant social and information resources

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We want to try to generate a spark of interest so that people go deeper, which ties back to that lifelong learning. The desire to link museum experiences to lifelong learning came up frequently.

We also want to leverage those existing databases so that we are not recreating them, but instead reaching out to the NASA databases and USGS databases and incorporating them into our teaching as well as our exhibits.

The next idea was fun to think about, that of creating smarter exhibits to push information as a user gets to a certain stage of interaction within an exhibit. How can we then drive them to a different level of inquiry so that they are actually confronted with what may be a new perspective on a scientific topic? This would bring them to ideas and content that they might not go to naturally, but the exhibit recognizes what might be a bias in their understanding and pushes them to reach for new understanding.

Finally, there is the idea of connecting visitors to relevant social and information resources.

Controversial Topics

Presenting: Erika Shugart, Ph.D., Principal, Erika Shugart Consulting, LLC

We then broke into small groups and each group tackled one of those tough topics. One group looked at controversial topics and how HCI can help deal with controversial topics. This is a bad photo of Australian farmers burning a government water report that is very scientifically accurate, and you can see how well they accepted that science. So what happens when you don't have your audience coming along as you're dealing with a controversial topic?

One of the challenges in this area is that science is only one way of understanding the world. There are many other ways of understanding, including belief and things of that nature. Dealing with controversial topics

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Controversial Topics in Science

- Science is one way of understanding the world
  - Acknowledge other ways of knowing and alternative world frames

From: http://watchingthedeniers.wordpress.com/2010/10/

Controversial Topics in Science

Solutions HCI can help with:

• Decision Support Systems that present complex problems with relevant science

• Experiential exhibits that demonstrate perspectives (Polar Bear and AGNES)

• Requires cross-disciplinary collaboration (e.g. decision scientists, social, biophysical, technology)

• Create smarter exhibits to surface underlying misconceptions or biases

• HCI can help highlight consequences of decisions and possible scenarios

requires acknowledging that there are other ways of knowing and understanding.

We talked about some of the solutions to this challenge and some of the ways we've seen HCI aid in those solutions. One is Decision Support Systems. These are mostly found in universities. They may be in scenario-based rooms that have individual stations with computers and large simulations going up on the wall, and sometimes things like Clickers that allow people to add opinions. Basically, these are large computerized systems that allow people to work through scenarios together and are responsive to those people's input, so the scenarios can change in real time in response to the decisions people are making. Often they have humans behind the scenes as well who are adding input. They are great integrated systems and can be quite interesting when trying to get teams of people to think about dealing with controversial topics that have a science base.

Another approach where we thought HCI could be helpful in dealing with controversial scientific topics involves experiential exhibits. It is one thing to tell people another person's perspective, it is another thing to force them to be inside that other person's perspective. One example cited was a polar bear exhibit where you are trying to get across ice floes in different years, and every year you put on a different set of feet and hands. As you go through from 1950 to today the hands get bigger and bigger, so you actually feel the weight

of the caloric output the polar bears have to expend because they are getting less food and it's a higher temperature.

Another is something I did at the Koshland called AGNES, which stands for Age Gain Now Empathy Suit (agelab.mit.edu/agnes-inducted-national-academy-sciences-museum). This is a gesture-based piece where you age in the piece and have to move according to the age. It forces you to slow down and walk in the shoes of others, giving visitors that perspective to help them think about controversial issues.

As we thought about solutions, recommendations, and places to go when considering controversial topics, we concluded that this requires a broader cross-disciplinary collaboration than has been talked about at this conference. It is not only getting the scientists and designers and computer programmers involved, but also bringing in the social scientists, decision scientists, cognitive psychologists, and others who come in with that understanding of how the human mind works. As a species we are really poor decision makers, so if you have people who understand that it definitely helps.

And again, referring back to something mentioned earlier, we are talking about creating smarter exhibits. Computers are starting to detect facial expressions. There are also programs out there that can detect things like inherent bias, things you may not even be aware of but computers can detect. Being able to detect what your visitors' emotions might be

and what their inherent biases might be, and then delivering information that would respond to that could be quite interesting.

And finally, HCI can of course highlight those future decisions and scenarios that enhance people's ability to think about the impact of their decisions.

Infinite Story of Science

Presenting: Christopher Stapleton, Creative Venture Catalyst, Simiosys

You have the infinite story of science that you are going into, just scratching the surface, and you have this infinite imagination, or are trying to. How do we connect this infinite imagination of the learner with the infinite story of science? Currently, we are only doing a very small slice of this.

The opportunity of human-computer interaction, from databases to interfaces, is to expand this informal science education to anyone, anyhow, anyway. We can expand the limitation of time by looking at learning opportunities life-wide, everywhere we are—at the mall, while we're sleeping, at breakfast. We can use these opportunities to go beyond and transcend the space by looking at different learning environments. HCI can not only expand the environment with a mobile device, like a magic wand, but also expand beyond the wall.
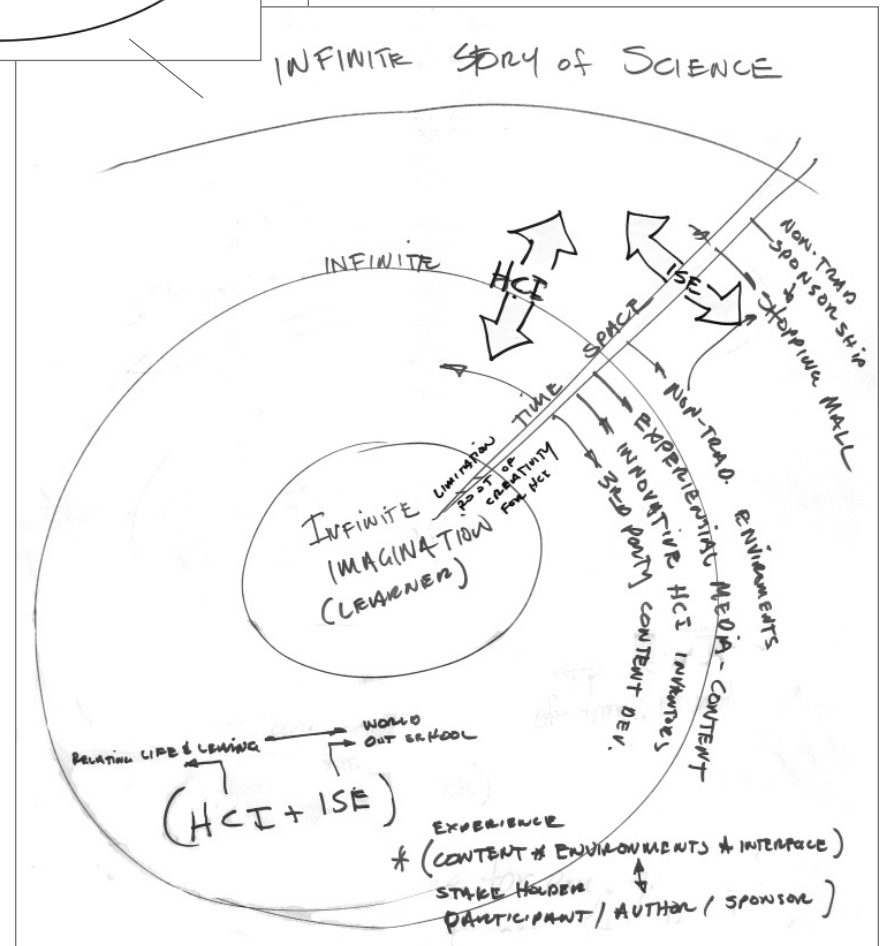
There is also expansion of money. Once we bring in new technologies there are new
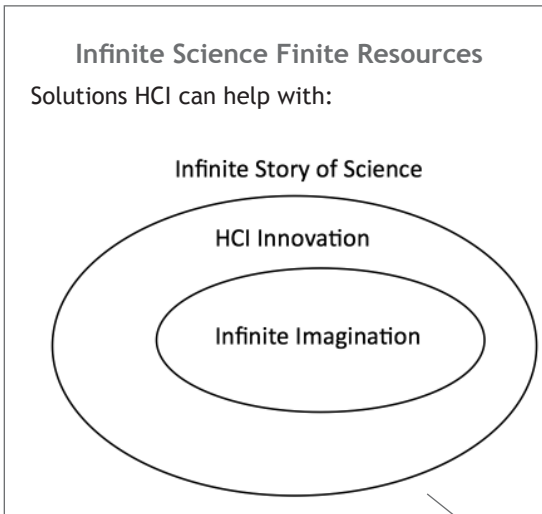
methods of not only delivering this content, but new ways of funding. It doesn't all have to be federally funded or user funded, there might be other alternatives out there that really expand the possibilities.

And it expands the experience, looking at it in a higher bandwidth, beginning to intuitively comprehend more of these complex areas.

In all of this we see that human-computer interfaces are really central to expanding

Infinite Science Finite Resources

Solutions HCI can help with:

Infinite Story of Science

HCI Innovation

Infinite Imagination

INFINITE STORY of SCIENCE

the huge mandate that this industry has of telling the whole story of science as much as we can and getting beyond this thin sliver. That really puts our mission central to the industry, to advance the industry. What we really need is to find out how to expand the time, space, and funding for informal science education anytime, anywhere, to anyone.

Conceptually Difficult Topics

Presenting: Olivia Castellini, Senior Exhibit Developer, Museum of Science and Industry, Chicago; and Shailie Thakkar, Volunteer

The challenge in terms of conceptually difficult topics is that they are difficult to visualize and conceptualize and there is a widening gap between subject-matter experts and the public. In addition, there is an aversion to broach-

ing difficult topics. Science is also emerging and advancing and it is difficult for museum practitioners to capture the current state and advancement of science in the larger narrative.

With respect to HCI, what that means is that museum practitioners and scientists have to realize that they are not the end users or visitors. They need to develop empathy for those visitors by employing those ethnographic and user testing methods discussed in the previous presentation in order to really understand the users' experience.

One of the things that we talked about in this subgroup that we missed listing as challenge, is the idea that there are basic, underlying science concepts that all of these difficult topics build on. There is a big gap there, so when we talk about things like the Higgs boson discovery, it is hard to talk about what is smaller than an atom when people don't know what an atom is. In terms of that widening gap between subject-matter experts and the public, the work the scientists are dealing with is getting more and more complicated and they are losing sight of the fact that the public doesn't have the kind of science literacy that's necessary to even start a conversation or start an experience.

However, there are opportunities that HCI presents for tackling some of these subjects. You can create a prolonged and varied type of engagement so that you can tackle a subject not just from the science facts, but perhaps

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Conceptually Difficult Topics in Science

- Challenges: visualizing and conceptualizing difficult topics; widening gap between subject-matter experts and public; aversion to broaching difficult topics; emerging science

- HCI: developing empathy for the end-user; museum practitioners and scientists must remember that they are not the same as the users/visitors

The Tough Topics group

the political aspects, the economic aspects, the social aspects. You can start to connect people to a science topic in a way that you couldn't do before.

You have opportunities for visualizing and interpreting the content. It doesn't do you any good if a researcher plops a whole bunch of raw data in your lap as a museum. You have to visualize that and you have to put it in a context for your visitor. HCI represents an opportunity for that as well.

There is also updatability. It is hard to do an exhibit about a topic for which there is, as yet, no punchline. Nobody wants to build a piece of software in their exhibit and then find out that they were just kidding about that whole Higgs-boson-origin-to-mass-in-the-universe thing. Who wants to go and redo their million dollar investment because it's all wrong? Can we

leverage HCI to create more flexible platforms for delivering that information?

HCI also offers the ability to connect people, both subject-matter experts and the public, and the public to the public. Can we use these technologies to have forums and discussions about controversial or difficult topics? There is also access to related aspects of a topic, which again might introduce more social aspects of the content.

A specific concept that came up for extending an experience beyond the discrete module and beyond the museum is that of creating an ongoing conversation between a domain or subject matter expert and visitors to the museum, letting people ask questions in real time using some kind of dynamic interface with respect to the module. HCI affords that kind of exchange beyond the building.

Conceptually Difficult Topics in Science

- Opportunities: prolonged, varied engagement, visualize and interpret content, updatability, create human connections (subject experts and forums), access to related aspects of a topic

- Creating a medium between domain/subject-matter experts and visitors in the museum that affords a dynamic exchange, asking questions, and continuing the conversation
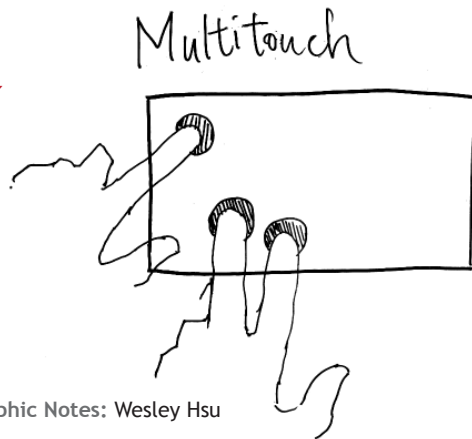
Multitouch

Graphic Notes: Wesley Hsu

Group Members

- Sina Bahram
- Markus Seidl
- Wesley Hsu
- Catherine Baudoin
- Peter Samis
- Bill Meyer
- Monica Smith
- Kris Nesbitt
- Ben Wilson
- Graham Plumb

Multitouch, Multiuser: Interactions Around the Table

Issues

Presenting: Peter Samis,
Associate Curator of Interpretive Media,
San Francisco Museum of Modern Art

The first question we addressed was whether we can get beyond sorting and browsing. Are there other interactions that are interesting? What are the limitations here? Sorting and browsing can happen with or without the multitouch table. Can we get beyond cards representing objects in the collection and perhaps adopt more game mechanics and employ varying metaphors? Are we treating touch tables like large tablets and perhaps not thinking in broader, more dynamic, more social metaphors?

Multitouch Issues

- Can we get beyond sorting and browsing?
- Adopting more game mechanics
- Are we treating touch tables like large tablets?
  - For gesture language should/for screen real-estate, no
- Continuous (vs. discrete) user interactions
  - Must work for arriving and departing visitors (partially re-entrant)
- Multitouch tables may not sense tangible objects (fiducials) well

Emulating Tablets?

In the case of gesture language you do want to emulate what tablets do because people are familiar with that and bring that intuitive knowledge to the experience, but when you are dealing with screen real estate it is a very different thing. Then you don't want to emulate what tablets do. • **Bill Meyer**, Director of New Media, Exploratorium

There is also the challenge of continuous versus discrete interactions. Are you restarting the table each time someone new arrives or is it a continuous interaction? And if it is a continuous interaction it has a social dimension to it.

Multitouch, Multiuser group

If one member of the ad hoc group that has congregated around the table disappears, then what happens? How does that affect the inter-action among the others? How do you maintain a continuous dynamic that is actually reward-ing to the people who are at the table? If there is only one person left, is it still rewarding?

Another issue we addressed in some detail is the fact that some multitouch tables do sense tangible objects like fiducials while others don't.

Opportunities

What are some of the opportunities going for-ward? People in the group were very reluctant to give up the tangible and the physical object, and thought there was real power in the mat-

Opportunities Going Forward

• Tangible objects as controllers or artifacts

• Implicit or explicit recognition of users and their needs/abilities/requirements

• Table is a doing space, wall a viewing space

• Ability to harvest experiences to take home via a surrogate (card, URL). Ideally with a little work required on part of visitor to add perceived value
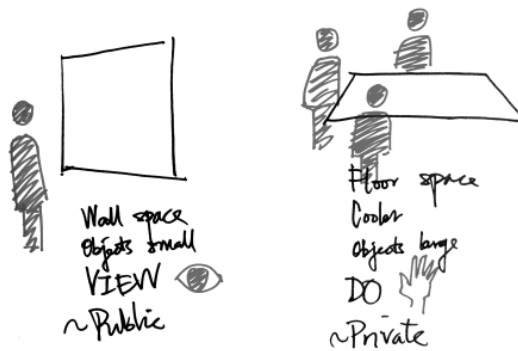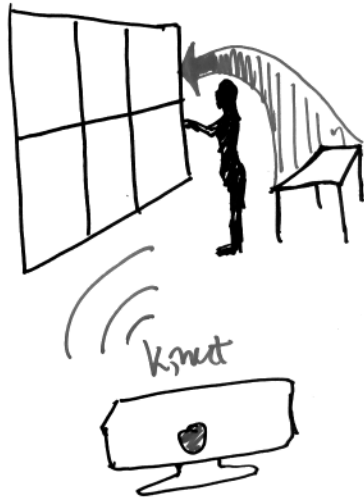
ing of physical objects to tables. There was also the sense that a table is a metaphor for a work space, a doing space, a making space. People are used to having objects and sharing objects, and just having a glass pane might not be as satisfying.

Tangible User Interface
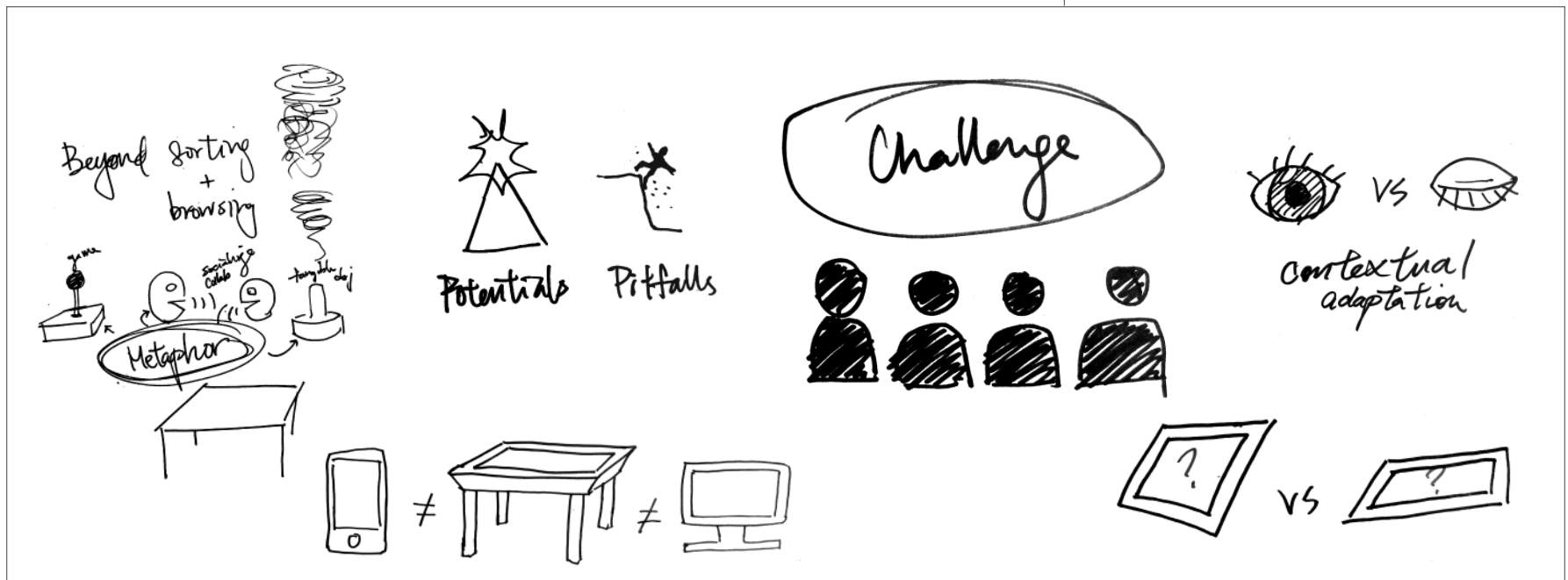
Rough working sketches during group discussion
(not necessarily accurate representations of the final ideas presented)

Sina was in the group, and we talked a lot about implicit or explicit recognition of users and their needs, abilities, and requirements, but not just in relation to different abilities. Sina talked about ways of making the table smarter. For example, maybe you put your hand on the table in a certain way and it understands you now need audio assistance. If I've got my hand on the table and move it a certain way, it suddenly tells me everything that is around me. There was the question of whether that happens just in my zone, with Bluetooth or a headset that I plug in for input, or for everybody around the table so that we can share in that kind of teachable moment. And does that become a sound design opportunity, provoking us to think about another aesthetic dimension to the table interaction?

We questioned the differences between a table that is horizontal and a multitouch wall, and the advantages and affordances that each one accommodates. The table feels like it is more of a doing space and the wall more of a viewing space. Tables also feel like more of a social space. If you're in front of a wall there is a kind of privacy barrier. No one else is going to get right in front of you, whereas with a table there is a shared space. Someone might reach into your zone and there is more social communion.

Another opportunity might be the ability to harvest experiences, to take them home via surrogates, transferring them from the table via card or URL.

About Discrete or Shared Audio on a Touch Table

- What Sina described is called a localized access overlay, or sphere of influence projected from the hand of an eyes-free user touching the table. The way Sina described it, it may go out only six inches or so, so that if you have a large table with such a user touching one section of the table, only that section is subject to access-overlay interaction techniques, and can speak or Braille the relevant information on an iPhone or other mobile device that visitor carries, without disturbing others interacting at the very same table. • **Bill Meyer**

- Or maybe they listen, but they don't initiate it in their zones. • **Peter Samis**

- Maybe if they move into your zone they are experiencing what you are experiencing • **Bill Meyer**

- We also talked about the idea that one hand is in that mode that triggers it, so anything the other hand does is vetted. You're not talking about a sphere of influence at that point, but connecting the two hands together so that it knows which touch is related to the person to whom it should give the audio. • **Participant**

- And that raises the question of whether there is a camera in the table or whether it's just a multitouch surface. • **Peter Samis**

Examples: Physical Objects Interacting with Tables

"Plankton Populations," Exploratorium

Bill Meyer

This exhibit involves maps of plankton population blooms, done in collaboration with some really high-end visualization scientists at UC Davis and MIT, so a lot went into this table. It's an example of a touch table sensing and interacting with physical objects. However, it doesn't sense rotational orientation—just x/y position. In visitor testing, more proved too confusing. There are informational panes, but rings become magic lenses exposing swimming, microscopic plankton species. People are surprised to have a reactive things to touch.
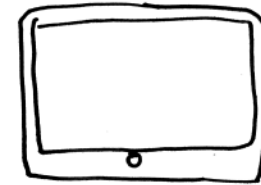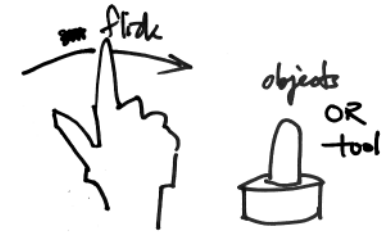
Tangible Fiducials

Graham Plumb

Here, museum collection objects are embedded in the pucks so there is a kind of AR quality about them. They are eliciting the information that you wouldn't get any other way.

Tangible Objects, Bishop Museum

Graham Plumb

[Video Clip]

The idea here was that the tool is also the

"Plankton Populations"

Tangible Fiducials

subject. You could do a taxonomy exercise just by picking up the tool, observing it, putting it down, and sliding it along. Here it involves an electron microscope experiment, so you are using the tool to zoom in to these scary looking flies.

Recommendations

Presenting: Peter Samis

We also talked about recommendations for future R&D. Clearly, one of those is experimentation with physical objects on tables. Another is techniques for curating or moderating visitor contributions. At MoMA you may have seen this [*below left*]: "I went to MoMA and..." People respond using a pen or pencil on the card, which is very analog and very physical from that point of view and captures emotion and personality. They then take that card to a scanning station in the lobby, which involves a completely brainless, simple action. There is a white counter, you drop the card in, it scans it, and then immediately projects it on the wall. It also puts it into the database, which also goes up on the website.

The center card here says, "I went to MoMA and saw a coat closet, trash

Peter Samis (left) and Bill Meyer hone ideas

Photo: Ideum

Visitor Contributions

I went to MoMA and...

GREW

What's your story? Leave your mark at MoMA.
MY FIRST NAME GARY   DATE 5.9/11
I'M FROM AFRICA   TIME 4.10 ®

I went to MoMA and...
Saw a coat closet trash and two water Fountains I'm very disaponted I did not see a dinasour you call your self a museum!

What's your story? Leave your mark at MoMA.
MY FIRST NAME Annabelle   DATE 2.23/2001
I'M FROM New York   TIME 3.3 ®

I went to MoMA and...
I entered
I looked around and
I felt like I opened up

What's your story? Leave your mark at MoMA.
MY FIRST NAME Anna   DATE 4/11
I'M FROM CT   TIME 1.10 ®

Recommendations for Future R&D

- Experimentation with physical objects on tables
- Techniques for curating or moderating visitor contributions
- Think beyond paradigms of handhelds and tablets
- Leverage the fact that multiple users gather around, for collaboration and competition
- Explore social games
- Explore three dimensions

and two water fountains. I'm very disappointed I did not see a dinosaur. You call yourself a museum!"

The Lemelson Center offers visitors the opportunity to create a map of America (and perhaps beyond to the rest of the world), and mark sites where invention has taken place. A lot of people nominate their own sites of invention. The question then becomes, how do you moderate, how do you cull all of those visitor contributions coming from the floor or online? The MoMA example was offered as one approach to that, but the question of techniques for curating or moderating visitor contributions is still wide open.

We also talked about thinking beyond the paradigms of handhelds and tablets. Then there is leveraging the fact that multiple users gather around for collaboration on the one hand, but also for competition, and the
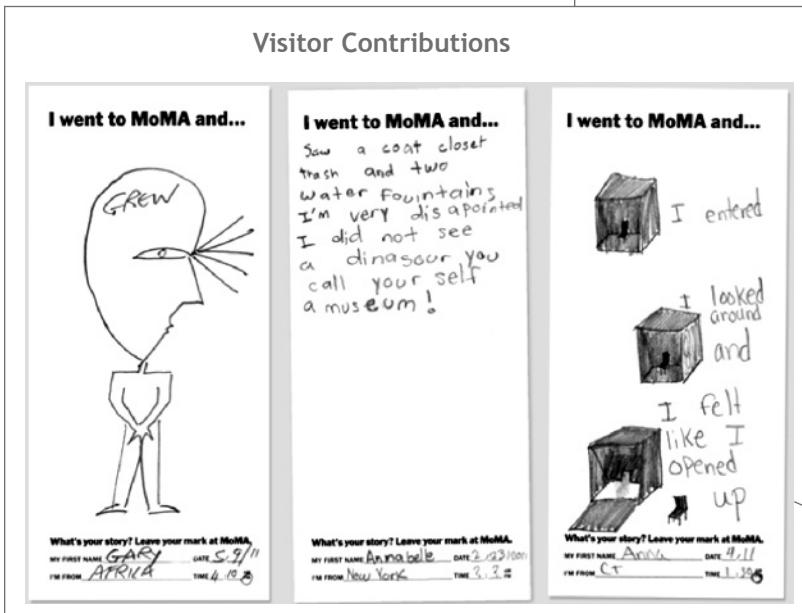
gaming models that could involve as well as the social dynamics. There are social games you can create as well. Sometimes they can be simulations of physical or geological things. One example that came up was *Maya 2012: Lord of Time* at Penn, done by Bluecadet [bluecadet.com/work/maya-2012-lords-time]. It simulates an archeological dig, with multiple people engaged around the table, and involves moving the sand away and discovering the artifacts and getting that sense of the dig. So there are different ways of collaborating and competing.
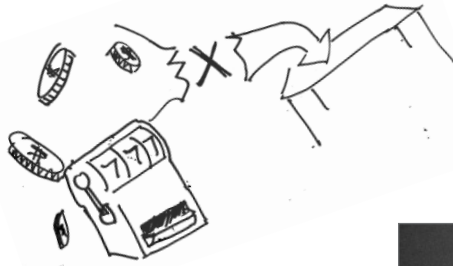
We also recommend exploring social games, and finally exploring that third dimension, which includes the space right above the table. Increasingly, with cameras and other technology, there is the ability to not even be touching the table and have it be interactive.
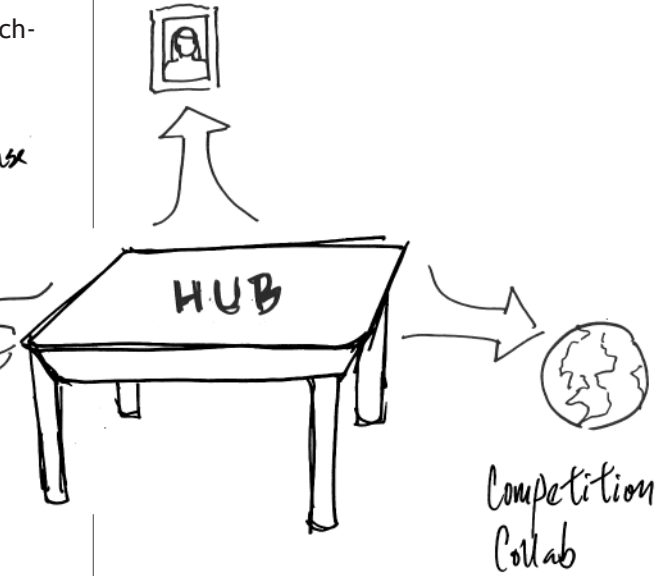
Multitouch, Multiuser group

Discussion on Interest Groups

INTELLIGENT USER INTERFACES

Profiling Human Emotions, Steering Learning

• My feathers were ruffled a bit during our breakout session and it has opened my eyes to one of the issues I don't think we've cracked open yet at this conference. Maybe we could call it CHI, computer-to human interaction. A few of you have actually touched on it, the perceived need for the technology itself to profile the user, to recognize the user's frustration, and so on. The new Microsoft Kinect system is going to actually read your face and assume that if you smile you're happy with what is going on. I am really troubled by that for all of the reasons that profiling should trouble you. And the existence of contradictory personalities such as my own obliviates the whole ability to profile because if you tell me I'm happy, I'm going to tell you I'm not. It is obviously something we are going to be moving towards, but it is a big puzzle.

Another aspect of this is that we already know there are a lot of different learning styles, people who learn in different ways, but we also each individually learn in different ways. I have a three-year-old daughter,

Kathleen McLean and Paul Orselli

and when she engages in some activity my wife comes along and helps her, and that is good and she learns from that. But when I am in the room I don't help her. She gets through her frustration and quickly figures something out, and that helps her too. So it's beautiful, it's this organic system, it depends on who's in the room, and she learns all of these different ways of doing things. Whereas if it were a computer saying, "You're frustrated, therefore A, therefore B," she wouldn't get that rich learning environment.

• **Jason Stevens,** Principal and Exhibit Designer, Flutter & Wow Museum Projects

IUI and Informal Science Education

• The field you might be looking for is intelligent user interfaces, or IUI. It's the idea that the interface is actually non-deterministic. Depending on input from the user, the environment, the data, or a combination of those, it behaves in a different way. If you're interested, you might want to look at that and preference systems.

It's an interesting point because in a museum, and in ISE in general since we are trying to not just single out museums, you have a particular point that you might want to make. In my breakout group we talked about starting with the content, not

the technology. If you are starting with the content, the difficulty is to construct an intelligent user interface that still conveys that content, but in different ways. And I don't mean the simple stuff like multiple modalities, where you can see it or you can hear it, but actually different ways. The major challenge there is going to be how much you are willing to either elicit from the user explicitly or infer implicitly, and that's an active area of research right now.
• **Sina Bahram**, Accessibility Researcher and Ph.D. candidate, North Carolina State University Knowledge Discovery Lab

Cognitive Tutoring: Prompts and Helps

• I think profiling may be the wrong way to think of it. There is the whole cognitive tutoring school of research going on that comes out of the Department of Defense and the military. With an SAT test, for example, as you go through the system it gives you helps and prompts, the way Jason described helping his daughter through a problem. Cognitive tutoring is probably something we should be looking at. As people interact with our systems we may be able to guide their interactions. • **Marti Louw**, Research Faculty and Designer, University of Pittsburgh Center for Learning in Out-of-School Contexts

Reading Levels of Frustration

• My point is that we all have different tolerances for frustration. I can be frustrated for 40 minutes before I give up, whereas somebody else may give up after two minutes of frustration. How does the system know my tolerance? And of course my tolerance changes during the day. • **Jason Stevens**, Principal and Exhibit Designer, Flutter & Wow Museum Projects

• With cognitive tutoring systems you can dial in your level of frustration as well as other kinds of things. • **Marti Louw**, Research Faculty and Designer, University of Pittsburgh Center for Learning in Out-of-School Contexts

CREATING TIMELESS EXHIBITS

Aesthetics, Timelessness, and Geography

• In the report-out by the Aesthetically Pleasing Digital Experiences group, Wayne LaBar said something that ruffled my feathers. It's probably because as a creative director I have to be a bit of an aesthetic snob.

Plenary discussion

Aesthetic Experience versus Style

• We are talking about the aesthetic experience, which goes much deeper than style and taste. I think we are getting style and taste and aesthetics kind of twisted up and I would love to have more time to have a deeper discussion about this. • **Kathleen McLean**, Principal, Independent Exhibitions

When I hear the idea that aesthetics have to be timeless it really irks me because I feel that aesthetics are interesting because they're *not* timeless, but change and evolve. We should also remember they are geographically related. When I look at British graphic design versus design from the Continent or Europe, it has a different quality to it. I kind of wish the interface for the Apple computer had been designed in East Germany and not California because I don't like the way it looks so shiny.

At the same time, I feel it is possible to create aesthetic design that doesn't date so quickly. That talks to the qualities that you were highlighting such as keeping it simple and elegant and so forth. • **Graham Plumb,** Creative Director, Snibbe Interactive

• I wonder how Dave Patten would respond to that? It was he who brought this up in our group. • **Wayne LaBar,** Principal, ALCHEMY studio

• If your permanent exhibitions in museums are around for a long time, and some of them are around for ten years, it should not feel dated. There is a worry that people get caught up in the aesthetic of the moment and that's what they embed into an exhibition. Five or ten years later it kind of looks awful. I'm not sure it's about being completely timeless, but it is about not being too bound up by the things that are of the now. • **Dave Patten**, Head of New Media, Science Museum, London

• How do you find that sweet spot? • **Graham Plumb**

• I think it's really hard. Even if it's electronic, quite a few museums don't have the funding to go back and make those changes because we're off doing the next thing. I think we're getting better at putting money aside to do those long-term changes, but it's not an easy thing to do. • **Dave Patten**

The Timeless and Technology

• I think we could all get sucked into building exhibits with Microsoft Kinect, which is a real interface of the now, and then in two or three years' time something far better comes along. Ten years from now we've got these exhibits running which are going to feel like they have an oddly old-fashioned aesthetic, though they were really pleasing when we put them in. That's my concern. • **Dave Patten**, Head of New Media, Science Museum, London

• It comes back to the underlying technologies in the same way and believe me, I know this. We have a very developed framework in ActionScript, which was definitely the right move four years ago, but now... • **Jim Spadaccini**, Creative Director, Ideum; Principal Investigator, Open Exhibits

- If the system works well, how does the visitor know whether it's dated or not? If we have a stable system and then put something new in and the IOS has to be updated, I'm not going to want do that because it might destabilize the system. • **Daniel Davis**, Media Producer, Smithsonian National Museum of the American Indian

- I think to some extent it's really important what you buy into when you're using digital media and technology. You have to plan from the beginning that it is going to have to be revisited, probably every three to five years, because the computers are going to change even if the platforms don't and are still viable. Some tweaks are going to be required or the thing gets so far away from the point where it can even be updated that it has to be completely redone. • **Bill Meyer,** Director of New Media, Exploratorium

- There used to be a genetics exhibit on the floor of the Exploratorium that ran on a Mac Plus. It finally got redone, but that was on the floor for 25 years. There was a timeless quality to that. • **Jim Spadaccini**

- True enough. At the Exploratorium we have many exhibits that we recently updated *en masse*, but in an ideal world I think museums would identify what each interactive experience itself is at the core, what they want to preserve, and then in some kind of regular

way revisit each so they don't get to the point where exhibits have to be completely re-coded due to technological obsolescence. • **Bill Meyer**

The Timeless and ISE

- I think there's an extra layer to the timeless quality as well when it comes to ISE because science is changing and evolving, so if you are looking at an exhibit that is about climate change and it was made in the 1990s, do you feel like you can trust it as much as if you were looking at an exhibit about climate change that has the aesthetic design done in 2010 or beyond? • **Erika Kiessner**, Interaction Designer, Aesthetec Studio, Toronto

PARTICIPATORY EVALUATION

- Someone mentioned participatory evaluation. I didn't know if that was a speculation or something that has actually been practiced. • **Jason Stevens,** Principal and Exhibit Designer, Flutter & Wow Museum Projects

- It is something that we have practiced with varying degrees of success, and some have been highly successful. It is a practice that involves members of the design and development team in the actual process of evaluation to varying degrees based on the nature of the project. Sometimes that only includes the development of the resources. Often it includes the collection of data be-

Experience-related Goals Driving Design

- In the Beyond the Screen group we were talking about experience goals leading the aesthetics, so it was less about how it looked and more about what it was trying to achieve. That can drive a lot of things, and I think it goes beyond learning objectives to actual experience objectives. What do we want people to think and feel? How do we want them to act? That can drive how things are actually designed. • **Mike Mouw**, Media and Technology Consultant, Gamut Interactions

Beyond the Tech: Broader Questions

• I feel like a lot of the discussions have been reactive to technology as it exists now, and are based on whether it's an iPad or some other specific technology and how to use that technology in this environment. To me, a lot of that is a blip in time in technology, which on some level is sensors, interpretation of sensors, and feedback.

I have some broader questions stemming from the discussions so far:

- What is the relevance of physical objects in a world where cultural production exists everywhere and nowhere at the same time?

- What does it mean to be able to participate? Thousands of people create an encyclopedia, the body of knowledge of the world, and perhaps participate in their own government unfiltered by traditional institutions of academia or museums. Are we threatened by that? What is our role?

I feel the technology is there and it is the role of cultural institutions and those in the field to think about ways that is being used and what our role in it is in the future. • **Olivia Jackson**, Media Producer, Oakland Museum of California

cause I think that is one of the most valuable steps. Ideally it also includes the evaluation discussion of the data and findings at the end. It is a powerful thing when an exhibit developer can be in the exhibit and see what we see when we are collecting data, and has the opportunity to reflect on it in that way. It is a very different dynamic in the discussion or reflection process when they have that firsthand knowledge. Email me and I can share some of the things that we've done. We have presented at conferences, so there are some things that are moderately public.
 • **Jennifer Borland, M.A.**, Media Programming and Learning Technologies Evaluator, Rockman et al.

• Part of the power of it as it was described was that the people who were involved in the design and the creation of the project were also involved from the get-go with the evaluation in figuring out what they were going to be evaluated for, so when they went out on the floor with the evaluator later on they were all in this kind of group mind-set.
 • **Peter Samis,** Associate Curator of Interpretive Media, San Francisco Museum of Modern Art

• We used to do this a lot, and a lot of it had to do with staffing resources. The people designing the exhibits had to get out on the floor and do evaluations because we didn't have a whole evaluation staff doing them. We now have a larger staff, but over the last year or so I've been wanting to push

the idea that everybody has to get out there and gather some of the information and talk with some of the guests, and I now have the language to do that.

Personally, I can see a huge difference in the conversations we have as a team about how effective things are when the people who are creating the exhibits are still living in a fantasy world where everything works. The evaluators come in and say, "These are the things that didn't work," and the designers say, "Well, it would work if people would do this."

With participatory evaluation we were able to dive in and have more real conversations, and we got to a point of shared understanding much more quickly. So I am throwing in my high recommendation. • **Kristen Nesbitt**, Director of Exhibits, Shedd Aquarium

Identifying Potential Pitfalls

THE DOWNSIDE OF TECHNOLOGY

NSF Proposal Reviewers' Concerns

• When we wrote the proposal for this conference, the reviewers who read the proposal before we received the NSF grant voiced the concern that this should not be a "tech fest." We assured them that we were going to look at the downsides and pitfalls of technology. I'm not sure we have done enough of that. • **Kathleen McLean**, Principal, Independent Exhibitions

• I think the words they used in voicing their concerns is that we would be "cheerleading the technology," and they had concerns that we wouldn't be critical enough about how and when to implement it. While "it depends" is a great answer, and I think we all know what that means, the question is how we get at that and figure out what questions we might ask about when technology is appropriate or not appropriate. • **Jim Spadaccini**, Creative Director, Ideum; Principal Investigator, Open Exhibits

• Or identify the shortcomings of technology right up front. • **Kathleen McLean**

Low Barriers and Profiling

• We talked about barriers a lot in the break-out sessions that I've been in. The topic of keeping a low barrier has been a theme. I also ranted a little bit earlier about the horrible future of computer profiling. • **Jason Stevens,** Principal and Exhibit Designer, Flutter & Wow Museum Projects

Content/Experience at the Fore and the Lure of Shiny New Things

• A couple of times people have mentioned the importance of starting with the content and

Reflecting on issues, ideas, questions

Ongoing Support and Maintenance

• One big question I have that I think is relevant to the Smithsonian and any large museum is being able to support it and maintain it. It's great when the exhibit first opens and you've got the people there who installed it, and you've done all your prototyping and all of those good things, but when you are having hundreds of thousands of people coming through, is it going to hold up for the five years that the exhibit is there? Is it going to become outdated, or do you just lack the support? We don't have a lot of AV tech support at our museum. You've really got to think about some of those practicalities. • **Monica Smith**, Exhibition Program Manager, Lemelson Center, Smithsonian National Museum of American History

the experience that you want to deliver and the danger of getting excited about a shiny new thing. Or someone else gets excited and decides we need to use this shiny new thing. I think that is a very real phenomenon that happens. It's something that came up a bit prior to the conference on the LinkedIn discussions, but I don't know that we've focused on it as much here. • **Tamara Schwarz,** Associate Director of Exhibit Content Development, California Academy of Sciences

• I'd like to speak up in defense of shiny new things. They get a bad rap sometimes. It's all in the way you approach it. If you have a shiny new thing in your hands you need to turn it around and look at it and ask, what is this actually good for? Are there special affordances that this offers the museum that

we couldn't do before? What is it that makes this special that we couldn't possibly accomplish through any other interactional means? What kinds of social possibilities does this make available to us? I don't think there's anything wrong with shiny new technology, you just have to be intentional in your use of it. • **Leilah Lyons**, Director of Digital Learning, Assistant Professor, New York Hall of Science / University of Illinois at Chicago

Limited to Indoors

• I was talking to Jim Spadaccini and said, "Hey, none of this stuff can go outside can it?" He said, "No." Half of my exhibit space is outside. It will be interesting doing the upcoming seven-years-in-the-future exercise [*see "Time Capsule"*], because it will probably be seven years before we actually start to work on our indoor exhibit plans. I thought, I'd better not be thinking in terms of what I've seen at this conference so far because seven years from now is when I'll be able to use some of this stuff indoors. That is a real limitation for spaces that are exposed to the elements in Chicago. That eliminates a lot of what you can put in your space. • **Allison Price,** Director of Education, Lincoln Park Zoo

Translating Media Between Venues

• I think one real problem in different venues is that you directly transfer media—games,

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Two Issues: Ecological Impact and Ubiquitous Screens

• I feel like the outlier advisor here. I am deeply conflicted about digital technology in cultural institutions. Thanks to Sina Bahram, we talked a lot about accessibility issues related to that. I know we won't have time to talk about these other two issues, but I think they are issues that sort of get swept under the carpet a little bit too glibly in our discussions.

One is the notion of the impact these digital tools have, just because of what they're made of, in terms of green design and sustainability and ultimately where they end up in the waste

stream. I think we don't ever come to grips with that in the way that we should.

The other thing I think we too glibly sweep under the carpet is this real impact that screens have on the social context. If we want to be social institutions (and that is *if*), I think we can't underestimate the impact of not only the screens that people bring into those institutions, but the multitude of screens that we provide for people in those institutions. • **Paul Orselli**, President and Chief Instigator, POW!

websites, social networks—and they don't directly transfer to that environment. A lot of effort needs to happen in testing and prototyping and play testing to see how that media and technology transfers into another environment and enhances that environment and doesn't split the focus or repeat what's at home. I see a lot of that and it is really important to put in that extra effort.
• **Christopher Stapleton,** Creative Venture Catalyst, Simiosys

The Need for More Prototyping

• One thing that I heard a lot about during the interest groups was prototyping. This is a room full of people who know that we need to prototype things and over half of the presentations talked about that: We need to do it; we need to do it better; it's really hard to do. We also talked about a lot of great examples of technology. I know in the Is This Tech Necessary? group we sat around and talked about really poor examples we've seen involving technology on the floor and said, "Boy, they've used tech really badly there."

It comes down to the question of that is so hard. We know it's time, we know it's money, we know it's cultural, but what is really keeping us from prototyping things and making them better? What's standing in the way of that? • **Erika Shugart, Ph.D.,** Principal, Erika Shugart Consulting, LLC

Example: Just Enough High-Tech

• I was having a conversation with Marti Louw about using technology but not overusing it. Again, it is looking at what is the human experience in something and honestly asking, would more technology add anything meaningful? An example that Marti brought up was using high-resolution Landsat images. At the Exploratorium we put up a 3x3 high-resolution video display wall that can display HDx9 in terms of all the pixels. She talked about how there are newer things that allow you to step up to a display and zoom in, and I pointed out that in my experience you may not need to do that if you have such a high-resolution image. The elegance is that as visitors simply walk toward the wall, they functionally zoom in because such amazing resolution only becomes apparent as one gets closer. It's as if everybody has their own magnifying glass. This is something in a museum that is not super-duper high-tech, but just high-tech enough to display a super high-resolution image. • **Bill Meyer,** Director of New Media, Exploratorium

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Evaluating Whether It's Effective, Getting What Isn't Off the Museum Floor

• One of the things that has been really interesting about this conference is that there have been a lot of great ideas, but there are also a lot of unknowns. Even though there are a lot of data and a lot of research being collected, we still don't know, in a lot of cases, how well any particular use of technology is working in our informal science environments.

We've seen a lot of lowering of the barriers to including technology in recent years. The costs are going down and it is becoming more available. We're lowering the barriers to changing the content or the stuff that's on the technology as skills and toolkits become more widely available.

I think one thing that we are not very good at is lowering the barrier to removal of these technologies. We get so invested in them in our spaces that they become permanent fixtures even if they're not working. You can front-load the decision making a lot, but you also need to evaluate it after it's on the floor and be brave enough to take it off if it's not doing what you want. • **Matt Celeskey**, Exhibit Design Manager, New Mexico Museum of Natural History

A Useful Tool

• The root of "technology" is the making, knowledge, and usage of tools. If we were a gathering of graphic designers I don't think we'd be saying graphic design sucks. And if we were a gathering of object collectors I don't think we'd be saying, "Do objects suck?" So to say there are pitfalls with technology is not really the right approach. It is about how we use it as a tool for what we are trying to accomplish. It's better to always think of it as a tool, a means to an end, not something on its own. • **Mike Mouw**, Media and Technology Consultant, Gamut Interactions

Mindfulness, Sharing, and Barriers to Wonder

• I feel it's the whole issue of mindfulness that becomes so important within these contexts and in these discussions. It is that constant negotiation of the time and the space and paying attention to that continuum. A lot of what is important about the tech aspects and interactions is about the sharing, including sharing with people who aren't there and being able to document personal narratives. My background is also in folklore, involving a lot of meaning making and narrative creation. I did my thesis on how people were using HTML (at that point) to create websites and tell their stories. As a professional and as a parent, when I have my kid come up and take my phone away, it seems like there is that barrier. I see that in the gallery when people are not experiencing wonder and awe because they are too busy caught up in a different moment that is not the moment they are in. • **Kristen Nesbitt**, Director of Exhibits, Shedd Aquarium

GUIDELINES FOR TECHNOLOGY USE

Three Simple Rules

• Back when computers and digital technology first started coming into the Ontario Science Centre we had a conversation about when we would use this stuff. We came up with three basic rules that I think still kind of work now after all of these years.

Rule number one is you never, ever use a computer. When you can't follow rule number one, you hide the computer, which is rule number two. If you can't follow rule number two, you make the computer the center of the experience, you make sure it's about that technology. While these seem like pretty simple-minded rules, and there are plenty of things you can say about them that are skeptical, we find these rules a continuously useful thing to keep in mind when we are contemplating the next wave of technology, and I think they still work. • **Kevin Von Appen,** Director of Science Communication, Ontario Science Centre

Who Is Serving Whom?

• I would like to frame this in terms of who is serving whom because technology is not inherently bad and humans are not inherently good. There are plenty of technologies that we don't notice anymore, like elevators, for example, or automatic doors. The problem here is that humans tend to internalize what they invest in. For example, there was DOS, with gurus who had invested huge amounts of time using their magic words to put their spells on the machines to make them able to do something. Then came the Windows-based interface and all of these DOS gurus were very resilient in giving up their priori-

ties because they had just lost their shaman-like positions.

So I think it really boils down to the question of who is serving whom. While one could make technologies that would require the users to jump through the hoops and learn a whole new language, whether it is gesture-based or something else (e.g., hold this in your hand, tap yourself on the head three times, look to the right, and things will happen), if you just look at it in terms of who is serving whom then you will know which technological solutions work and which do not. • **Slavko Milekic**, M.D., Ph.D., Professor & Chair, Department of Art + Design Education, University of the Arts, Philadelphia

• To follow up on what Slavko said, I heard the idea once that technology is everything that has been invented since you were born. • **Erika Shugart, Ph.D.,** Principal, Erika Shugart Consulting, LLC

Considering All Potential Tools Before Opting for Technology

• In the "Is This Tech Necessary?" discussion, we talked about some of the things that have been touched on here, but I think we can't underestimate this issue of what message we are hoping visitors will walk away with. First, what is the most important aspect of that message, and then what is the best tool to make that happen? That is not to say that I am against technology, obviously

I am not because I am here, but in thinking about technology we need to think about whether it is the best way to get across this message that is so important to us.

There is one question I think we can all ask

Where Does Technology Fit in the Puzzle of Context and Meaning Making?

• In some ways I feel like I know less and less about the most effective way of getting proper context and meaning making across to people. In the old days in an art museum, the gallery withheld all of the context that might actually help people understand what the artists were coming to grips with at any given time. We were able to put a lot of that into multimedia programs, but they still weren't necessarily accessible, you got to them afterwards.

With multimedia mobile tours you could begin to put the context and meaning onto those. Then questions arise about the audio tour, even if it's a multimedia tour and even if it's randomly accessible. At SFMOMA there is more of a schismatic divide. There are those with the real sense that technology is not just a tool, as we've been saying here and understand it here, but is somehow antithetical to the presence of a sensitive viewer in front of an artwork.

When I was just thinking about technology, technology was always the solution. But when I think about interpretation as a whole then I start thinking, what about wall labels? What about the text? What about bringing humans into the gallery on a more regular basis who can be hosts and talk to people, not via arti-ficial intelligence but real intelligence and just-in-time information? All of those things are part of the puzzle.

So I kind of feel like I know less about when technology is appropriate than I used to. • **Peter Samis,** Associate Curator of Interpretive Media, San Francisco Museum of Modern Art

• I really identify with this situation because I went to art school years and years ago and I really do not want technology to invade my space as I'm standing in front of a painting trying to experience it. But I'm also in the situation of trying to be a media producer who is creating media that will go into museums. I would feel very uncomfortable creating an app that you take around the museum as a device.

I think what makes technology really powerful is this temporal quality that means that you can create connected experiences. In fact it is very, very manipulative regarding how people will behave in a museum. As experience designers we manipulate, though I don't know if that is the right word. We create, we manage this experience. • **Graham Plumb,** Creative Director, Snibbe Interactive

A Place at the Organizational Table

• One of the things I always kind of hate about these conversations is that we frame the conversation as if we are still asking for a place at the adults' table at Thanksgiving, and that is really bad. It is a given that we are part of the institution and our organizations at this point. You don't have librarians out there asking whether books are a good idea or not, or exhibit designers asking whether exhibits are a good idea or not, or art curators asking whether art is a good idea or not. I think we're beyond that. We need to stop thinking in terms of a technology strategy plan or something of the sort. You are part of the strategy of the organization. Technology is part of what the organization does, how it does it, and what it should be doing. It's not a question of if, it's how. **• Bruce Wyman**, Principal, USD Design | Mach Consulting

ourselves: This may be a great tool for what we want to do, but what are some other tools? Let's just think for a moment about the array of tools at our disposal and then consider whether technology is still the best one. In considering all of the other options have we decided yes, this is the best way to do it? I think it is just a matter of being careful to ask ourselves that. **• Monica Smith**, Exhibition Program Manager, Lemelson Center, Smithsonian National Museum of American History

• All of the work I do is dependent on fairly new technology, so I am a big fan of technology, but for the last 20 years I have always employed the rule: Just because you can do it doesn't mean you necessarily should do it. I think a lot of people have said something similar.

So I love technology and what I am about to say is not an indictment against technology. However, one of my deepest and most emotional museum memories is the first time as a child when I walked into the Museum of Natural History in New York and saw those incredible dioramas. I can picture them in my mind's eye right now. It gives me almost a physical reaction. So yes, we can use technology to create those emotional, magical, "Wow" moments, but that is not the only way we can create them. I'm basically agreeing with what everyone else has said. We have this incredible array of tools to use.

Let's just always use the ones that get us where we want to go. **• Susan Kirch**, Creative Director, Right Brainiacs, Los Angeles

Developing a Heuristic for Tech Decisions

• Coming home from the reception at Ideum we were talking about social media in our personal lives, and when you sign up for something and when you don't. One heuristic that I use in my own personal life when it comes to technology and social media in my home is that I use technology to make time, not waste it. It helps me understand what things I want to continue to do and support and what things I want to pare down. It occurred to me that it would be cool to have a heuristic like that when we are thinking about developing exhibits with technology. It wouldn't be about wasting time necessarily, but it could be about ISE and learning in some way, and could also relate to things like the maintenance as well as the visitor experience. **• Beck Tench,** Director for Innovation and Digital Engagement, Museum of Life and Science

TIME CAPSULE

PREDICTING FUTURE HCI+ISE SCENARIOS

Creating a Time Capsule

Overview

Conference participants formed six working groups, each focusing on the future of human-computer interaction in an ISE setting in the year 2020. Each work group drafted a vignette describing a future scenario. Those vignettes were then shared in a plenary session and appear on the following pages. This segment of conference documentation will also serve as a stand-alone time capsule, which will be emailed to all conference participants (and others who sign up), seven years from now. Check your inbox on June 14, 2020.

Plotting the future of the Shedd Aquarium

Predicting the Techno-Future of Six Institutions:

- Indian Pueblo Cultural Center, Travis Suazo
- Explora!, Joe Hastings
- New Mexico Museum of Natural History & Science, Charles Walter
- San Francisco Museum of Modern Art, Peter Samis
- Shedd Aquarium, Kris Nesbitt
- London Science Museum, Dave Patten

Time Capsule Orientation

Jim Spadaccini
Creative Director, Ideum
Principal Investigator, Open Exhibits

Olivia Jackson mentioned earlier that much of the technology we are discussing is a blip in time, which leads right into this time capsule activity. If we are spending money developing these types of interactives, in all conscience we need to think about where all of this technology is headed.

At this point we want to bring the ideas discussed thus far together and think about possible scenarios in the year 2020. To do that we are going to be looking at six different organizations. We are lucky in that we have at this conference all three of the executive directors of the three New Mexico organizations that are part of this activity: Explora!, the New Mexico Museum of Natural History and Science, and the Indian Pueblo Cultural Center. All three directors are relatively new in their positions within the last year, so the timing is fortunate and the time capsule activity offers a chance to help predict potential futures for these institutions.

 We also have three other institutions to round this out including some larger institutions, an art museum, an aquarium, and a large science museum: the San Francisco Museum of Modern Art, the Shedd Aquarium, and the Museum of Science in London.

The Task for the Workgroups

We are asking each group to envision how these institutions may (or could) change in the next 7 years and what the visitor experience might look like in 2020. Each group should explore possible vignettes of visitor interaction in 2020, which will then be shared with the larger group. Each activity will start with a 5-10 minute presentation by the institution's stakeholder. It will cover the history and unique culture of the institution, the audience and constituents of the museum, and the range of experience that visitors currently explore.


Your task is to envision what these institutions will look like in seven years. If we come back to the Indian Pueblo Cultural Center, walk through the door, and go through the galleries, what will we see? What will visitors be doing? What is different?

We have a lot of questions regarding what the future of these institutions will look like [*see "Envisioning 2020" in sidebar on next page*], and we don't expect you to answer all of them. Questions regarding the personal devices that people bring with them has already been a hot topic during this conference. Can visitors use those devices to connect to other exhibits in the space, and what does that interaction

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Consumer Space vs. Museum Space

Consumer space is moving at such a fast pace, we need to keep in mind what types of devices and expectations our visitors will bring. Can museums keep up? Should they? Will we see an acceleration in technology use in museums (and other public spaces)?

Jim Spadaccini
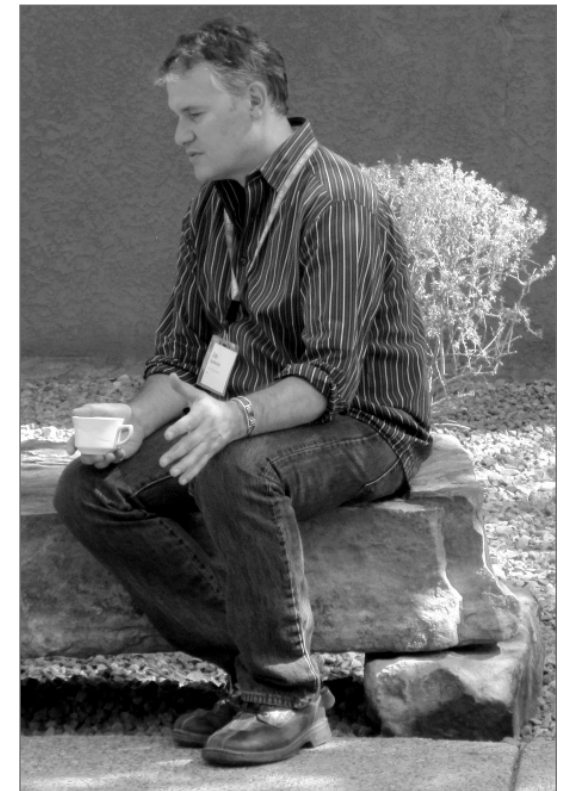
Envisioning 2020

In 2020, what will the initial experience be as visitors enter the grounds or come in the through the front entranceway?

• What personal or mobile devices will visitors bring? Can they use these to interact on the floor? Can they connect with exhibits or with other visitors? What does this interaction look like? (Or do museums ask folks to check their devices at the door or restrict their use?)

• How does the visitor experience change in terms of interaction with the exhibits and with each other? How seamless (touchless) is the tech? Does it take you out of the experience? Is it more ubiquitous? More invisible? More experiential?

• Are there examples of exhibit types that you think might change with new educational approaches using HCI technology?

• Is wayfinding enhanced? If so, how?

• Will visitors share their experiences with others in real time? Or post visit? Does the museum have ways to encourage visitor follow-up and "take aways"?

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look like? Is it a plastic card with a URL? Is it something a little more compostable? Or, as some have suggested, do you ask people to check their personal devices: "Please remove your goggles, your watch, and your phone and leave them at the door."

How does this change the visitor experience? How seamless or touchless is the technology? Is it a ubiquitous experience so that I am not initially aware of the technology incorporated in some of these exhibits? Does it take you out of the experience? Is it more invisible, more experiential? Again, a lot of these are things we have talked about over the last few days.

Are there examples or exhibit types that you think might change based on new HCI technology? Is wayfinding enhanced and if so, how? Will visitors share their experiences? Is there a post-museum experience? Is there a pre-museum experience?

What we are looking for is vignettes, little scenes of what might be happening in these institutions in 2020. That may involve something that happens when I come through the entryway of the museum, or when I walk down one of the gallery spaces, or when I engage with a certain exhibit or set of exhibits.

The kicker is that all of you are going to get an email in June of 2020 with the results from these activities. And in fact I have a visual representation of this.

Here is the time capsule floating in space, and in it are all of your ideas.

There are a few other things I'd like to talk about to set this activity up. One of the things I've been thinking about in considering the future is that frequently the first version of that technology fails. Apple would consider this a failure, and Apple is a very failure-adverse group. Microsoft seems to take it a little better. Why didn't these devices persist? There were some fundamental flaws, and the flaws

The first version falls short

1987-1998

1996-2011 (last release)

aren't always what you think they'd be. There was a great story about the Palm Pilot, which was actually much more successful than these devices in that same time period. The story is that the engineer used to carry around a model of the Palm Pilot. When they would have meetings and say, "Oh, we should have it do this, and this," he would respond, "As long as it fits in here." There was the sense that having that form factor defined it, even though the Palm Pilot doesn't do as much as these other two devices.
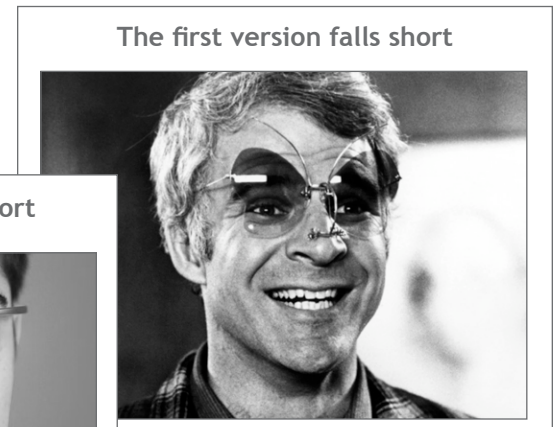
Obviously it's not just about devices but also software. You probably remember RealVideo. They were a powerhouse, a juggernaut back in those days, the first streaming video.

Then there is CUCME, the first video conferencing. "CU" stood for Cornell University. This is the early days of the Web, back in the days of NSFNET, and every university had their own little program they were working on.

The first version falls short

1993-2005 (last release)
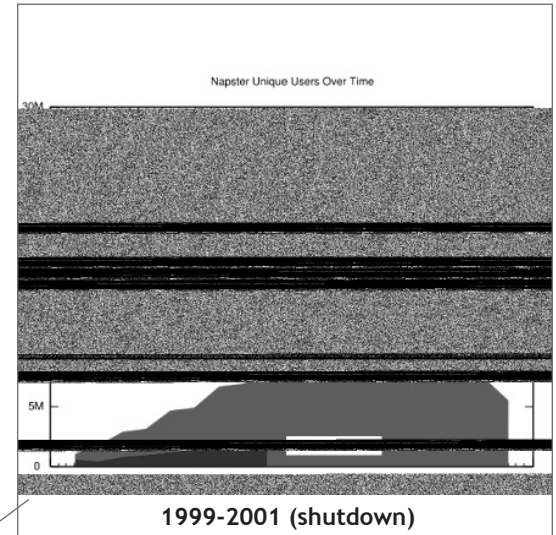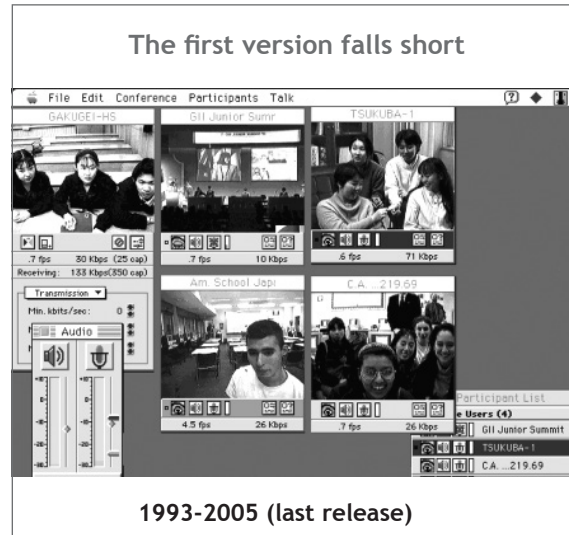
And there is Napster. Notice the spike and then the decline before they were eventually shut down, so they had already peaked before they were forced to quit.

And then... who knows? The picture at far right shows Steve Martin wearing an invention called the Opti-Grab in the 1979 movie, *The Jerk*. In

The first version falls short

1995- 2010 (last release)

The first version falls short

1999-2001 (shutdown)

The first version falls short

2011-?

The first version falls short

all seriousness we don't know the future of Google Glass. It could be Windows CE, but it's not out yet.

There are a couple of other ways to think about this. Just seven years ago Science on a Sphere was one of *Time*'s Best Inventions for the Year, Jeff Han did his Multitouch Table Talk at TED, the Wii was released, Twitter was created, and Facebook became available beyond the college crowd. That was just seven years ago. What hadn't happened yet includes the iPhone, iPad, Android, Windows 7, and Kinect. All of those were yet to come.

Let's go back a little further in time. You might remember these ads that reveal how AT&T envisioned the future 20 years ago.

made, Netscape Browser hadn't been released yet and wasn't on anyone's radar. This was still back in the days of Mosaic. The first couple of public HDTV broadcasts were in 1996. Real-Player launched in 1997 and was gone ten years later.

Just seven years ago

- Science on a Sphere (*Time* Best Inventions of 2006)
- Jeff Han's Multitouch Table TED Talk (August 2006)
- Wii Released (November, 2006)
- Twitter is created (March 2006)
- Facebook opened to everyone ages 13+ (September 2006)

Yet to come...
- iPhone (2007)
- iPad (2010)
- Android (2007)
- Windows 7 (2009)
- Kinect (2010)

AT&T *You Will* Ad Campaign
See a compilation of all 7 ads:
www.youtube.com/
watch?v=5MnQ8EkwXJ0

You Will (20 years ago)

AT&T Ads 1993

A lot of the things they predict in these ads actually happened. When those ads were

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You Will (20 years ago)

AT&T Ads 1993

Yet to come...

- Netscape Browser Version 0.9 (October, 1994)
- First public HDTV broadcast (July 1996)
- RealPlayer streaming video released (1997)
- Dragon Naturally Speaking - Speech Recognition (1997)
- DiamondTouch Multitouch Table (2001) WordPress started (2003)
- Depth sensing technology behind the Kinect (2005)
- YouTube founded (2005)

There is an even better (and funnier) futuristic vision video produced by AT&T that might offer inspiration for this time capsule assignment.

AT&T Connections: AT&T's Vision of the Future
http://www.youtube.com/
watch?v=yFWCoeZjx8A

What we are looking for in response to our questions are little vignettes like these that tell a story of technology in the year 2020.

Explora!

Presenting: Joe Hastings, Executive Director, Explora!

Speaking from the year 2020, this is Joe Hastings, former Director of Explora. I personally have an ambivalent stance on the role of technology at Explora, but I did come to believe that it was very important that we embrace it in certain ways. That didn't happen during my tenure, but I paved the way. We are going to talk about how we got there by offering a bit of a preamble and will then present a case study.

Case Preamble

Presenting: Various team members

Who are the folks coming to Explora in the year 2020?

The people who come to see us seven years from now are going to be living in a world where there is a permanent digital layer, so they are going to already have a lot of knowledge about invisible things. The people are inseparable from their devices. The question is, what can Explora uniquely do that children can't get outside of the museum space?

How does Explora feel about post-1970 technology?

Joe Hastings' last act as director was to

Explora Case Preamble

- Who are the people?
- How does Explora feel about post-1970 tech?
- Why and how are we using it?
  - Tools
  - Archeology
  - Part of the material world or culture
- What questions do people walk out with?

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introduce the Commodore 64, and thus he was run out on a rail. But this started a new idea at Explora. That is the idea that rather than be stuck on how we do things specifically, we should go back to our basic principles regarding

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Time Capsule Team

Leader: Joe Hastings

- Anna Lindgren-Streicher
- Bill Meyer
- Jennifer Elliott
- Leilah Lyons
- Wayne LaBar

- Nora Galler
- Paul Orselli
- Ron Eppes
- Tom Aageson

Explora team in session

What questions do people walk out with?

As a local who has taken three children to Explora over the years, what I like about Explora is that my kids walk out with question, not with answers. I love the big elevator because my youngest son always asks, "Why can't all elevators have couches in them?" What questions will people walk out with in seven years? We are going to show you our response to that later.

• Participant

Explora team

what we really want to have happen and use the best technology, whether it be pre-1970 or post-1970, to actually achieve the impact that we want to have with on our visitors.

With this mindset, we started introducing technology in the form of measurement devices and other scientific tools, and technology that allows people to be able to record and take home parts of their experience. Technology is becoming as much a part of being a human being as use of the wheel, and we knew we had to accept it into our science center.

Why and how are we using technology?

In every one of the incidences we've listed, "tools, archeology, part of the material world or culture," we are using technology as a way to allow people to get a value-added experience beyond the physical experience. They don't interfere with each other, they are complimentary to each other.

Those terms—tools, archeology, part of the material world or culture—are words we use and ways we think about who we are at Explora. We value tools. Archeology is about evidence of human use at Explora, and we celebrate materials. By thinking in these terms, we can introduce technology in a way

that is less threatening and more authentic to who we are.

Case Study: The Fountain

Explora Fountain

The fountain is our case study. Everybody wants to mess about with the fountain. It is physically central in the building and it is also cast in concrete, so it's not going anywhere. It is also cool, and we want to control it and do more things with it. Everybody on the team had ideas about the fountain and it seemed like a ripe place to use some technology to bring it to life.

7 Years Out

Augmented Reality X-Ray
• Any non-specific device
• Zoom in:
  - Mechanics
  - software
  - water flow

We have determined that in seven years we know that people will walk in with some technology that can enhance their experience, and what that device itself is doesn't matter. One response to the Explora Fountain is a desire to know what is inside and how it works. The "duh" technology there is augmented reality—let's take a look at the mechanics that run this machine.

Another approach we considered was a first-person, "be the water" experience, so that you can actually go through the fountain yourself, see where the water goes, how it comes out, and how it circulates through.

You could also control and program the fountain using flow-based programming. Your personal tech device would allow you to access a flow-based programming experience so that you can dictate the water flow, the trajectory of the jets, when it squirts, how long a squirt, and so on, which not only allows you to control what the fountain does, but also introduces young people to programming in a way they probably will be doing a lot of when they leave Explora.

A final idea involves using Leap Motion-like technology to enable visitors to manipulate the water flow in the fountain.

Time marches on, and now we are looking twenty years out. The visitor walks in with their device. At this point the visitor and the device are one and the same, and you can't really think of them separately anymore because your device knows so much about you. For example, it knows you did a Ph.D. in laminar flow, so when you look at this exhibit it points out things. Or the exhibit may be doing something different because it knows you're there now and who you are. The experience is based on you. It also knows that the three people around you are colleagues of yours who also know about laminar flow, so all of a sudden it amps it up to a whole different level that it wouldn't have done if it knew the visitors in front of it knew nothing about laminar flow.

Another possibility is that you can start playing with the nozzles, *à la* 3D printing of 2013, but now you can actually make changes to the properties of the materials in real time. This might involve a plug-in device that allows you to physically redo the nozzle in real time.

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20 Years Out

- Cloud-based pedagogical systems
- Fully activated context-aware integration on mobile devices
- Real time (form of integrated 3D printing) for the nozzles
- People and their devices are essentially merged (i.e. in a user experience they can functionally be thought of as one)

Team Explora

Science Museum, London

Presenting: Dave Patten,
Head of New Media, Science Museum, London

We don't have any fancy visuals to show you because we think most visuals will become small and personal by the year 2020.

Dystopian Vignette: Overwhelmed and Confused

We looked at a number of vignettes and the first offers a kind of dystopian view of the museum of the future. We are increasingly gathering more and more information about everything in the museum and making it available to everybody. In this vignette, you come along as a visitor with your mobile device which is similar to the one you have now, but it is a bit smarter, a bit faster, and unbreakable. You enter the museum and you are overwhelmed by the blitz of information that the museum delivers into your personal device, with no real sense of navigation or orientation around that information. You just get completely confused and give up and go home.

The moral is that we need to be really careful because that could be where we end up if we don't do some work.

Vignette Two: Making Parents Smart

The second vignette involves using the technology to make parents the smartest people in the museum, allowing parents to scaffold the children's experience. The question is, how can we deliver content to parents in a timely fashion? We didn't talk about the technology that might make that happen, but focused more on our desire to investigate how we might do that. We have begun to look at how we give parents information in particular exhibitions to scaffold that learning, but to do that across the museum would be fantastic.

Vignette Three: Visitor Feedback to Science Research and Policy Makers

We then looked at giving people a longer term engagement with the museum, particularly through feedback into the scientific community. If you're at an exhibit you might take away that content and leave some feedback, but we want to find mechanisms to get that feedback back into the scientific research community and to politicians to inform science policy in a meaningful fashion.

Time Capsule Team

Leader: Dave Patten

- Christopher Stapleton
- Dan McCulley
- Erika Kiessner
- Karen Elinich
- Monica Smith

- Robert Ketner
- Slavko Milekic
- Tamara Schwarz
- Wesley Hsu

Science Museum team in session

At the moment we gather a lot of visitor feedback and reflect that back to other visitors. We have not found really successful ways of getting that back to the scientific research community, and have been even less successful using that to talk to politicians to help inform scientific policy. We want to use technology and build relationships in the scientific community to be able to do that and think that would be really valuable.

Vignette Four: Extended Scenario with Smart Exhibits, Smart Building & More

We spent the longest time looking at a future where everything in the museum holds its own content. Everything, every object, every display, has a persistent URL that holds all of its own content. It knows when it was made, who invented it, who used it, and the people associated with it.

The building has pervasive, high bandwidth, free WiFi access. It is also a smart building, so the building knows a lot about itself. For example, you want to visit the museum but don't want to come when the museum is really busy, so you message the museum and ask the building to let you know when it's not too busy. The doors are smart doors, monitoring how many people come in and out, so the building knows when there are less people in the museum. About three o'clock in the afternoon you get a message saying, "All of the school kids have gone home and the museum is fairly empty, so

if you want to come along now it is going to be a pretty comfortable experience."

You set off to visit the museum and on your way, an intelligent agent from the museum sends you a message saying, "Would you like to sign up for some privacy agreements with the museum? Would you like your visit to be broadcast? Do you want to make your likes and dislikes known so that you can have conversations with other visitors and other visitors can share things you're interested in on the floor?" There would be various other privacy settings that could be set as well in preparation for coming to the museum.

As you walk into the museum wearing your augmented reality contact lenses, you can walk around and see augmented reality bub-

Science Museum team

bles above the heads of other visitors, listing the kinds of things they're interested in and the kinds of questions they're asking. You might get the information about the objects in this way as well, receiving information the objects are giving off.

You walk up to an object and start to engage with that object, and the object delivers a lot of information to you through your personal device. You're visiting with a friend, and as you look at the information you decide you're really interested in the design of a steam engine, so you get your device out and a pico projector on the handheld device throws a projection in front of the object. You say to your friend,

"Come and look at this. This is really cool the way this was designed."

And your friend says, "Yeah, maybe, but have a look at this piece, this is even better," and pops their projector up, and this starts a conversation, sharing those visuals that have been delivered by the object.

The object itself may join in that conversation and say, "Hey you two, what you're looking at may be interesting, but do you realize that if you walk around the other side of me you'll find this?"

While this is all happening, because you have set your privacy settings onto broadcast, one of your friends in the north of England is looking at the object you are broadcasting and says, "Hey that's really interesting, but I really want to see the small widget at the bottom. Can you take a look at it for me and can you take some pictures?" You start a conversation with someone outside the museum, which becomes part of the experience. While you are doing that, other people can choose to join in with that discussion around that object or they can just observe what's happening.

That is the kind of future that I would certainly like to see, and I'm keen to go back and see if I can make it happen on a small scale perhaps with just one object.

Learning Vignette: Time Travel Exploration at the Museum

Presenting: Christopher Stapleton, Creative Venture Catalyst, Simiosys

With all of this invented technology the Science Museum is an amazing place, and yet they cut their education staff by 50%. They recruited all of these school teachers to think of ideas and before the last one was fired, the teachers created this really cool game design tool. Every object has at least ten different threads and intersections of information and connections with other things.

Now I'm a school teacher and I visit the Science Museum and want to create a really cool alternate reality game for my students when they visit the museum. The building was started during the Great Exposition, so I'm going to take this

alternate reality back to Jules Verne's time, the time of the Great Exposition. All of the objects are time machines, and with this game design tool I can create this great mechanic that takes students through all of these connections and relationships. The object's "circa" date is the key to the time machine and they have to work together and travel over different time zones. At the end, they come back and tell their own stories about all of the discoveries and mysteries that they were able to unfold. So this was a day at the museum (as opposed to *A Night at the Museum*), where all new stories that you hadn't even thought of are created in between the exhibits.

New Mexico Museum of Natural History and Science

Presenting: Charlie Walter, Executive Director, New Mexico Museum of Natural History and Science

There are certain things that are missing currently at the New Mexico Museum of Natural History and Science. We do a wonderful job going back millions of years in time, but we stop 10,000 years ago with the Ice Age. There is not much at the museum about current natural history or current issues. Also, for our strategic planning process we decided that one of the most important things is that we need to do a better job of being statewide. So the idea is, how do we look at the last 10,000 years and then project 10,000 years into the future?

One of the questions we addressed is, what does it look like when you come in the front door? We decided that the front door is the state line, and when you cross the state line you're there. We envisioned four different vignettes using

future technology so that when you cross that state line you are all of a sudden immersed in what we do here.

Vignette: Water Use and Data Collection

Presenting: Beck Tench, Director for Innovation and Digital Engagement, Museum of Life and Science

I will talk about water use and data collection as a potential vignette for a visitor who may be in a rural community, which is currently a difficult community for the museum to reach.

We envision that the technology you will have, your personal device, is something wearable and potentially object ubiquitous so that you don't have to look through a screen in order to see information. One of the major issues for the museum and New Mexico in general is water use. We pictured a scenario in which information about

THE FRONT DOOR IS THE STATE LINE

Time Capsule Team

Leader: Charlie Walter

- Beck Tench
- Brian Kelly
- Charles Compton
- Erika Shugart
- Kevin Von Appen

- Libbey White
- Matt Celeskey
- Olivia Castellini
- Steve Snyder
- Ben Wilson

Charlie Walter presenting, Kevin Von Appen holding graphics (Von Appen: "I do not pinch and zoom." Audience member: "If we pinch, you zoom.")

WATER USE

DATA COLLECTION

*New Mexico Museum
of Natural History and Science team*

your water use at home is something that is carried with you wherever you go, so the museum can display for you what your water use is in the context of what your actions are.

Here we have a person washing dishes, and projected around them is what their water use is doing to the state and its water reality if everyone were to use water the way this person is using it. That projection could also occur when you are at the grocery store or when you are out in nature. You might see a projection of water above your head, or you could see dry desert, or somewhere in between.

Vignette: Augmented Reality

We feel that enhanced modeling and other work being done with augmented reality is going to extend over the next seven years so that we will be able to have real-time, updated, high-resolution digital modeling of the state available. Based on that, we will be able to do

some interesting things with augmented reality outside the museum doors.

AUGMENTED REALITY

When we talked about getting people into the museum and about doing rural outreach, the vignette that came up was the possibility of a rural outreach van with augmented reality windows. The augmented reality would enable you to see that last 10,000 years or perhaps the future 10,000 years as you're driving across the state, presenting the content that the museum knows is there to people as they interact with the landscape.

Vignette: Remote Connections, Conversations, and Learning

Presenting: Kevin Von Appen, Director of Science Communication, Ontario Science Centre

Core to the museum is a satellite center at Sandia Mountain, which is linked to the museum floor down in Albuquerque. Here we apply all of the things you've heard about transparent and ubiquitous computing, which allows information to be shared and the layering of historical models and future projections. This would take place in the context of either school visits or family visits, both on the floor of the museum and up at Sandia Mountain. Visitors at each location are able to communicate and share what they are seeing with each other in real time.

If I am up on the mountain and taking a photograph of something, or if I'm using a sensor that's embedded in the mountain, that information is available and visible to the person who is on the museum floor and vice versa. These are actual conversations that are enabled.

We talked a lot about telepresence and distance learning, so we've made a couple of assumptions. One is that there is ubiquitous wireless (or whatever the appropriate technology is) on the floor of the museum that is always on and always available to everybody. Two, that all of the schools are wired in such a way that these things are visible in real time from the museum floor or from the mountain top.

The Campaign for 20,000 Years

We decided we should call this "The Campaign for 20,000 Years" because in addition to technology helping us fill this void regarding what has happened in the last 10,000 years, we can also project the next 10,000 years through modeling and data collection.

• Charlie Walter
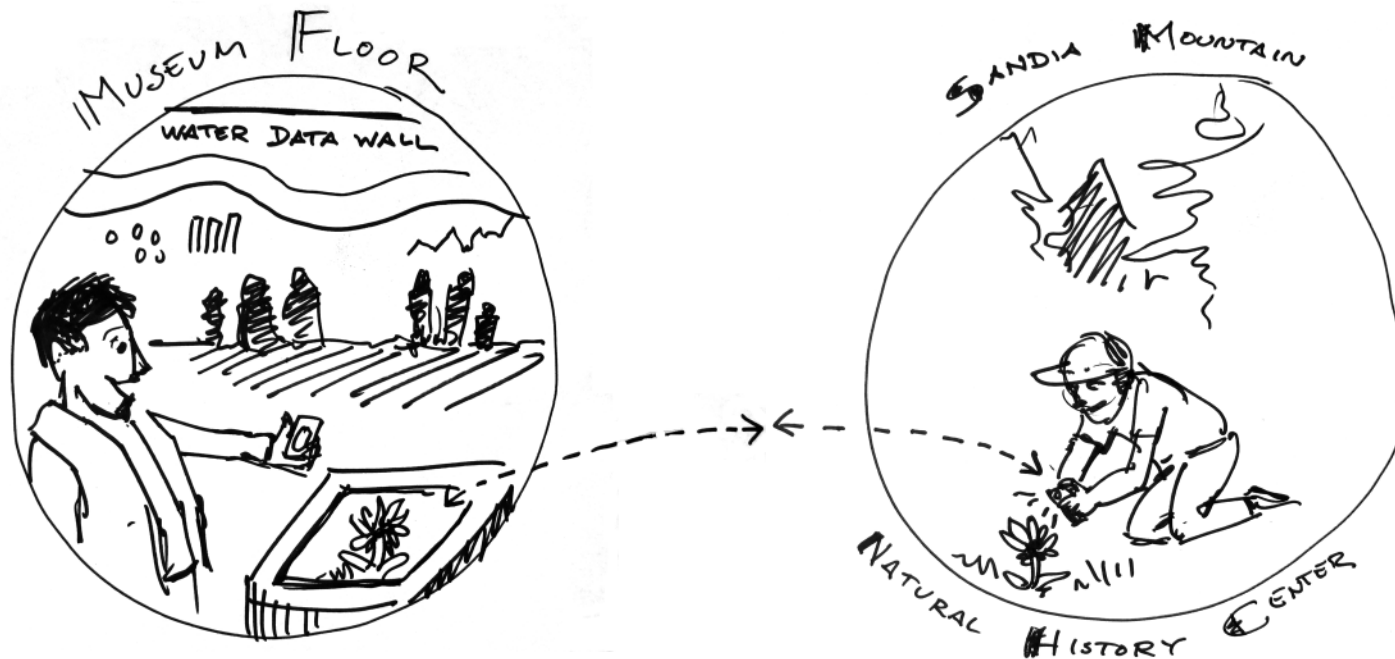
Keeping Up with Changes in Science

While the introduction to the time capsule activity included looking at what technology was like seven years ago and twenty years ago, one thing that wasn't discussed was what science was like seven years ago and twenty years ago. We thought field trips and museum visits would help level the playing field regarding what science is, through conversations scientists have with children and also with adults who interact with the museum and advance their science knowledge. • Beck Tench

New Mexico Museum of Natural History and Science team

Discussion Point: Lifestyle Changes

Presenting: Kevin Von Appen

One of the ideas that Beck Tench raised that really got us talking was not just how science was seven years ago and what it is now, but how people are likely to be living seven years from now. We did not come to a conclusion. We had one idea in which parents, educators, and museum staff would have greater flexibility in their work lives so that even on a Monday, parents could be participating in a field trip. This led to an interesting discussion about what we've seen in the past seven years, with people working longer and harder, and a move away from telecommunicating back to being in work places like Yahoo.

That is more a point of discussion rather than a conclusion, but we thought it is definitely a context for technological change in museums that we should consider.

San Francisco Museum of Modern Art

Presenting:

Peter Samis, Associate Curator of Interpretive Media, San Francisco Museum of Modern Art
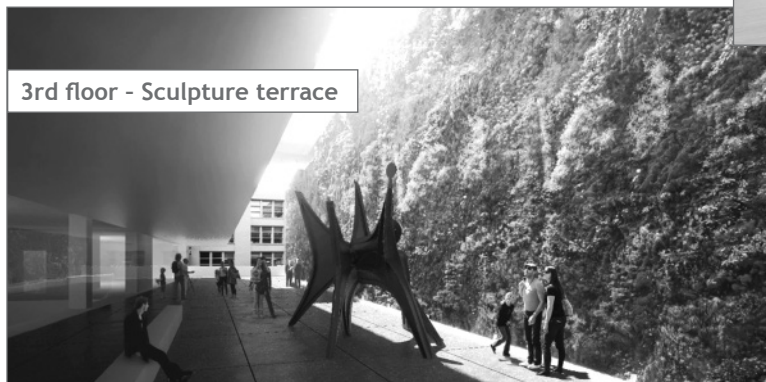
Here are a few visuals of the new SFMOMA.

Ground floor – Howard Street gallery

3rd floor – Calder gallery

3rd floor – Sculpture terrace

5th floor – City gallery

Time Capsule Team

Leader: Peter Samis

- Seb Chan
- Suzanne Pierce
- Bruce Wyman
- Francesca Samsel
- Graham Plumb
- Jason Stevens
- Kate Haley Goldman
- Mike Mouw
- Susan Kirch

And here is the future of San Francisco.

SFMOMA team

The Future of SFMOMA

Presenting: Jason Stevens, Principal and Exhibit Designer, Flutter & Wow Museum Projects

In a post-apocalyptic world, SFMOMA has remained the bridge between art and community. After World War 3.0, occupied lands are relatively cut off from the Independent Republic of Kalifornia (IRK), and peaceful tourism by the conquering Antarctic victors are increasingly common.

Border controls are used as engagement sites to invite visitors to IRK into the experience of pluralistic art at the preeminent SFMOMA site.

In fact, SFMOMA has adopted a pervasive strategy towards engagement inside and outside of the galleries. Because the entire collection has been digitized, the works can be licensed and distributed throughout the community on the back of cars, in homes, and on buildings.

Interventions both outside and inside the galleries are all technology-supported, but always designed to set the stage to create more meaning and connection between art and people.

Inside the galleries, displays and design have been modified to accommodate erratic brownout conditions throughout the course of each day. It is bloody hot in San Francisco now, and SFMOMA has undergone renovations to passively cool the building, so people are flocking there during those brownout periods.

Importantly, the newest Word Lens app

includes image recognition that provides simultaneous translation of all labels. Each artwork restores its own context of origin on demand via the Lens, and your journey is accompanied by a binaural audio with a voice or soundtrack of your choice (state approved, of course). Triangulation-enabled recognition makes location-based experiences possible, providing just-in-time curation as well.

In the IRK, we lost a great deal of our art and iconic works to scavenging forays by the victorious forces. For that reason, the cultural shift has created a greater sense of value among the populace for the existing materials, and SFMOMA excels at creating opportunities for deep experiences with iconic artworks that highlight the world of the collection.

One way that SFMOMA has enabled depth of experience is through collaborative games that are staged within the facility, drawing groups to interact with the collections. In addition, users can "touch," "sense," "hear," and "taste" artwork in the SFMOMA galleries. The "Lick a Pollock program" is particularly popular.

War veterans cannot all access the facility in person, so SFMOMA created a program to serve as post-traumatic stress relief through art. To this end, each piece has extensive remote access options, as well as "push technology" to provide extended access to augment information available about the piece or collection.

Visitors may use their own devices to select

from an array of expert-curated and outsider-curated experiences. This is done with their own personal devices, such as the umpteenth generation of Google Glass. These encourage people to personalize their interaction with the works. Technology will streamline some of these processes of making your own meaning and relationship with the collections.

While individual experience and connection to the art is emphasized within the facility, there are also elements of the facility that create a context space to help people orient to "Why am I here?" and "What does it mean?" through small group interaction. For example, holographic pop-ups are designed to draw people into artwork. In addition, visitors are invited into a large-format mapping space that provides a traveler's guide program, enabling people to select a route on an interactive map using art from the facility.

SFMOMA remains dedicated to building connections into the community by remaining open on weekends to encourage families, as well as developing an Art and Technology Match Program where technologists adopt an artist. Artists are still starving for work—some things never change. Through the TechStars Art incubator program, SFMOMA incubates and tests start-up technologies in the spaces.

Even more extreme, SFMOMA has licensed images to TESLA so that images are shown on dashboard displays, and there is guerrilla projection mapping around SFMOMA grounds, creating an Art in your Neighborhood program.

"SFMOMA epitomizes the new reality of the Independent Republic of Kalifornia. The transitions and experiences of the war have marked our culture. Today, we value plurality and focus on the integral place art has always held as a key way that human beings make meaning."

SFMOMA team

Indian Pueblo Cultural Center

Time Capsule Team

Leader: Travis Suazo

- Catherine Baudoin
- Marti Louw
- Dan Davis
- Charles Veasey
- Jennifer Borland
- Olivia Jackson
- Markus Seidl

Indian Pueblo Cultural Center team

Presenting: Travis Suazo,
Executive Director, Indian Pueblo Cultural Center,
and additional team members

We had a great dialog, which started by looking at those visitors coming to the institution who don't know anything about Pueblo culture or about Native Americans in general. They're here because we are a must-see if you're in Albuquerque. So we really have two audiences: Native Americans, and Pueblo specifically because we are a gathering place that is owned by the 19 Pueblo communities; and general market visitors. The perspective we focused on was that of marketing to the general audience and their visitation here.

About the Center

- Opened in 1976
- Trust land: reservation within the city of Albuquerque
- Owners: 19 pueblos in new Mexico
- Mission
- Static museum - seeking to make more current
- History, lodging, religion, art
- Integrated multitouch
- Gateway to 19 pueblos of new Mexico - informing visitors of the proper way to visit a community

Visitors/Audience

- Pueblo communities and students that reside in the communities
- Urban Native peoples in Albuquerque (within top 10 population-wise)
- Non-Native visitors to Albuquerque

So our Pueblo communities and students residing in those communities are one sub-audience. We have a large, urban Native population within the city of Albuquerque. And then we have the non-Native visitors, who are the focus of this future scenario.

Ideas

Pueblo dancing is a major activity at the IPCC, and we discussed that in relation to Kinect games that involve dance. Is it possible to get every visitor dancing by training them through Kinect? There are cultural sensitivity problems there, so the answer is probably not.

Vision

The Pueblo culture is very much about time and space. Our vision was to take the physical space here and then expand the experience to connect people and resources across time and space. All of our ideas radiate from this central point.

When you visit the IPCC in the year 2020, first you have to get out of your hovercraft and walk into the lobby, where your credit card is already charged because your phone is on. Then when you physically enter the building there is the big, open, round space in the center. We are going to turn that into an actual connection to the pueblos.

Vision:

Connect people & resources across time and space

Pre-visit
- Get out of hovercraft
- Use hands-free phone to buy ticket
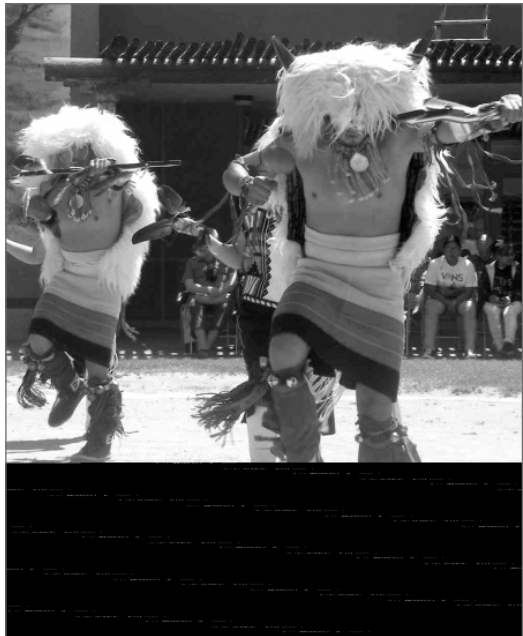
Ideas

- Dance: Kinect (might be viewed negatively)
- Immersive dance performance – time-shifting + Streaming - place-shifting
- Games: stick games
- Language Interactive: instant feedback
- Collect stories & youth voices (story-corps)
- Continuous flow re information - map-based interactive
- Visual scavenger hunt
- Connected resources

Some of what is up on the display there would be live video feeds of people actually working in the pueblos—training to be a nurse, plowing the field, making pottery. These are live feeds of people actually doing live things in the pueblos.

When we have dance events, those live feeds throw the dance back out to the rest of the world. If I am a Native person sitting in San Francisco, or I'm in one of the pueblos, I can throw open the window into that dancing world, play my drum along with the drummers, and dance with the dancers. My video feed shows up back on the walls at the center, so

there is that connection across space and time.

This also allows for conversations, so there are scheduled conversations about the community and about problems in the community, with representatives from the 19 pueblos on the video feed on the wall, all talking about a common issue and holding a virtual discussion across the space as the visitors walk through.

Part of this is all about exposing the idea that distance and time don't matter, that out there in the pueblos right now, there are thirty galleries that are open, there are kitchens where you can visit and eat a meal. As an individual in the pueblo I can come on the video feed and say, "For the next 30 minutes, if anyone is going to be in my vicinity come on by. I'd love to talk about my language or culture with you." It gives the real-time dynamic: Here is what is available today that is out there in the world.

As the gateway to the 19 pueblos, a large majority of the learning experience starts here. That includes etiquette, general location, history, and background regarding each of the tribal communities. But we also have a need to support our tribal communities. So beyond our gift shop and supporting our artisan base, we see this as an opportunity to engage our artisans in their homes, in their communities.

If the artisans have an open gallery and they are actively creating, then we may have a point-of-view camera that shows that live feed of someone working on a sculpture out in a pueblo. Or an artisan may have a gallery that is

Zoom in to different sites for live video feeds or recorded assets of interest/cultural significance - live Q&A
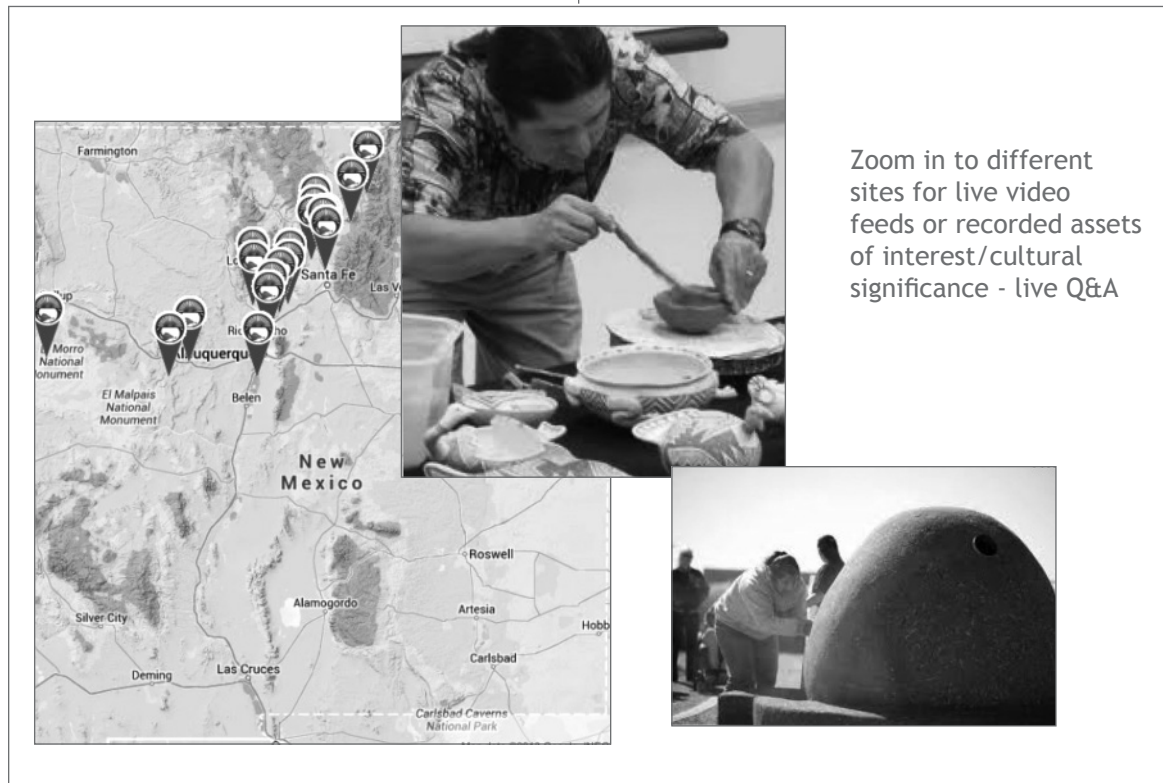
open and accepting visitors to the community, which offers the artisan the opportunity to sell their artwork and visitors the opportunity to talk to them directly. That would come up on Google Maps and show that this particular artist, working in this particular art form, is available if you would like to stop in.

Another part of that cross-feed is a live feed, and because the artisan is being shown in real time, a visitor may have a question about what they are seeing and ask, "Why are you doing it that way?"

And without stopping, the artisan may re-spond, "Because this is part of the traditional way to do it," or "this strengthens the pot so it doesn't crack."

There is also a language interactive display *[see sidebar]* where we play a word in the Na-tive languages and then you try to reproduce that word to see how accurate you can get. An-other idea is to link that language interactive to the ability to gain access to different spaces in the environment. For example, if you can say "hello" properly, it opens the door and lets you out, but if you can't say "hello" properly you're stuck until you learn how to say it.

Because there are a lot of school children who come through the IPCC, we also talked about using that same virtual, time-space-shifting technology to allow classrooms in the pueblo to interact with classrooms visiting the IPCC. There could be collaborative art design across the groups, with the real students and the

virtual students all in the same classroom creating art together and getting that cross-interaction.

Post-visit
- Print souvenir at home on 3D printer
- Listen to traditional stories streamcast on demand
- Go to a pueblo!

Most of the exhibit space is historical and stays much the same, other than the time-space shift, but when the visitor goes home there are post-visit experiences. For example, earlier groups mentioned smart objects. If you see a beautiful sculpture or pot you'd like to have in your home, you can get a virtual printout of it, take it home, and buy it so the artists gets his or her money.

There is also this oral history, and it is a very oral culture. Instead of sitting in your car and listening to *Car Talk* as you drive to work, you can listen to Native stories. Snippets of these stories in the museum then tie you to podcasts that give you a new native story once a week or once a month.

And again, the IPCC is a gateway exposing you to Pueblo culture. After you are oriented to that culture you can use a map to get to the pueblos for a deeper experience.

Language Interactive

Indian Pueblo Cultural Center team

Shedd Aquarium

Time Capsule Team

Leader: Kristen Nesbitt

- Carrie Bruce
- Erik Lizee
- Eve Wurtele
- Allison Price
- Marco Mason
- Sina Bahram
- Charles Xie
- Paul Marty

Presenting: Kristen Nesbitt, Director of Exhibits, Shedd Aquarium, and additional team members

In terms of its technology, the Shedd Aquarium is perhaps a little behind where the world is and sometimes a lot behind where the world, so we may need to back this seven year projection up a bit. A number of the things we came up with could be implemented now, whether that motivation is there to do so. This team had a range of ideas divided into six different aspects we want to target.

Crowd Control

The aquarium gets more than 2.1 million visitors a year, upwards of 12,000 a day, so that is a lot of people coming through a relatively small space with about 120,000 feet of exhibits. We imagined using seamless technology to moderate the entrance line and the crowd flow through the building, and attract the optimal number of people to special events or unique. This would connect with the systems control of the building so if it is getting really hot in a particularly crowded area, the system would automatically moderate the temperature. Something similar would be done to moderate sound levels. Both may be possible with current technology, but we don't do it.

These are logistical elements to choreograph

Shedd Aquarium team

Target 1: Crowd Control

- Technology – moderates the line, moderates crowd flow through building

  - Moves people through space to take advantage of under-utilized areas

  - Attracts (the exact right number of) people to unique animal behaviors happening at that moment

  - Shapes experience to minimize and leverage impacts of others – sparks appropriate conversations and group activities

  - Connections with systems control of building to reduce temperatures and adjust comfort level in all ways for guests in real time

the overall experience. What we find is that the stress of the overall experience impacts guest comfort level and excitement about being there, so we want to get rid of that stress.

Exhibits

Target 2: Exhibits Themselves

- The animals and environments are always the highlight and priority

- BUT – use of immersive HCI to change over course of year and visit
  - Exhibits change seamlessly to reveal different seasons
  - Day/night
  - Responsive to current events and guest concerns (transform spaces to show potential environmental impacts, etc)

Because we have a living collection, the animals and the environments are always the highlight and the priority. We talked about using immersive types of human-computer interaction that would change over the course of a year and over the course of a visit. For example, if you come to an exhibit in the wintertime it will look like it's actually snowing out, whereas if you come back to that exhibit in the middle of summer, the temperature is higher, you see trees in full flower, and so on. Every time you come it would be different because it shows seasonal changes and night and day transitions, using projection and whatever other technology is appropriate to create an immersive environment.

We could also respond to current events. If there is, god forbid, a big oil spill in the Caribbean, we could show a glimpse into what that might actually look like under water, using AR or other kinds of immersive technologies, and encourage people to act based on that.

Animal Visibility

The third target deals with animal visibility. Allison Price [Lincoln Park Zoo] brought this up because we both have issues with animals hiding. What if you could come up with augmented reality so that the snake or the lion can hide behind the rock that it wants to hide behind, but that rock becomes clear so that the guests can see through it? The animal still has the comfort, but visitors gain visibility. [Allison Price: We're not really sure whether it's the snake that's getting the augmented reality or us.]

We also talked about what Marco Mason called "smart fish," which is already done with some animals in general just for health reasons. You could reveal individual traits with individual animals, showing off this kind of hidden viewpoint. That could link to other things we talked about like gesture identification. We see a lot of visitor behaviors such as pointing or people ducking down to look at something. Instead of having to step aside and look at a fish ID station or reader panel, you would see identification of the animal that you've pointed out or engaged with in some way in your own vignette window.


Target 3: Animal Visibility

- Use of augmented reality to make substrate "clear" when an animal is hiding behind it.

- Let guests give each other hints on where to see hidden animals (live feed)

- Chips or recognition allows reveals about each individual animal – reveal interesting features, movements if you choose to see them

- Habitat glass becomes personalized touch screen through glass type experience – you gesture and you see what YOU want to about the animal

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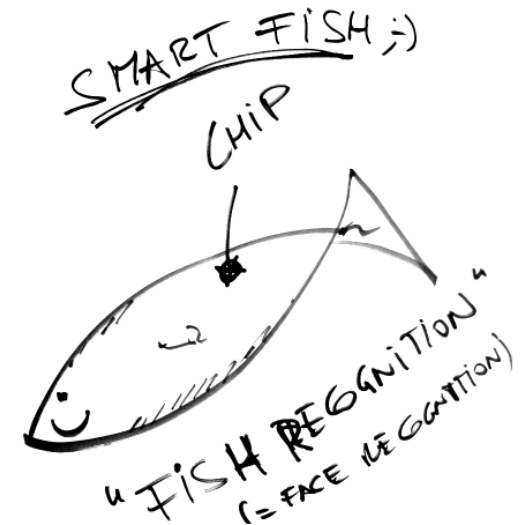
An Aside About Fish and Chips

• I really dig the idea of taking advantage of the fact that many of these animals already have chips in them, so is there a way we can utilize that to trigger more information. If the visitor points and says, "Oooh, what's that?" the chips that are in the animals right now can trigger information. • Participant

• You're saying right now, in 2013, those fish already have chips in them? • Audience member

• Just like people already have chips in their pets. It links to health records. • Participant

• For example in the new stingray exhibit in order to be able to distinguish, for health reasons, between 50 different individual animals, they would each have a small chip embedded so that you can call up immediately the total health history of that animal.
• Kristen Nesbitt
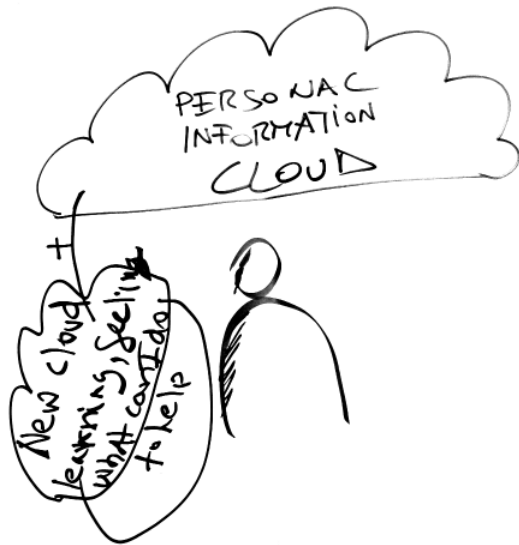
Customized Experience

Target 4: Customized Experience

• Seamless content flow....with customized and experiential elements....

• The information about you on the cloud helps shape your experience...

- Customized prompts based on who you are (able to be moderated by your desires for the day)

- Connect our out-of-aquarium lives to in-aquarium experience—living in the cloud and drawing from lived experience to point out, connect, etc., to your past and future experiences

  • On your dive trip to the reef, you saw these animals

• Customized "virtual guides" – I want to hear from a researcher, an aquarist, a mom...to get specific content

• Simulate animals experiences – How would things sound, look, feel to this animal?

We spent a lot of our time talking about a customized experience and seamless content flow. Earlier groups talked about a future in which our personal information and data follow us on our personal devices, but there is another vision of the future that foresees all data on the cloud. This is the trend in both research and technology, and whether that is good or scary it is something that exists. We have a life on Facebook and in other places, and the data on the cloud is our data.

If, for example, you visited the Caribbean Sea six months ago, took a picture, and posted it

on Facebook, that is then part of the data in the cloud. When you go to Chicago and visit the Shedd Aquarium the cloud might suggest, "Oh, you swam near this fish," and a relationship is made.

We know that people come in with these lived experiences, but there is such a high density of animals and things going on in the exhibit space that people aren't always cognizant of those personal connections. This technology allows us to say, "This is someplace that you have been 20 times and you didn't know these animals were all around you." Or, "We know you just bought tickets to Portugal on Travelocity.com, here are some fish that live off the coast of Portugal that you might want to take a look at." It is just a matter of combining all of the data that you are already putting out there, accidentally or not.

A vignette we imagined is that you come to the museum with a class, and the theme of the museum is brains. Everyone in the class has a personal device and they use those devices to test their own personal hypotheses about brains. There are different points in the museum they go to do this, and there may be a graduate student from the university on hand. Every NSF proposal requires you to indicate broader impacts. A wonderful way for a professor to address that is to say, "My graduate students are going out and talking to children at the Shedd Aquarium." That's fantastic for everybody, and the graduate students learn how to communicate with students as they

Design = Innovation

participate at one of these stations in the aquarium.

All of the class's recordings and hypothesis testing and observations have been retained by the database in the museum. The kids also have access to the database and there are things they can take home as well. At the very end they are given ideas regarding what they can do to help.

You could also have a customized guide via an interface device as your general guests come through, telling them the particular infor-mation that they are interested in. You may want to hear from a scientific researcher. You may want to hear from another family about what they liked. You can adjust the content throughout the course of the visit, so if you get tired of what you're hearing you can switch to another type of information.
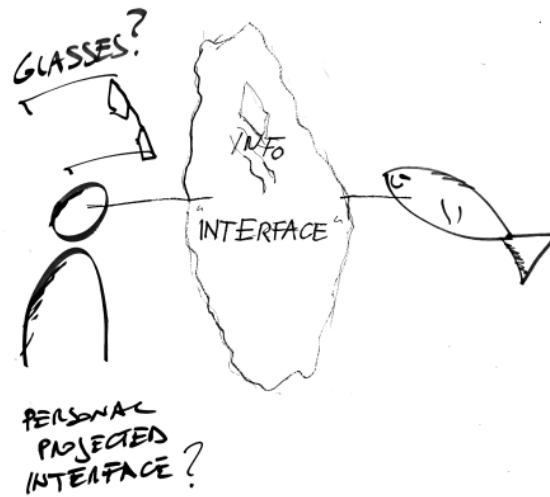
Making a Difference

Target 5: Inspire and Facilitate Making a Difference

- You see the effects you've had on environments and animals

- You get action steps you can take...based on the animals you've come to care about

- You get connected to others who want to join in

- You get easy ways to share your action steps and encourage others to take them

- This goes with you .... Beyond the visit...but gets tracked and displayed onsite to generate buzz and participation

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Another target that is mission-based is to inspire and facilitate making a difference. The Shedd's mission is that animals connect you to the living world, inspiring you to make a dif-

Erik Lizee (who had to leave to catch a plane) underlined the importance of human resources (e.g., ecologists, cell biologists, fish physiologists, natural product chemists) and using design as innovation in order to control different aspects of the system. It's not just about the technology, it's about content, about experience, about many things. Design can be a way to foster and facilitate this collaboration. There is research being done in San Francisco on design thinking and on other ways to approach a complex project. We have to think about the imagination of these human resources as a very important part of the technology we are making. • Marco Mason

ference. Through this trusted guide, drawing from information about you on the cloud, you can see the effects of your past behaviors on environments and animals. If you went out and did a beach sweep in the past, now when you loo at beach-related species it would say, "Hey, remember when you went out on that beach sweep? You helped animals like this."

If you are particularly interested in an animal you can learn action steps you could take at home, and there would be follow-through with that. You can get connected to others who want to join in and you can share your action steps. All of this goes with you beyond the visit, and information gets tracked back to the aquarium to generate excitement and interest in other visitors.

Shedd Aquarium team

A lot of conservation organizations will use pledges (e.g., I'm going to conserve water, I'm going to do beach clean-ups once a year with my family). What if some animal that you spent a lot of time looking at when you were at the Shedd were to pop up on your Facebook feed or your Google Glass device saying, "Hey, you're brushing your teeth, maybe you should turn off that water!" That dynamic animal that you connected with at the aquarium serves as a reminder of that experience

or emotional connection to help you follow through on decisions you made. This would feed back into the overall system at the Shedd so that as a guest you would be able to see that 150 people have done these actions on behalf of this animal.

No Matter What...Wonder

Target 6: No Matter What

• ALWAYS allow space, time for contemplation... socialization....exploration....

• AND **SPONTANEOUS MOMENTS OF WONDER**

Finally, we would always want to allow time for contemplation, for socialization, and for exploration outside of these other experiences, and for those spontaneous moments of wonder. We had a woman come through who was cutting a colleague's hair who said, "I never knew before I came to the Shedd that a seahorse was not a mythical animal, and then I rounded the corner and saw it." We want to be able to not have everything so tightly controlled that you can't have those spontaneous moments.
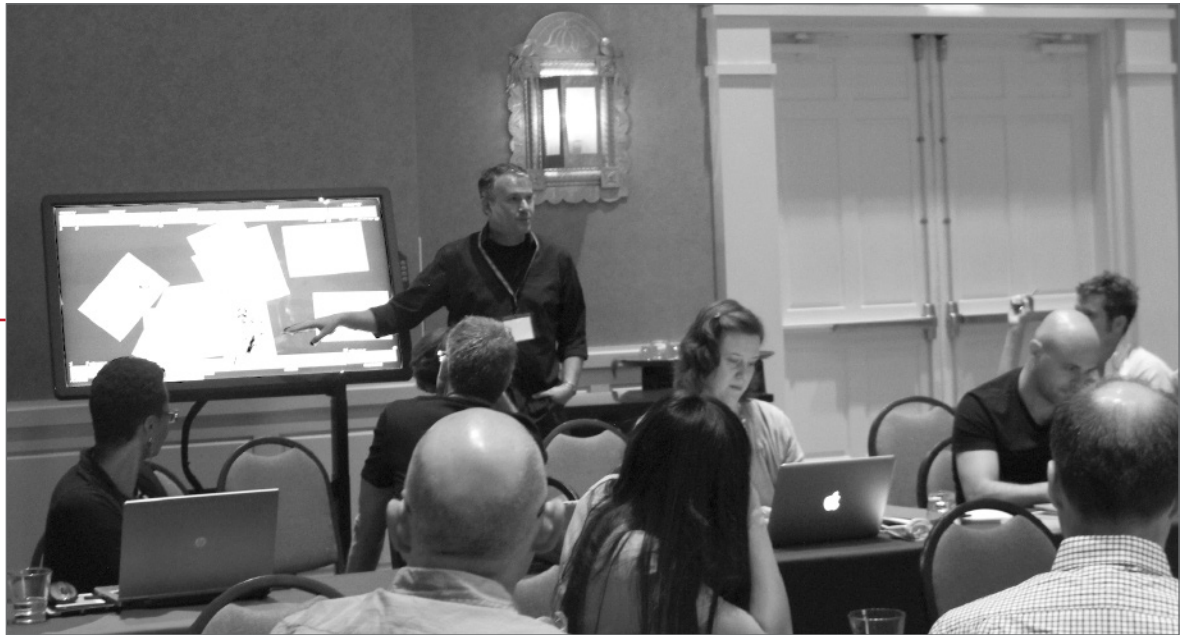
ATTACHMENTS

(HCI+ISE)

Pre-Conference Workshops

A trio of pre-conference workshops, open to HCI+ISE attendees and to New Mexico area residents, was held at the Hotel Albuquerque on Tuesday, June 11th, 2013. A brief synopsis of those workshops is offered on the following pages.

Jim Spadaccini addresses workshop

Graham Plumb (left) demonstrates apps to Peter Samis and Paul Marty

Technology Showcase

During a two-round Technology Showcase session, 21 conference participants demonstrated a range of software and hardware related to human-computer interaction and informal science education. A list of Showcase projects and participants is offered in this section with an accompanying photo gallery.

Pre-Conference Workshops

OPEN EXHIBITS

Open Exhibits is a National Science Foundation (NSF) sponsored initiative that outlines a community-driven approach to designing and developing multitouch applications. This workshop introduced the Open Exhibits project and attendees learned how to create a multitouch, multiuser application using the Open Exhibits software development kit (SDK) with XML, CSS, and/or ActionScript. Attendees also learned how the Open Exhibits framework can be driven by a museum's database of digital assets.

Multitouch and multiuser experiences are changing the ways in which people interact with computers. This new form of interaction has become commonplace in public spaces in the form of kiosks, exhibits, and other installations. Multitouch experiences allow designers to move away from traditional graphical user interfaces and incorporate more natural and intuitive controls. Shared surface computing, multitouch and multiuser environments present a new complexity in design. Encouraging collaboration and communication among multiple visitors may take precedence over traditional interface concepts such as designing efficient ways for individuals to navigate or accomplish tasks.

The Open Exhibits SDK was created with these design challenges in mind. The SDK features the Creative Markup Language (CML) for rapid content authoring, the world's first Gesture Markup Language (GML), and prebuilt multitouch media components.

The workshop explored the technology and design aspects of multitouch, multiuser exhibit development through hands-on application building using the Open Exhibits SDK. Discussion focused on the challenges and possible solutions to the multitouch, multiuser user experience, including:

- Gesture Markup Language;
- Creative Markup Language;
- Multitouch and multiuser design strategies; and
- Linking museum digital archive databases to Open Exhibits.

Finally, the workshop introduced the Open Exhibits project and Open Exhibits SDK. Workshop attendees were able to experience the Open Exhibits software framework through one of Ideum's multitouch tables, and then learned how to create a basic application using the framework.

Open Exhibits Facilitators

The workshop was developed by Open Exhibits and Ideum. Those involved included:

- Jim Spadaccini, Creative Director of Ideum and Principal Investigator of Open Exhibits
- Paul Lacey, Chief Technical Officer of Ideum and Developer of the GestureWorks Analysis Engine
- Charles Veasey, Project Manager and Lead Developer of Open Exhibits.

openexhibits.org/
NSF DRL# 1010028

Charles Veasey, Lead Developer, Open Exhibits

Photo: Ideum

(HCI+ISE)

**CMME Facilitators**

This workshop was developed by a team involved in the CMME project, led by the Museum of Science, Boston. The group included;

- Anna Lindgren-Streicher, Project Manager of Research & Evaluation at the Museum of Science and CMME Project Manager
- Ben Wilson, Interactive Media Manager at the Museum of Science
- Charles Veasey, Project Manager and Lead Developer of Open Exhibits
- Sina Bahram, PhD Candidate in Computer Science at North Carolina State University.

Photo: Ideum
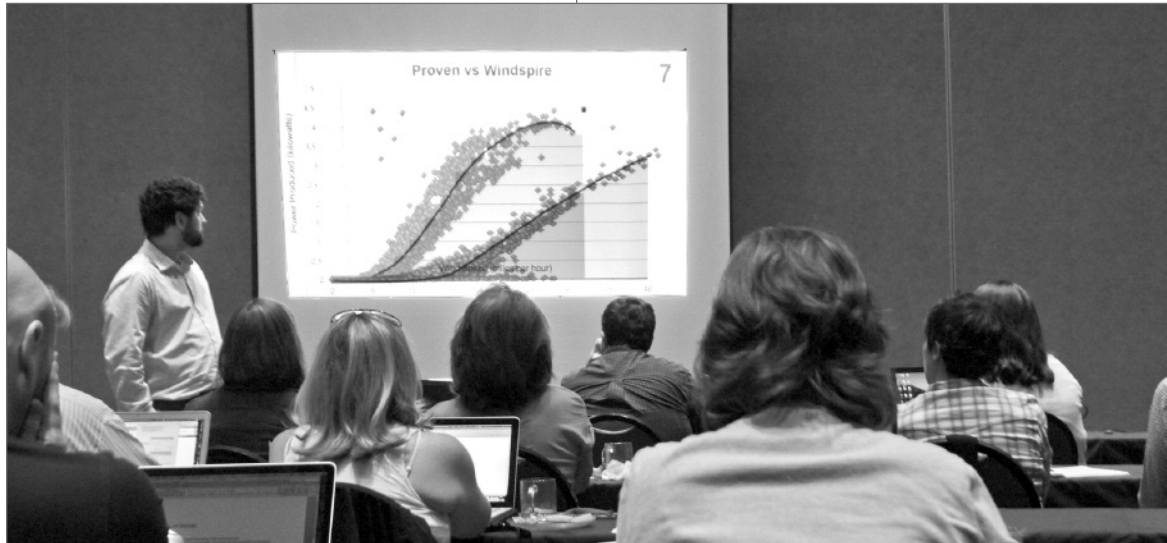
CREATING MUSEUM MEDIA FOR EVERYONE (CMME)

Creating Museum Media for Everyone (CMME) is a collaborative National Science Foundation (NSF) sponsored project that seeks to further the science museum field's understanding of ways to research, develop, and evaluate digital interactives that are inclusive of people with disabilities. People with disabilities, including those with age-related limitations, are an increasing part of the population. Although digital interactives hold much promise for meeting the needs of visitors with disabilities, many of the latest approaches to these interactives pose challenges for use by these visitors. Through this workshop, participants were introduced to the products and processes CMME and other related projects are creating to better meet the needs of and reduce the challenges for all museum visitors, including those with disabilities.

The workshop began with an overview of the design and user testing approach used to develop digital interactives for the CMME project and at the Museum of Science, Boston. The workshop also featured demonstrations of and hands-on time with four different examples of digital interactives that are inclusive of visitors with disabilities. Designs presented in this workshop were developed using a framework of inclusion to better accommodate the needs of people with disabilities, but they were also intended for use by all visitors.

The four digital interactives included:

- An approach to embedding audio into multi-touch tables through the Open Exhibits framework, developed at Ideum.

- A multimodal way of exploring data represented through graphics, audio, and haptics, developed at the Museum of Science.

- The Touch It, Key It, Speak It (TIKISI) system, a multimodal way of exploring graphical information in an eyes-free fashion on a tablet or touchscreen, developed at North Carolina State University.

- A universally designed touchscreen interface that is inclusive of people with disabilities, including those with limited mobility, who are blind, or have low vision, developed at the Museum of Science.

Creating Museum Media for **everyone**

*Ben Wilson,
Manager, Interactive Media, Museum of Science, Boston*

AUGMENTED REALITY FOR INTERPRETIVE AND EXPERIENTIAL LEARNING (ARIEL)

Augmented Reality for Interpretive and Experiential Learning (ARIEL) is an NSF sponsored project to create an exhibit platform that uses scientific visualization techniques to transform modern visitor interaction with traditional hands-on exhibits. This workshop introduced the ARIEL project's software, interface designs, and learning impacts.

Augmented Reality is an emerging technique for interaction and communication that has yet to be fully explored. ARIEL Builder is free software, developed to facilitate the use of augmented reality technology in informal science learning experiences. The target user community includes exhibit and program developers who work at hands-on science museums. While the software was developed with this community in mind, all developers are welcome to use ARIEL Builder. In fact, those involved in ARIEL look forward to seeing how it might be adapted for other purposes!

This workshop explored the design opportunities with AR, using The Franklin Institute's prototypes as subjects for discussion. The coincidental learning research was also presented, offering evidence of the impact that AR can have on the informal science learning experience.

http://www.fi.edu/ariel

A R I E L

ARIEL Facilitators

This workshop was developed by:

- Steve Snyder, Vice President, Exhibit and Program Development, The Franklin Institute
- Karen Elinich, Ed.D., Director of Educational Technology, The Franklin Institute.

Photo: Ideum

Brian Kelly, Technical Designer ARIEL Project, Franklin Institute; Eric Welch, Prototype Developer, ARIEL Project, Franklin Institute

Technology Showcase

Ben Wilson offers a demo to Kathy McLean

Gesture Interface Approaches & Data Sonification

Developed for the NSF-sponsored project, Creating Museum Media for Everyone

Ben Wilson, Manager, Interactive Media, Museum of Science, Boston

www.mos.org/

Augmented Reality for Interpretive and Experiential Learning (ARIEL)

Karen Elinich, Ed.D., Director, Educational Technology, The Franklin Institute Science Museum

• Prototype Device Design
• Learning Research
• Software Development • ARIEL Builder

www.fi.edu/ariel

Karen Elinich (behind table) and Brian Kelly prepare to showcase the ARIEL technology

Ideum staffer Darold Ross goes hands-on

Gravilux & Oscilloscoop
2 apps for Leap by Snibbe Interactive
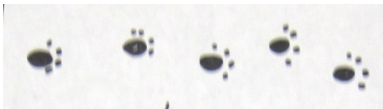
Graham Plumb, Creative Director, Snibbe Interactive

www.snibbeinteractive.com

**Local Projects
presents
Gallery One**

Tiya Gordon, Studio Director,
Local Projects

www.localprojects.net

*Tiya Gordon presenting
Gallery One*

Observe to Learn

**Animal Ethology (behavior)
App (iPad & iPhone)**

Allison Price, Director of
Education, Lincoln Park Zoo

www.lpzoo.org

*Allison Price in Discussion
with Paul Marty*

Jim Spadaccini and others play around

Playing Valcamonica

Developed with Open Exhibits software

Markus Seidl, Professor, University of Applied
Sciences, Media Consulting Research Group,
St. Pölten, Austria

mc.fhstp.ac.at

(HCI+ISE)

Charles Xie in tech discussion

Mixed-Reality Labs

Charles Xie, Ph.D., Principal Investigator, Concord Consortium

www.concord.org/~qxie

**EM Spectrum
Science Storms
at
Museum of Science and Industry, Chicago
+ Ideum**

Olivia Castellini, Senior Exhibit Developer, Museum of Science and Industry, Chicago

www.msichicago.org

ideum.com

Olivia Castellini (right) demonstrates a touch table

**Exploring Sensors
Aesthetec Studio for TIFF Kids 2012
A Study on Unintimidating Electronics**

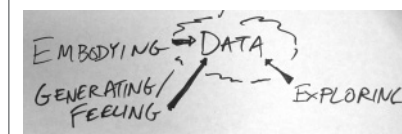Erika Kiessner, Interaction Designer, Aesthetec Studio

www.aesthetec.net

Erika Kiessner explaining her wired Altoid tins

The Kidspark Explorer

Kevin Von Appen, Director of Science Communication, Ontario Science Centre

http://www.ontariosciencecentre.ca

Kevin Von Appen in discussion

Experimonth

Beck Tench,
Director for Innovation and Digital Equipment, Museum of Life and Science

experimonth.lifeandscience.org

http://www.becktench.com

Beck Tench talks about Experimonth

Leilah Lyons

**Embodying Data
Generating/Feeling Data
Exploring Data**

Leilah Lyons, Director of Digital Learning, Assistant Professor, New York Hall of Science, University of Illinois at Chicago

http://www.cs.uic.edu/~llyons/

(HCI+ISE)

Eve Wurtele and Charles Xie

Meta!Blast

...computer game for cell and metabolic biology

Eve Wurtele, Ph.D. in Biology, Professor, Iowa State University

**http://gdcb.lastate.edu/faculty_and_research/bios/eswurtele.shtml**

Explorable Images

UPCLOSE, University of Pittsburgh Center for Learning in Out-of-School Contexts

CMU Create Lab, Carnegie Museum of Natural History

Marti Louw, Research Faculty and Designer, University of Pittsburgh Center for Learning in Out-of-School Contexts

upcloselrd.wordpress.com/people/marti-louw
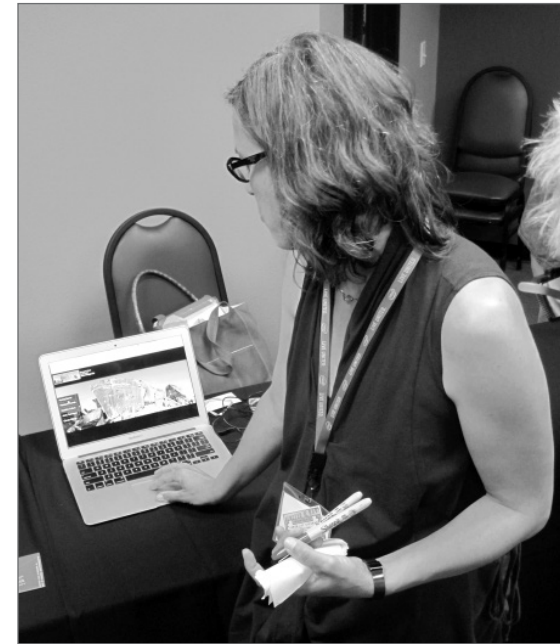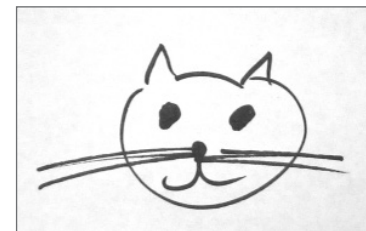

Marti Louw with Explorable Images

Habitat Tracker

Florida State University

Paul Marty, Associate Professor, Florida State University

marty.cci.fsu.edu/

Participant snaps a photo of Paul Marty

Open Exhibits Collection Viewer

**Connecting to Collective Access
(free for museums)**

Jim Spadaccini, Creative Director, Ideum;
Principal Investigator, Open Exhibits

openexhibits.org/

ideum.com

*Jim Spadaccini discussing the touch table
with Dave Patten as Erika Kiessner and
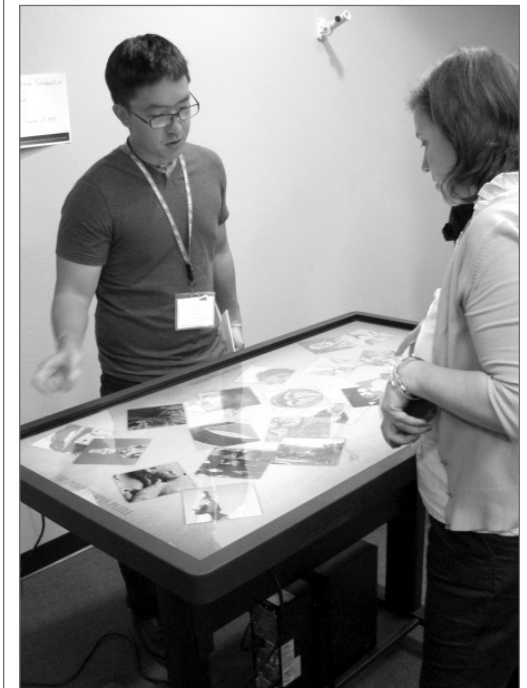others try it out*

Phydigital Interspace

**Innovation PlayTank with Creative
Problem Solving**

Interplay Experiential Learning Theory

Christopher Stapleton, Creative Venture
Capitalist, Simiosys

www.christopher.stapleton.net

http://www.simiosys.com

Christopher Stapleton offers a demonstration

*Wesley Hsu answers questions about
the touch table*

**Balboa Park Online Collective
+
Open Exhibits
+
San Diego Museum of Art**

Wesley Hsu,
Web and Touchscreen Developer,
Balboa Park Online Collaborative

balboapark.org/bpoc

openexhibits.org/

Erik Lizee showing off the Bug Scope

Bug Scope
Video Microscope RFID Viewer

Erik Lizee, Director of Exhibit Design
and Development, McWane Science
Center & Aquarium

www.mcwane.org/

**Soundstation +
Oakland Then
and Now**
Oakland Museum of
California

Olivia Jackson, Media
Producer, Oakland
Museum of California

www.museumca.org

cargocollective.com/
ojack

*Olivia Jackson (right) fields
questions about her demo*

Eye and Gaze Tracking

Slavko Milekic, M.D., Ph.D.,
Professor & Chair, Department
of Art + Design Education,
University of the Arts,
Philadelphia

www.uarts.edu

*Slavko Milekic shows how eye
and gaze tracking works*