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**Part I:  
Museum as learning laboratory: Developing and using a practical theory of  
informal learning**

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Museum leaders are increasingly being asked to justify museum practices to funders, agencies, board members, and other stakeholders who seek “hard evidence” of success. In an environment of shrinking resources and calls for greater accountability, leadership often finds itself in the position of needing to justify the existence of museums. Given limited funding resources for education, why should society be committed to the relatively expensive proposition of underwriting informal learning environments? What is the value of the museum experience compared to a classroom lesson, website, video, or educational toy that covers the same content? What are the unique learning experiences that museums support?

Many elegant arguments about the role of museums have been made in response to these kinds of questions (e.g., Roberts, 1997; Weil, 2002), and many have commented on the pivotal museum moment that started their career interest (i.e., Poundstone, 2000). But none of these arguments have been based on what the rest of the educational world is coming to consider credible empirical evidence (Town, Wise, Winters, 2004). Museum leaders need a foundation of research that goes beyond professional beliefs, personal experience, untested hypotheses, or studies that describe the museum learning experience but do not provide evidence that can be generalized to the field (Koster, 1999).

So who is working on these issues? Haven't we done decades of research on how people learn in museums? Why don't we have the research-based answers that museums need? There is a paradox at the heart of museum learning research. On the one hand, we really do know a lot about how visitors use museums. We know why they come, what they expect, whether they read signs, how they use interactives, and what it is that they walk away with in terms of concepts, facts, and skills.

But we are still grappling with how it is that all of these separate studies might accumulate into a larger, coherent body of knowledge. Many of the studies have been conducted to satisfy evaluation requirements of specific exhibitions. Even when these evaluations find their way out of file cabinets and into more general circulation, they may not support generalizable lessons learned for the field. Good evaluation is focused on particular questions that arise in particular projects. Good evaluation helps an institution learn about its own practices. But even the best evaluation does not necessarily address generalizable questions that might inform the whole field.

In this article we argue that museums, particularly children's museums, are well positioned to become unique learning laboratories. Laboratories that would not only produce research about why museums are important educational and cultural institutions, but that would also be the site for new discoveries in the basic science of how children learn. This article is the first part of a two part series that describes a new model of collaborative research and practice for children's museums. The first of the two articles considers what it would mean for museums to be learning laboratories. We describe our partnership with the Children's Museum of Pittsburgh and make the argument that the field of museum research needs to develop and use a practical theory of informal learning. The second article, to be published in the next issue of *Hand to Hand*, will discuss some findings of our research and evaluation work with the Children's Museum. Together, the two articles provide a case of what it might mean to have a sustained, in-depth program of research and practice in the context of a partnership between a museum and university researchers.

### **Building a theory for museum learning from the ground up**

The University of Pittsburgh and the Children's Museum of Pittsburgh have built an integrated institutional partnership over the last eight years. When we began our work together, the field of museum learning research was in something of an identity crisis. Many of the conversations in the field were around issues of how museums were different than schools. There were many articles arguing for different definitions of informal, free-choice, or museum learning. This reflects the historical trend that museums have often borrowed their learning theory from researchers who were primarily interested in schools. For example, museum

learning has explored uses of behaviorism (Melton, 1935), post-Piagetian constructivism (Hein, 1998; Gelman, Massey, & McManus, 1991), Gardner's multiple-intelligences (i.e. Project MUSE, Davis, 1993), and, our own recent favorite, socio-cultural theory (Leinhardt, Crowley, & Knutson, 2002; Matusov & Rogoff, 1995). These imported theories have been useful in helping the museum world think about learning and identifying ways that learning in museums is similar to or different from learning in schools.

But there are limits in how far we can stretch a borrowed theory to fit the problem of museum learning. We are not the first to note this problem. Museum researchers have often argued that there remains a huge gulf between what we say learning is, and what we can actually measure. For a while, many people thought that this was primarily a technical problem. If we could just come up with some more clever systems of measurement, we would be able to do as good as the school-based theories in being able to tune our practices to a system of valid and reliable measurement. But recently, many have begun to realize that the gap we are facing is not a measurement gap. It is a theory gap.

Museums have long been consumers of educational theory and educational research, but they have not yet taken up the challenge to contribute substantially to a rigorous debate about learning and education. At some level all human activity might be described as millisecond-level responses in the brain. At the same time, those responses occur in head of a person who is acting on a lifetime of experience, who is interacting with other people and with tools, and who is living in a particular cultural and historical context. Somewhere in between the poles of neurons and cultural history lie most of the field of cognition and education, and their questions about the ways that people learn, perform, and problem solve in disciplines such as art, math, science, literacy, history, etc. There is no single unified theory of cognition that works for all levels of this hierarchy (Bruer, 1997). Instead, researchers and practitioners choose particular problems to address and then build and use theories and methods that are tuned to their problems (Rogoff, 2003).

Museums are not schools. There are two basic assumptions of school-centric learning theory that do not fit well to the problem of museum learning. The first is what we call the grain-size assumption. Grain size refers to the basic "chunks" of activity or knowledge that a theory considers. In school-centric learning theories, knowledge is defined as the kind of thing that can be taught and assessed in schools—in a single class period, in six-week thematic unit, or perhaps over a school year. There are, of course, active theoretical debates about the best way to conceptualize this knowledge (Sfard, 1998; Greeno 1997; Anderson, Reder, & Simon, 1997). But, regardless of one's favorite theoretical orientation, the field tends to define successful learning in terms of students being able to engage in problem solving, testing, or activity that will facilitate their progress in the next

level of the education system. Essentially, knowledge is defined by what can be practically taught, assessed, and used in classrooms. A second assumption of school-centric learning theories is that a classroom provides the context of learning. One can assume a culture of students who more or less are there to learn, teachers who more or less are there to teach, and a system and curriculum that more or less enforces these roles. Research focuses on questions such as how students learn in groups, how powerful examples can be used by expert teachers, and how individual student learning transfers to future tasks.

School-based, cognitive and brain research have all made great strides into understanding the ways in which learners come to learn. But to understand learning in museums, one must also think through the broader implications of the museum environment. Visitors do not necessarily come to a museum to learn. And museums do not solely exist to teach. Museums are cultural organizations that house research collections, that represent cultural beliefs and that offer visitors a rich social, leisure time experience where learning of museum-sponsored content may be an outcome. Therefore we need a theory of learning that is able to account for the ways in which exhibit supported learning is taken up by visitors within the context of their own personal agendas and within the context of their own prior experiences. To directly assess the factoids gained by visiting an exhibition, seriously misses the points and undervalues the more affective, cultural and social outcomes that come from visiting a museum. Leaders in the field have raised concerns that much of what we know about families' use of museums comes from the perspective of assessing whether an exhibit or program has been 'successful' according to a museum's stated objectives (Ellenbogen, Luke, & Dierking, 2004; McManus, 1994). Such research may satisfy funders of the assessed program, but assessing experiences in this way ignores both the impressive cooperative learning strategies used by families as they visit museums, and the vast array of leisure and learning resources involved in family life (Hilke, 1987). It becomes critical then, to understand the mediating techniques families use in shared learning experiences, and how these experiences fit the larger learning context. We need to find ways to press a theory of museum learning to account for, and serve the rich and unique museum context.

### **What Museums Have to Offer as Learning Laboratories**

In fact, educational researchers are becoming increasingly drawn to museums as research sites for this very reason. Museums are being noticed by researchers from a variety of disciplines as attractive and complex sites to conduct research.

First, museums are filled with people; people who are potential research subjects. This may sound like a superficial observation but in fact, the access to research subjects is a major draw for researchers. Psychologists and educational

researchers working in a university laboratory setting must submit their studies to the same review board that reviews medical studies. Then, families must be recruited and scheduled one by one to come to a lab for the experiment. In a museum setting, we can run a study of family learning in two weeks that would take six weeks or more in a university setting. We can ask families to take 30 minutes out of their museum visit to work with us, and they don't have to make a special trip into the university solely to participate in a research study.

Second, museums are learning environments with complex tasks. The museum provides a naturalistic setting in which to watch parents and children working together, and exploring exhibit topics of mutual interest. Researchers are increasingly interested in moving beyond an experimental model to more naturalistic studies of learning and development. Whereas for years the standard developmental psychology study involved individual children performing isolated tasks in controlled laboratory settings, most current research focusing on children's learning recognizes the importance of context. Factors that used to be considered nuisance variables are now thought to be the most important influences on how children learn. For example, recent cognitive development work has sought to describe children's processes of learning in relation to family activity, parent talk, and cultural context (Rogoff, et al., 2003).

Third, museums are filled with staff who develop new learning environments and can work in partnership with researchers to think through complex issues about learning and knowledge. On many levels researchers find museum work exciting and challenging, where abstract theories about learning are enacted. We believe that the opportunity to talk through these issues with museum practitioners, to engage in self-reflective conversations about how daily practice and daily research intersect with higher order theories and ideas is a mutually beneficial practice that advances the mission and work of both parties.

Museums might begin to think through the ways in which they could become learning laboratories, from providing access, to developing a long term partnership where researchers become part of the design process. In the next section we discuss the chronology of our partnership.

### **The Story of a Partnership**

In our work with the Children's Museum of Pittsburgh, we have tapped into each of the three kinds of opportunities pointed out above. Over the past eight year the partnership has grown and evolved. We are often asked by other museums and researchers how to build sustainable partnerships. The truth is that we did not set out to build what we have become.

The partnership between UPCLOSE and the CM started small and was, from the beginning, based on similar interests in supporting family learning. Kevin Crowley had just arrived in town as a new assistant professor interested in family learning in museums. Jane Werner, Head of Exhibits and Programming at the time, had just finished developing Mister Rogers Neighborhood—the museum’s first major traveling exhibition—and was beginning to work on ideas for a new educational vision for the museum. Jane asked Kevin to be on the programming advisory committee and Kevin asked Jane if he could conduct a few small observational studies of families at the museum.

For the first few years, the partnership was small. Kevin and a few students would run a research study of their own, tapping into the availability of families to study. Occasionally they would help out with a small evaluation for the museum. When Kevin got a grant from the National Science Foundation to study family science learning, he asked the museum to be one of the sites. Meanwhile, Jane had become director of the museum, and was now leading a plan to take her new educational vision and place it at the heart of a major capital campaign and expansion. As the research and expansion both moved forward, it became more and more common for the two groups to recognize new opportunities. Jane’s team set out to design a family-friendly museum while Kevin’s research moved increasingly towards conceptualizing the role of family conversation in children’s museum learning—using exhibit areas as a focus for studying museum learning. Our collaborations became more frequent, more sustained, and more productive.

In 2002, we saw that a new model for working was emerging and we decided to formalize the arrangement by building a department at the museum, the Department of Research and Evaluation. Kevin was made the director, and his students became the evaluation staff for the museum.

Eventually, the research agenda grew beyond the study of what visitors do, to include a bigger picture of what staff were involved in—a major expansion and revision of the museums’ museum’s mission and vision. In 2003, Karen Knutson began an ethnographic study to examine the changing organizational culture and institutional learning at the museum. Jane authorized and insisted that this be an open and honest study, would follow the museum’s working processes at all levels. Karen documented board meetings and board retreats, all staff meetings, staff retreats, architects’ visits, departmental meetings and most importantly, the weekly management meetings. This year, now that the new museum is open, the study will include substantial evaluation of exhibit areas and the museum experience for visitors. Crowley and his team, had now become UPCLOSE, and they worked with museum staff side by side in development meetings, discussing and then later studying mediation strategies. This documentation of the different levels of the communication process will be put together as a book and

multimedia artifacts, with the hope that other museums can learn from the process.

With the opening of the newly expanded museum in November, UPCLOSE opened a satellite office and research space that is just off the museum floor. We now have three workstations, and open seating space that we can reconfigure to bring in exhibit prototypes off the floor for study. Kevin, Karen, and UPCLOSE researchers sit in on exhibits and programming development meetings. Karen has taken over as Director of Research and Evaluation, and Kevin, as director of UPCLOSE, continues to be closely involved in museum work, most recently collaborating in the ongoing development of the NSF-funded traveling exhibition, *How People Make Things*.

## **Conclusion**

In this, the first part of a two-part article, we have begun an argument that the time has come for museums to consider themselves seriously as learning laboratories. We have described the structure of a partnership between a university and a children's museum. As time has progressed we have found new ways to work together, and new projects to explore. Our partnership is not about researchers looking into the museum process or about museum staff asking the research world for lessons learned. Rather, we have found new ways to share expertise, explore mutually interesting topics, and chart a research agenda that serves both the field and the museum. While we have common ground in the issues we discuss, we come from different points of view. Researchers ask the questions that museum staff may take for granted, while museum staff force the researchers to ground their abstract theorizing in the real world of practical implications. In the second article, we will present examples of how we have worked together, highlighting innovations in design and evaluation and contributions that inform the broader questions of how children's museums are a unique and important part of the broader educational and cultural landscape of family life.

**Part II**  
**Museum as Learning Laboratory:**  
**Bringing Research and Practice Together**

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In the first article of this two-part series, we argued that museums are fruitful locations for learning research, research that can improve museum experiences as well as inform broader questions in the learning sciences. We described how we have built a research and practice partnership with the Children’s Museum of Pittsburgh. In this, the second article, we describe processes of how we have worked together to support family learning in the new exhibits at the museum. In particular, we talk about how ongoing learning research has been embedded into the museum’s exhibit prototyping and signage development processes.

**Prototypes and Blitz Studies**

Where do good interactive exhibits come from? Do they come from moments of inspiration or from thorough analysis of educational concepts? Certainly great exhibits can come from inspiration. We can point to many instances of exhibits that sprang from the mind of an inspired individual: they are artistic creations. The best of them also provide the visitor a way to connect with powerful ideas within a discipline. Another approach is to begin with the education plan and work towards experiences that will accomplish it. This approach, most often followed by teams doing the classic three-year, federally-funded traveling exhibition, leads to an educationally relevant learning environment. The best of these also provide powerful visitor experiences

No matter which approach a museum takes in the design of its interactive exhibits, there comes a crucial point at which the educational or artistic vision must meet the real time experience of an audience. In many cases the first suggestion of real visitor experience comes at the design table. Museum staff are passionate. They bring to the table their own ideals about education and their own beliefs about what visitors do. Built on their own learning history and memorable interactions they happened to see on the floor, many museum staffers have an ideal visitor in mind. This is the visitor they design for, and the visitor they judge their success against. Strangely enough, this ideal visitor also seems to embody their owners’ particular perspectives and biases about museums. When debates emerge around the project table, these ideal visitors are often brought forth to defend a point of view. Museum design conversations can sometimes get bogged down when people start “hijacking the visitor” in this way (MacDonald, 2002).

In many if not most museum situations the visitor's perspective enters the design equation only in these idealized hypothetical conversations. In more fortunate museums, front-end evaluation helps to bring at the very least, the interests, attitudes and prior knowledge of visitors to the design process. The case is quite different for science museums, where, in many cases, some kind of "on the floor" prototyping is incorporated into the design process. This is true also of the Children's Museum of Pittsburgh, where we have been part of the process of building an organizational culture of prototyping that grounds the creative design process in a systematic analysis of educational impact—using the experiences of real visitors with mocked up versions of new exhibits.

UPCLOSE researchers' contributions to the prototyping process revolve around the "blitz" study.<sup>1</sup> These are quick, turn-around studies that provide useable information to coordinate design and learning objectives throughout prototyping cycles. The typical blitz study occurs in a two-week window. When a prototype or sign concept is ready to go to the floor, the exhibit team and researchers brainstorm a few questions for study. The research team designs a simple study that often involves videotaping about 30 families using the exhibit. Working with undergraduate research assistants, the researchers do a quick coding pass at the data, tabulate indices of success, categories of talk, types of interactions or whatever else the team decided they were interested in finding out.

The emphasis in the blitz study is on speed and highly relevant information that will be needed for decision-making. Unlike our other research studies, blitz studies are not designed to be published as peer-reviewed articles. We do not spend months developing detailed coding schemes, we do not go through several rounds of pilot work to develop assessment instruments and we do not write formal reports. In many cases the data we collect is used to inform later, more involved research studies.

Blitz studies produce real data. But the data is not the bulk of the contribution of blitz studies. The data provides a concrete starting point for a conversation between the team and the researchers. The researchers dash off a one- or two-page handout that summarizes patterns in the data, interesting interactions and some noteworthy quotes from visitor talk. But these handouts do not draw conclusions. The interpretation and analysis of the findings take place in large part around the team meeting table. The idea is that the researchers are not being positioned as the definitive experts on learning. The whole team is engaged in experimentation. Anyone on the team can pose hypotheses, make inferences and challenge what the data might mean. Although the blitz studies

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<sup>1</sup> We borrow the name "Blitz Study" and some of the concept from Carnegie Mellon University's Center for Automated Learning and Discovery, a university/corporate research partnership.

have certainly produced data that has helped the team to make specific design choices, perhaps the larger impact has been through the growth of a prototyping culture at the museum, where staff work creatively, expect revision, and hold up their work for empirical scrutiny.

One of the most difficult moments in a team-based design process is figuring out how to be openly critical. The blitz study facilitates an open critique by giving the team the voices (experiences) of real visitors to lend weight to a critique, while not authoritatively closing down a discussion with absolute findings. The blitz study helps the prototyping process remain open and experimental.

### **Finding a Place for Parents in a Children’s Museum: The Role of Signage**

Throughout the prototyping process, conversations among researchers and museum staff began coalescing around the role of parents. How should we think about parents in a children’s museum? UPCLOSE research studies had begun describing how parents could guide and extend children’s discipline-specific learning in museums. The prototyping and blitz studies had provided many powerful examples of parents and children collaborating effectively. But they had also provided many examples of missed opportunities: parents turning into teachers who controlled the interaction; children working solo while their parents stood back and tuned out; or parents who tried to become involved but could not, for one reason or another, find a way to engage effectively with their child and the exhibit.

How can we make a place for parents in a children’s museum? The first step was to make the environment and the experience interesting to adults as well as children. We were already working on this as part of the prototyping process. But it soon became clear that exhibits and experiences were only one part of creating a place for parents. The other part required some direct communication between the museum and the visiting parent. We soon realized that we needed some signage.

“Signage” is a fighting word in many museums. The actual mechanics are hard but clear. There are lots of resources to help with the challenge of explaining complex concepts and subtle curatorial intent in 50 words or less at an eighth-grade reading level (e.g., Serrell, 1996). But what is not as clear as the mechanics is that those 50 words represent a tangible statement about who the museum thinks it is and how they think about their visitors (Bal 1996; Roberts 1997). Despite the difficulty and importance of the task (or perhaps because of this), signage is often slapped on to an exhibition at the last minute.

The museum decided to embark upon the unusual course of putting signage through the complete prototyping process. Starting one year prior to opening the

new exhibits, the director, developers, designers, educators and researchers met several times per month to conceptualize how parents could connect with their children in each exhibit space. Voicing our opinions, often divergent and always deeply held, it became clear that we had touched upon the core of our beliefs about museum work. We were not just talking about those 50 words. We were talking about the ideal roles of museum visitors, of parents, children, families and the role the museum and museum staff in creating, managing and mediating an experience.

The initial meetings were long, highly animated and sometimes even painful. Two new staff members, Amy Smith and Marti Louw, were assigned to develop and design signage for the new museum. They walked somewhat unbiased into a group of people, both staff and researchers, who had earlier discovered where individual points of view met, or were in conflict. Without strongly drawn sides, these two were able to serve as outsiders, and to ask the pointed or naive questions that pushed the various participants around the table to engage in lively philosophical discussions about museums and mediation.

After several of these meetings, the group developed an organizing structure for the museum's signage. Signage was seen as an opportunity to communicate with visitors, and an opportunity to enrich the museum experience. There are four levels of signage in the museum. The first two types are intended to provide visitors with the minimal information needed to engage with the exhibits. Advanced organizers are large-scale graphics and text that marked major exhibition areas. Information signage includes safety and usage instructions. These kinds of signs have always existed in the Children's Museum.

The next two types are the main focus of the signage prototyping process. Disciplinary content signage is intended to provide parents with background information about the content of exhibits. The idea here is that parents often have the interest and opportunity to learn about what their child is exploring. These signs address the parent as a learner in adult terms. Parents will be stronger educational partners for the children if they continue their own lifelong education in art, science and culture. Signage that speaks directly to parents as learners has become part of the museum's overall effort to make itself interesting and comfortable for all members of the family, not just for the children.

The final level of signs are called interaction scaffolds for parents. These signs are intended to seed parent-child conversations, suggest novel manipulations and otherwise encourage parents to engage with their children and the exhibit. These signs are often small, direct and placed at the center of the action where parents will notice them when they are engaged with the children. Sometimes this took some work to figure out. For example, in the early childhood space we

ended up projecting interaction scaffolds on the floor because parents were mostly spending their time bending down to be with their crawling babies.

This approach to signage is intended to be a tool rather than a prescription. Not all spaces need all four types of signs. Furthermore, the look, the contents and the system are developed to match the look, feel and concepts of each of the exhibit spaces.

## **Conclusion**

As we write, the new museum has been open for four months. UPCLOSE and the Children's Museum are now at the beginning phases of a year of research that will feed into developing the next round of prototyping and signage. Studying visitors in the new museum's spaces suggests that some of what we developed appears to be working while other elements clearly need to be revised. This is perhaps the most important element of our partnership. We have agreed that the process of developing a museum should never be complete. Revision is expected as we learn more about who our visiting families are, how they use the exhibits and what we, as a museum, believe about our role in promoting family learning.

So the question remains, why does the partnership work? Trust is the key to the partnership. This partnership did not emerge fully formed in the last six months. We have been working together for eight years. The partnership has grown and changed. The sense of trust (and friendship) that has emerged is central. It is central to both the management of the partnership but also to the way that we work together on prototyping. Trust is needed to share failure. For many museums evaluation is something that marks the success of a project. For us, much of our research occurs during the process, and it has taken some time for both parties to become comfortable with sharing a concept or a prototype that may not succeed.

But perhaps the most important key to our relationship overlap in our core organizational missions. The museum strongly values research and has incorporated research as a key agenda item. The UPCLOSE mission is centered on the study of learning in informal environments. We don't dabble in the study of visitors, we don't want to do an occasional study at the museum; research in museums and other informal settings is our core mission. At some level we are outsiders functioning as insiders at the museum. Over the course of our work together we have developed a shared set of understandings that facilitate our ongoing discussions of large issues like supporting parent mediation in a children's museum. At the same time we have the distance and organizational remove to be able to offer honest commentary without institutional barriers that sometimes hinder internal evaluators.

In this article we have described two examples of how research has become embedded in the museum's prototyping and signage processes. Our focus in this article has been ways that the museum has utilized the researchers with an eye towards improving museum practice. However, there is another story to tell as well: It is the story of how our learning research has become more connected to the cognitive ecology of childhood. We began this two-part series of articles arguing that museums are increasingly being identified as potential learning laboratories. As the learning sciences realize the importance of context and family structures in "basic" learning theory, there is an exploding need for places to do research on families engaged in everyday, authentic learning activities. We've seen the interest as we and other researchers present findings from our museum work to the learning research community. We think the time has come for children's museums to stop thinking about how they can be consumers of learning research and realize that they have a significant responsibility to become part of producing the next generation of knowledge about how it is that children learn and develop as individuals, parts of families and as members of larger communities.

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