Building Informal Science Education (BISE) Research Synthesis

A REVIEW OF RECOMMENDATIONS IN EXHIBITION SUMMATIVE EVALUATION REPORTS

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Abstract

Summative evaluations of museum exhibitions are generally conducted with the aims of measuring whether an exhibition met its goals, identifying areas for improvement, and assessing impact. In many cases, evaluation studies also serve to advance the field by providing lessons for funders, policymakers, or practitioners beyond the project.

This report includes details from summative evaluations that included recommendations, particulary those that might be useful for lessons learned and suggestions for improvements to the exhibitions that were evaluated. Most of the reports were from 2006 to 2011; they represent a range of topics and institutions. Randi Korn & Associates submitted far more summative studies than any other author.

Using a bottom-up method of review, the issues that emerged as most common included orientation, conceptual communication, boundaries, the need for prototyping, and utilization (both under- and over-). These topics have wide applicability across types of institutions and topics for exhibits.

The language used in making recommendations was found to be more of "considerations" rather than commands. This report concludes with the author's recommendations for making recommendations in summative evaluations of exhibitions.

INTRODUCTION

At the time I reviewed it, the new Building Informal Science Education database included all of the science-related evaluations that had been posted on informalscience.org through January 2012. The more than 400 reports had been coded for a variety of factors, including the type of study,

methods, author, and institution. The dataset included 96 summative evaluation studies of museum exhibitions.

As a museum exhibition practitioner, I am very interested in finding helpful information to improve my practice in the planning, development, and assessment of exhibits. I am also interested in pulling together information and data to synthesize and share with the field--about what we know about exhibit labels (Serrell 1996), the time visitors spend in exhibitions (Serrell 1998), and judging excellence in exhibitions (Serrell 2006). Thus, when the BISE group invited me to look at the database and investigate a question of my choice, I was delighted. As an author of several of the reports posted on line and now part of the BISE database, I was most curious about how the advice in my evaluation studies compared to others' and if there were trends that could be shared and applied.

About 50 of the 96 BISE summative evaluation studies were by the Science Museum of Minnesota BISE team to include "recommendations," and in this report I review the kinds of advice these reports provided. Recommendations included suggestions, lessons learned, or considerations for making changes. Of particular focus for my synthesis was information that could add practical value to the visitor studies field. The works of 17 evaluators (including individuals, firms, and multiple authors for a single report) are included. See Table 1 for a list of the exhibits, institutions, authors, and dates. The sample of reports is not random and the advice is not representative of the entire BISE database or the visitor studies field, rather a more personal, qualitative selection.

METHODS

The category for the search of the BISE database was "exhibition"; the evaluand was "summative"; and the search was for the particular word "recommendations." Several other closely related words might also have produced additional hits, such as "suggestions," "lessons learned," or "considerations," but I decided to stick with a more limited scope while testing the concept of a synthesis study using the BISE database.

The actual search was performed during a phone conference among Sarah Cohn, Amy Grack Nelson, and myself, as we were logged in to the NVivo database. Once the filters sorted/selected/identified the reports, a log of the BISE code numbers for each report was generated. I then went to the BISE database of reports and downloaded the reports to see the context and full content of the recommendations.

<u>Issues with Inclusions and Exclusions</u>

I was looking for reports that were summative studies about exhibitions targeted for a general audience (e.g., adults, families, non-specialists). Some reports initially selected by the search turned out to be less useful for this synthesis because they were:

- research-based rather than exhibition evaluations
- focused on one audience segment only (e.g., toddlers, teenagers, visually impaired)
- primarily formative rather than summative
- several exhibitions lumped together in one report
- about exhibitions that were a smaller part of a larger program that included other media or settings (e.g., movie, after-school)
- contained recommendations that were made primarily by visitors, not the evaluator

- turned out to contain "conclusions" but no specific "recommendations"

Excluding reports with the above issues brought the list of 50 reports down to 38 that were analyzed and included here.

Some museums and organizations don't post their studies on informalscience.org that may have been useful for this synthesis. While some post evaluations on their own websites, those resources were beyond the scope of this report.

Review Process

Over several months, I read and re-read the reports for types of recommendations that occurred. Many occurred more than once; a few were made in a dozen different instances. I was looking for recommendations that had applicability for more than one setting but were not so general or obvious as to be unhelpful. For example, the recommendation to "make sure that people understand that sharks are not mammals" is not widely useful, but neither is a broad generalization, such as "make communication clear."

After generating a summary of 22 different recurring issues, I had an extended phone conversation with four people from Randi Korn & Associates about their impressions of common or typical recommendations, that is, ones that they found themselves making over and over again. RK&A reinforced my summary and added useful and important observations, which I have incorporated into the discussions that follow.

There were a couple of things about using the database that I found frustrating: some documents (.pdf and .doc) could not be easily word-searched, and some text couldn't be copied and pasted directly from the

report files. These problems might be due to my inexperience with using the files rather than a deficiency with the BISE database. In a synthesis study, it is critical to include as many voices and examples as possible, but obtaining extended quotes were not feasible for this trial.

All of the examples and shorter quotes included in the "Findings" are followed by the BISE NVivo identification numbers to help readers locate the original studies on their own.

FINDINGS—DESCRIPTION OF THE SAMPLE

Refer to Table 1 to see the BISE code number of the exhibitions, institutions, authors, and dates of the 38 reports included in this synthesis.

Dates of Reports

The dates of the studies in this synthesis ranged from 1996 to 2011, as the dataset included all reports posted to informalscience.org by May 2012. More than half of the reports in the first sort for "recommendations" were dated since 2006, which suggests that the rate of sharing evaluation reports through informalscience.org has increased in recent years.

Authors

Fifteen evaluators (including individuals, firms, and multiple authors for a single report) are quoted in this review. By far the most frequent contributor, which accounted for 40% of the total, is Randi Korn & Associates, Inc. Multiple studies (two to four each) came from six authors. Single contributions came from another eight evaluators.

Institutions Represented

The types of institutions where evaluations occurred include science museums, science centers, children's museums, botanic gardens, aquariums, a zoo, and museums of history, natural history, and science. Regionally, they ranged from Anchorage, Alaska to Miami, Florida.

Most of the evaluations that were tagged for this synthesis represent a single study in a single institution. Seven institutions had posted two to four reports.

Exhibition Topics

This sample from the BISE database contained a diverse selection of science disciplines, e.g., botany, zoology, astronomy, biology, ecology, geology, and health sciences. Fewer topics focused exclusively on technology, engineering, and mathematics, although, in some reports, these themes occurred in interdisciplinary relationships with the other sciences. Topics ranged in scale from the nano to black holes.

FINDINGS—MOST COMMON ISSUES AMONG RECOMMENDATIONS

Recommendations made in summative exhibition evaluation reports included suggestions, lessons learned, or considerations for making changes. Five issues stood out among the recommendations because there were multiple examples regarding the need and ways to improve each:

- Orientation
- Conceptual communication
- Boundaries
- Prototyping
- Utilization

Each of these will be reviewed separately below, and many of them have overlapping and complimentary recommendations.

But first, a word about *labels*, which were mentioned in a number of cases:

> *I have devoted a lot of time to thinking and writing about museum exhibition labels—those interpretive devices we see on walls, panels, interactives, on computer screens, in videos. I have been very pleased to see improvements over the years in the ways that curators, designers, educators, and other exhibition-makers have been using words in exhibits. There are fewer issues these days with type sizes (too small), legibility (low or poor color contrast, reflections, shadows), and readability (complex vocabulary). When I published* Making Exhibit Labels *in 1983, most of the examples in the photos were of what not to do. In 1996, the second book,* Exhibit Labels: An Interpretive Approach*, contained many good examples. Now, wonderful models abound: witness the winners of the label-writing competition held by the American Association of Museums for the last five years (see http://www.curcom.org/curcom_comp_labels.php).*
>
> *Nevertheless, almost all of the issues listed above and in this synthesis are grounded in, relate to, depend on, and contain missed opportunities for the apprehendability*[1] *of exhibit labels in the designed environment. That is, the words are there, but too often*

[1] This is a word I've heard Sue Allen use. My editor keeps changing this word to "apprehensibility" but they don't mean the same thing. Being apprehensive means being nervous-- the opposite of what I want to infer. Would "understandable" be better? Sue says she likes apprehendability because of its sense of immediacy, not something you gradually make sense of. I agree. See Allen, 2007.

visitors can't, don't, won't, didn't see them or understand them, and, thus, were not able to use them in meaningful ways. This is a more subtle problem than the font size or color of the type. The degree to which the words help visitors find personal meanings, i.e., see themselves, be reminded of prior knowledge and experiences, connect emotionally, and feel competent is, to a large extent, under the direction of exhibit-makers. The big challenges (e.g., orientation, boundaries, utilization, communication) for exhibitions are intricately and inextricably linked to the apprehendability of texts. Good labels don't guarantee meaningful engagement nor do they work for every person, but good label texts afford engaging experiences. In the discussion of issues below, the apprehendability of labels will be a recurrent theme.

The following pages will summarize the issues that emerged from my review, starting with the ones that had the most examples. Numbers in parentheses are the BISE reference numbers. Some issues will undoubtedly be missed or not get the emphasis some readers might wish, but in this qualitative overview my biases will obviously come into play. Comments in italics are my personal observations that resonate positively with the first five recommendations.

<u>Recommendations about Orientation</u>

In my experience, orientation is often the single biggest challenge to get right in exhibitions, and recommendations for improvements often stem from problems that relate to orientation. This trend was also found in my review of the ISE reports.

Issues with orientation took the form of the various physical, conceptual, and psychological needs of visitors. One aspect of orientation was communicating who the exhibition is for: "Better advertising might bring more interested visitors in…" (90). Museums also failed to let visitors know that their exhibitions even existed (21_1) and whether the exhibit was meant for adults or children. What age, height, or weight limits an interactive exhibit element might require needed to be "informed and enforced" (374).

Another important aspect of orientation was the need for a clear entry message. "The introduction section should be modeled after successful exhibit components and not simply be stand-alone panels that only give title and donor information" (24). Poor placement of the introductory panel can result with it being underutilized (199). "The exhibit entrance lacks a focal point… The current banner on the left of the entry was rarely read by visitors" (5). "The exhibition currently lacks an advance organizer, orientation guide, or map…. Providing a map or advance organizer at the entrance…can help visitors connect to the Big Idea and the main themes…" (189). At the Tech Museum, "The video introduction area and the *Transformations* photo booth in *Life Tech* had high attraction among visitors. However, visitors did not experience them as introduction areas, nor did they realize the gallery's themes" (30).

In *Altered State*, some interviewees specifically mentioned the absence of an introductory area, "…while others wanted, but could not identify, clear connections among the exhibition's core messages and many themes. Introductory panels are imperative" (238).

Then there is getting visitors to the door in the first place. The otherwise

highly effective *Plant Lab* needed improvements in letting visitors know through wayfinding signage or hand-held guides that the *Plant Lab* existed and that it was meant for visitors, not just botanists (200).

In several cases, exhibitions in children's museums were intended for adults as well, but this needed to be made clear. "In addition to children, make adults feel equally welcome so that the Garden is perceived as an intergenerational space, not a children's play space" (21_2). "Revise the marketing materials to make it clear that this exhibition is not just for small children" (115_1)--especially when the exhibits work well for older and broader audiences and are targeted to them as well. A study of Cell Lab asked if there were ways to make it more adult-friendly (57_1).

I find it surprising how often poor orientation is an issue in all types of exhibitions.

Conceptual Communication

I've been a champion for the idea of exhibitions having a "big idea" and being very clear about it. Some people's evaluations agreed with the need for one.

Recommendations for improving conceptual communication were similar to those for improving orientation. If visitors are to understand the content of the exhibition in a new way, not just by using their prior knowledge, it is important to set the stage for the exhibition's big idea and reinforce it throughout the displays. "They need to be very explicit about the larger themes for any exhibition. Visitors, like audiences at a lecture, need to be told what the *Traits of Life* exhibition is about, reminded of what the exhibition is about and left with a final message reiterating the theme." (9)

Communicating concepts clearly requires exhibit developers to avoid creating experiences that compete with the intended messages. Exhibits that do not support the main message can distract visitors' attention. In *Wild Music*, the majority of visitors readily connected with the exhibit content, but they missed two learning objectives. "These objectives may not have fared well because the three most-attended exhibits…did not directly address these learning objectives" (199).

Prior knowledge can be a barrier to the acquisition of new knowledge, especially when misconceptions are involved. A misleading or misunderstood word can send the wrong message, e.g., "shark embryos" led visitors to think that sharks were mammals (53). An especially complex topic can lead visitors to jump to the wrong conclusions: "The exit interviews also exposed common misconceptions of technology that does not exist, such as diagnostic nano-sized video cameras that are injected into the skin or taken as a pill" (50).

A highly attractive exhibit does not guarantee good science communication. This was clearly demonstrated by the missed opportunities an exhibit: many visitors stopped at this element, but their feedback indicated that they didn't grasp the complicated topic of oxidation, referring to it as "anti-oxidants" (82).

A familiar claim in advertising media is that kids can learn at a science center without even realizing that they are learning because they're having so much fun. This idea was challenged in the *Moneyville* evaluation. If people are learning without even knowing it, how can they learn that they know it? If they are having fun doing math, they might recall the fun, but

not the math. "(S)omething very valuable may be lost when the mathematics is not made compelling for its own sake" (81).

On the other hand, other studies found that the exhibits some children did not think were fun was because they did not understand them (21_1).

Recommendations for better conceptual communication included ideas about alignment of components. This can be as straightforward as putting things next to each other that go together. Connections are easy to miss, whether it's between two objects, two exhibits, or a film and an exhibit. The visuals, themes, and signage need to reinforce each other (73_4). "Try to create stronger physical connections between exhibits so that visitors recognize that the exhibits go together" (252). If visitors are being encouraged to make comparisons, the objects (or experiences, phenomena, etc.) should be unmistakably accessible. The same goes for contrasting opinions: "If it is important to you that people realize that both opinions are represented…you might want to make it more obvious" with better signage (107_1).

The issues of orientation and conceptual communication apply to materials used for marketing as well as the in-exhibit experiences: "Perhaps the current emphasis on 'circles are everywhere,' though accurate and accessible, is too broad a characterization of what the exhibit offers, and it may reinforce the idea that the exhibition is only suitable for a very young audience" (115_1).

Setting objectives for what the exhibition is intended to communicate was repeatedly recommended in evaluation reports. With measureable objectives against which the evaluation results can be compared, the effectiveness or success of an exhibition can be determined. That is, when the museum's

intentions become more clear, the degree of success in achieving the intentions is also clearer. Other evaluators also recommend setting objectives up front: "What emerged from the research work and the focus on conversations was an improvement process for exhibits…. The first step is to get a record of the designer's stated intentions for the exhibit—by having the exhibit designer envision the best-case usage of the exhibit and the types of conversations designers would ideally like to hear at the exhibit" (153 & 411).

The setting, context, or size of an exhibition can contribute to its successful communication. In the case of *Black Holes*, the size of the host museum played a role in the visitors' exhibit experience. Visitors spent more time at the exhibition when they were visiting a smaller museum than at a larger one. "Their ratings also indicated higher enjoyment and more learning at the smaller venue, variables that are typically related to more time spent" (276).

Is less more? I have often recommended that an exhibition be less dense (5, 195, 196). Overwhelming visitors with too many things and too many ideas was an issue that has been evidenced by visitor comments or less-than-thorough use of the exhibits and labels. Ways to remediate an overwhelming exhibition include eliminating some of the information-heavy components and deleting underutilized exhibit elements (28, 153 & 411). Ways to avoid making an overwhelming exhibition in the first place include setting clear and limited objectives and having a well-defined big idea.

<u>Recommendations about Boundaries</u>

Also related to the issues of orientation and conceptual communication is the issue of boundaries. Differentiating one exhibit area from another, i.e., where one exhibition ends and another begins, can be a big problem for

visitors. The relationship between an exhibit space and a lab or classroom might not be clear. The same recommendations for improving orientation apply here: A coordinated effort of design, signage, and staff facilitation is needed.

Nearby spaces can compete with each other for visitors' attention (82). When an exhibition occupies more than one room, the boundaries can be less than obvious. Signage with arrows to point the direction of flow can help, especially if the exhibition rooms are located on more than one floor or across a hallway. "Only 50% actually saw the second floor" (189). "Visitors do not conceptually or physically experience the two areas that comprise *Exploring Life on Earth* as one exhibition…. Visitors need to be told what an exhibition is about so they can think about the ideas and specimens in a particular context" (28). Discontinuous exhibit spaces need to have a strong design identity to make them feel like they are parts of a whole. "Make the space more clearly connected to the rest of the exhibition" (374).

The use of temporary walls or partitions can create visual boundaries if demarcations are not clear. "Many interviewees said the exhibition layout prevented them from understanding 'the big picture.' Adding select partitions to *Altered State* might alleviate this issue by creating a more structured learning environment. Furthermore, since partitions would reduce the number of entrance and exit points, it is possible that visitors would spend more time at individual exhibits and in the exhibition as a whole" (238). In *Animal Secrets*, manipulatives meant for the Stream exhibit migrated to a nearby water feature meant for younger children. "Consider adding a wall between the two water areas to help separate the activities" (101).

Lack of differentiation between exhibit areas can also impede the evaluation process, especially tracking-and-timing studies, because subjects wander in and out of open floor plans (41). "This made it challenging for data collectors to 'hang on' to visitors during their time in *Animal Secrets* as they often briefly explored and then moved into the adjacent galleries. In a few cases we noticed that they returned later; however, by then data collectors were engaged in an observation of a new visitor group" (101).

A similar result I've found when evaluating exhibitions with poorly defined boundaries is that, in exit interviews, when visitors name their favorite exhibit, it turns out to not be part of the exhibition being evaluated.

The Need for Prototyping

If it's an interactive exhibit element, it needs to be mocked up and tried out.

The need for prototyping and remedial evaluation was another recurring theme (3, 5, 21, 28, 30). Prototyping is the process of observing visitors as they use exhibits, either in mocked-up form (formative evaluation) during design development or during soft-opening activities before the grand opening. These small-scale, relatively inexpensive studies quickly inform exhibit developers about ways to improve exhibits. Observations provide evidence for the degree to which exhibits are meeting the intended experience goals. "(W)hat did emerge was an important process for exhibit developers to become clearer about envisioning the ideal interactions, and to become more grounded in the reality of what is happening at specific exhibits," what Inverness calls "groundtruthing" (153 & 411). In the summative evaluation of *Animal Secrets*, it was noted that a previous remedial study had been done, which had "already made for a better visitor

experience," and there were "very few issues that needed addressing" (101) after the earlier recommendations had led to helpful revisions.

Prototyping is best done on exhibits that are fairly far along in development but still flexible enough to make changes. Before going on the floor, they should have passed a readiness test with the exhibit developers, i.e., the components did not violate any obvious best practices in regard to their logical or conceptual design, which could prove distracting to visitors. "Research on conversations worked best when prototypes were fairly advanced in their development. Navigation and invitation issues had to be resolved before conversations could be the focus of the work; otherwise, visitor conversations tended to focus on these things and not the conceptual ideas" (153 & 411). Prototyping should reveal unexpected problems, not ones you already clearly know about.

For the *Hunters of the Sky* exhibition, the evaluation plan included remedial suggestions to be accomplished before a summative evaluation was conducted. Extensive recommendations were offered to improve two components that had the explicit goal of stimulating an examination of people's values and opinions (107_1).

The opportunity for remediation through prototyping before an exhibition traveled to other sites was mentioned in several studies. The TEAMS III report contains many component-specific recommendations to inform remedial changes, especially regarding ways to increase engagement and to include and encourage social conversations (153 & 411). Another report included eight focused component-specific findings and recommendations for improvements (105_2). Another report providedthe recommendation to pare down the size of an exhibition to 75 elements from 106 elements when it

was in Anchorage before it traveled to the Smithsonian where there would be much more competition for visitors' attention (196).

Prototypes allow exhibit developers to see their content in context, which can be useful for making design decisions, spotting potential problems, or building confidence about success. "The best way to test the effectiveness of a given presentation style is to do so in the context of exhibit content" (72). For example, this mistake would have been caught during formative evaluation: Visitors referred to an inconsistency between what they read on an interactive label and what they could find on the display itself (e.g., missing buttons). "Ensure that within the text for each interactive display there is no reference made to nonexistent component parts" (19).

Ineffectual interactives were pointed out in several reports. Prototyping is most critical for interactives, which often go onto the exhibit floor untested for apprehendability and durability. When something is broken, visitors can be confused: Is there something wrong with the exhibit or is there something wrong with them? Often, visitors will blame themselves for not being able to understand how to operate an inoperable interactive device. "Interactives that didn't operate properly were a main source of frustration for most visitors in our study" (53). Broken, missing, or nonfunctioning exhibit elements can be avoided through daily maintenance routines and schedules, but often it doesn't happen (21_1). This can contribute to bad impressions. "Keep popular exhibits and exhibits near the entrance operational. They receive the most use and represent primary experiences for visitors" (30). Replenishing exhibits with fresh supplies might need to happen more than once a day.

Inadequate or ineffectual interfaces with computer interactives lead to confusion, missed opportunities, and frustration. Signage and graphics need to reinforce what visitors do intuitively or expect to be the appropriate or correct thing to do (21_1).

In addition to testing the effectiveness of exhibits from a conceptual and operational standpoint, the affective nature of labels was assessed with visitors to the Tropical Pavilion, where the study found that "They want to remember the names and how to recognize plants. But they also want to remember the *feeling* of being in a rainforest, the feeling of peacefulness" (203), and the recommendation was made to emphasize the aesthetic enjoyment in the signage.

Exhibit developers who use formative evaluation and prototyping will discover and be able to remediate design and label issues before the final installation is made.

<u>Recommendations about Utilization</u>

There were many references to visitors' over- or under-use of an element or an area in an exhibition. Underuse of wall text, interactives, and audio units was common, and the reasons varied.

Underuse was due to a lack of orientation and understanding the boundaries (missing or skipping a room), or it was due to the location of an exhibit element (hidden, or at the end) in *Animal Secrets*. It was because the element lacked sufficient attractiveness or the labels were not apprehendable. " 'Build An Ant' does not seem to get a lot of use or attention. Some visitors told us they did not understand what to do. It needs more direct signage with a few starting instructions" (101).

Wall panels of text-only are notorious for low attracting power (28), unless the exhibit theme is particularly compelling and visitors are motivated to read. "In general, panels without artifacts did not attract or hold visitors. Consider alternative options, such as: using panels sparingly; reworking panels to include artifacts or simple interactives; or embedding panel messages in existing computer interactives" (30).

At least three spaces in the *California Condor Rescue Zone* were not well used, and the recommendation was that, in the future, remedial evaluation could discover and improve areas where visitors are missing opportunities to become engaged (384).

Visitors' use of audio components did not meet the expectations or hopes of exhibit developers in *Beautiful Science*. Visitors often skipped the handsets placed along a row of exhibit cases, seemingly because, if a person stopped to listen, doing so would interrupt the traffic flow as others moved along in a linear pattern. Placing duplicate audio units out of the traffic pattern, with seating, might improve their attractiveness (195).

Audio units were included in *Tissues of Life,* primarily to enhance visually impaired and blind visitors' experiences at five exhibits. The units were also intended to augment the experience of sighted visitors. Most visitors did not use them, however, and many of those who did expressed disappointment. Children found them attractive and were more likely to use them than were adults, although the content was best understood by an adult audience. Recommendations included:

- "consider that audio will likely have an immediate appeal to children and use this natural behavior to promote audio as an interpretive tool for children who often do not take the time to read text"
- "help sighted visitors understand the audio's purpose—so they can make an informed decision about whether they would like to use it to enhance their experience"
- "the Museum may need to explicitly note the reason for the audio in the Museum brochure and encourage floor staff to explain and promote it" (369)

Overutilization of an area or element was considerably less common. In more than one case when it did happen, it involved long wait times to use some key exhibit elements, such as the climbing wall in *SportsWorks* (374).

In *Expedition Health*, some components were very popular or took a long time to complete, causing crowds, backups and other traffic-flow problems. Lessons for the future and recommendations in the evaluation (247) included:

- Design exhibits that are as much fun to watch others use as using them yourself, so that the waiting-in-line experience is positive
- Have a docent available to talk with waiting visitors about what they were seeing on an overhead monitor of the activity
- Alert casual visitors "…when the gallery is crowded with students (giving them the option to return later when they might enjoy greater access to exhibits and programs)"
- Assign a docent to specific components to help visitors use the device properly and quickly
- Discourage visitors from cycling through the program more than once (which was more likely to happen with children)

- Summon a technician quickly if the software malfunctions

FINDINGS—OTHER ISSUES AMONG RECOMMENDATIONS

Two other issues came up multiple times: creating exhibits and environments that encourage parent-child interaction, and the need for facilitation for some exhibition topics. Finally, three other issues were mentioned several times: advice for traveling exhibitions, electronic card readers, and seating.

Recommendations about Parent-Child Appeal/Interaction

Some reports recommended making hands-on exhibits that would appeal to children and hold their attention while the parents could pay attention elsewhere, i.e., have different exhibits target different audiences (90). Others, however, stressed the need to make exhibit elements have a broad appeal to adults and children working together for multigenerational interactions. "Make exhibits appeal to both age groups (adults and kids) at the same time to encourage social learning, so family groups don't split up" (41).

When parent-child interactions were a goal, it was important that parents understand their role (21-2). Parents may not be sure what to do, and they need to have clear instructions for how to contribute to a child's learning (384). In *Go Figure*, the same recommendations were made about helping adults engage with their children. "[P]arents needed additional assistance in knowing how to use the exhibition and to understand the teaching philosophy underlying the exhibition" (24). Parents may need help in very specific situations, e.g., directing children in the correct way to use binoculars or microscopes (22_3), or they might need this information

themselves. A video that shows appropriate behaviors for parents and explains children's developmental needs can be helpful (24).

Facilitation

Facilitation of visitors' use of an exhibit element is typically accomplished by signage, video, written guides, or docents.

Exhibits that require facilitation but need to have "down time" or are inactive when no staff is available would benefit from having a video of the interaction/activity of it when it is in use. This might be especially important if the exhibit element contains information vital to the exhibition's main theme (189). There were missed opportunities in *Wild Music* with unmanned discovery carts that contained relevant science content (199).

In some cases, exhibits were challenging for children even with adult support. "The activity cannot depend on staff facilitation to be understood" (101). If volunteers, docents, guides, explainers, etc., are necessary to make an exhibit work for visitors, there will be many missed opportunities for positive experiences when help is not nearby or if the visitors' learning-style preference is to be self-guided.

Some content is simply too difficult or complex to communicate without mediation. In the case of *It's a Nano World*, "…an unmediated science exhibition is not designed to be and may not be the proper medium to accomplish the difficult task of introducing the sub-visible through models" (50). Guides facilitated better exhibit experiences for visitors to *Nano* when it was at Epcot (registered trademark symbol needed).

Seating was needed for AV stations (5) and computer interactives (41) for the whole family—not just one stool (81)—with varying heights if the audience is largely multigenerational (19).

Electronic card readers were popular and effective in some cases (374, 276), but underused in others (247), and follow-up visits to the institution's website were much less frequent than expected in all cases. "Although the visitors intended to visit their personal website after leaving the museum, very few actually did so. In addition, there is a lot of information on the *Black Holes* website that most visitors did not access" (276). Card-use needs to be promoted in the exhibition, and links to electronic sites should provide a positively reinforcing follow-up experience, not just more information. Prototyping different strategies to encourage broader use was suggested (247).

Advice for traveling exhibitions was thoroughly addressed by Inverness (153 & 411) and Circles (115_1). Traveling Experiment Gallery (12) contains extensive recommendations about public relations, maintenance, training, configurations, safety, and staffing. "Responsibilities of the host site" are listed in *Electric Space* (19).

DISCUSSION

The Language of Recommendations

Most evaluators seem to be cautious about sounding too directive or critical when they make recommendations in summative evaluations of exhibitions. They use words and phrases like "Should…," "It would be more powerful if…," "Consider doing…," "May want to think about…." For examples of recommendations that are more specific and directive, see Serrell (5) and

Beaumont (101). I typically used verb commands, such as "strengthen…," "add…," "post…," "explain…." "rewrite…," "move…," and "list…," in less conditional voice. Beaumont may have taken a more directive approach because she was making recommendations based on not only surveys, observations, and interview data but also on a critical review and walk-through with museum staff, suggesting that her voice was speaking for more stakeholders and represented consensus rather than her sole opinion.

The Applicability of the Recommendations

Most of the recommendations in this report are applicable to other types of exhibits, not just science exhibitions. Issues such as orientation, conceptual communication, boundaries, and the need for prototyping are also common to many art and history exhibits. Sharing the successes and failures broadly across all disciplines among museum colleagues can improve our practices.

Another small group of case studies emerged from the data: exemplary examples of exhibitions. Several exhibitions did not need many of the typical recommendations made here, and they can set a high standard for us to strive for and serve as benchmarks for things that worked well: *Dynamic Earth* (26), *Black Holes* (276), *Expedition Health* (247), *Secrets of Circles* (115-1), and *Plant Lab* (200). These exhibitions had high success with meeting their intended visitor outcomes and had effective formats and diverse presentations without being overwhelming. "It is not often that RK&A has the opportunity of evaluate such an effective exhibition," Randi Korn said about *Dynamic Earth* (26). After summarizing Secrets of Circle's high degree of success and the evidence for it, Sue Allen went on, "That said, we list here some recommendations that may be helpful for CDM's future exhibition development projects… " which is an example of lessons that can be learned even in a very successful exhibition (115-1).

An exemplary case on the other end of the spectrum, one that included many of the recommendations covered here, was *Sugar from the Sun* (171). This evaluation had most issues/categories mentioned, made in very concrete contexts. There were problems with orientation, conceptual communication, and especially the label writing and design. Reading this report is a good reminder for what not to do when making an exhibit. Even our best intentions to make an innovative and original exhibition can fall short.

Who's Missing? What's Missing?

I found it surprising that the initial list of 50 reports did not include summative evaluation studies conducted by many long-time researchers, many of whom are members of the Visitor Studies Association and the Committee on Audience Research and Evaluation. Why not? Posting reports on informalscience.org is voluntary, and, although the National Science Foundation encourages grant projects to submit their summative evaluations, there is no rigorous policy or penalty for failure to do so. If museums or evaluation companies have their own websites where they post their reports, it wouldn't hurt to duplicate the postings on informalscience.org as well, especially if they are exemplary in some unique or innovative way. It's never too late to post a past study.

Some authors/evaluation firms do not wish to publish or post their reports for political, proprietary, or personal reasons. Sometimes this means not sharing negative findings that might throw an unfavorable light on an institution or individuals involved in producing the exhibition. Client privacy can be a bigger concern than sharing methods and the full range of results

with museums heavily dependent on attracting and sustaining grant money to support the development of exhibits.

But there clearly is a difference between won't and haven't: Some evaluations have not been posted simply because the authors have not gotten around to doing it yet.

Not mentioned in these reports (many published before 2006) was much about social media, smartphones, or other digital technology, which is a constantly evolving area. There is a lag time between the integration of a new technology into an exhibition, a reference to it in an evaluation, and enough other recommendations to identify any trends before another new bit of software comes on the scene.

Recommendations for Making Recommendations

The rate of building up the BISE database has increased in recent years, and that trend will hopefully continue. More standardizations in the format will make searching the reports easier, as long as the formats still allow some creative flexibility for authors.

Broadening the base for types of topics/institutions to include many excellent studies done in non-science museums would be welcomed.

Evaluators in VSA, CAISE and CARE should encourage each other to post their reports to help develop a culture of sharing. Some firms and individuals specify that sharing the report is a condition for part of their contract with the institution.

My advice for making recommendations in summative evaluation reports is to go ahead and make them. Without couching them in meek tones, be specific and give the context and evidence for why the recommendation is being made. Evaluation is recognized today as a valuable part of the process; it's no longer us (evaluators) against them (designers, curators, etc.). Criticism is about the work, and the work can always be improved.

The usability of the reports is essential for improving practice, and evaluators should write reports in ways that make them easy to read and that contain readily applicable advice. It's never all good news, is it? If we don't acknowledge any missed opportunities or downright failures, the motivation to do better is lost.

FINAL THOUGHTS

How will my work as a museum exhibition evaluator be different as a result to doing this review? I remember Roger Miles, as the head of exhibitions at the Natural History Museum, London, who in 1972 asked "What must we think about and do if we are to succeed in designing effective educational exhibitions for the general public, and how must we organise ourselves to ensure that these things get done?" Forty-plus years later, many museums still are reluctant to question the process or success of their communication of science in the informal setting. They assume the effectiveness of their exhibition media because it is there. To do a better job-- and there are always missed opportunities and better ways of doing things-- we need recommendations from others in this business for inspiration and guidance. I will continue to offer mine and look forward to hearing yours.

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ABOUT THE AUTHOR

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Table 1. Studies analyzed and reviewed

BISE #	Exhibition	Institution	Evaluator	Year
5	Science Under Sail	Anchorage Museum	Serrell & Associates	2000
9	Traits of Life	Exploratorium	Hein	2003
12	Traveling Experiment Gallery	Science Museum of Minnesota (SMM)	Selinda Research Associates	1998
19	Electric Space	Space Science Institute	Randi Korn & Associates (RK&A)	1997
24	Go Figure	Minnesota Children's Museum	RK&A	2001
26	Dynamic Earth	Newark Museum	RK&A	2003
28	Exploring Life on Earth	Milwaukee Public Museum	RK&A	2002
30	Tech Museum (4 galleries)	Tech Museum	RK&A	2000
41	Molecules	New York Hall of Science	Serrell & Associates	2001
50	It's a Nano World	Sciencenter	Edu, Inc.	2004
53	Wild Reef	Shedd Aquarium	Beaumont	2005
72	Kachemack Bay	Pratt Museum	Visitor Studies Services	2004
81	Moneyville	Oregon Museum of Science (OMSI)	Inverness Research Associates	2004
82	Amazing Feats of Aging	OMSI	McNamara	2005

BISE #	Exhibition	Institution	Evaluator	Year
90	Current Science & Technology Center	Museum of Science Boston	ILI	2006
101	Animal Secrets	OMSI	Beaumont	2007
171	Sugar From The Sun	Garfield Park Conservatory	Selinda Research Associates	2008
189	Skyscraper	Liberty Science Center	ILI	2008
195	Beautiful Science	Huntington Library, Art Collections, and Botanic Garden	Serrell & Associates	2009
196	Yupik Science & Survival	Anchorage Museum	Serrell & Associates	2009
199	Wild Music	SMM	RK&A	2008
200	Plants Are Up to Something	Huntington Library, Art Collections, and Botanical Gardens	RK&A	2009
203	Tropical Pavilion	Brooklyn Botanic Garden	Giusti	2008
238	Altered State: Climate Change	California Academy Sciences	RK&A	2010
247	Expedition Health	Denver Museum of Science and Nature	McNamara	2010
252	Science & Art	Arkansas Discovery Network	RK&A	2010
276	Black Holes	Harvard Smithsonian Center for Astrophysics	Goodman Research Group	2010

BISE #	Exhibition	Institution	Evaluator	Year
369	Tissues of Life	SMM	RK&A	2004
374	SportsWorks	Saint Louis Science Center	Israel	2007
384	California Condor Rescue Zone	Los Angeles Zoo	RK&A	2011
105_2	Conservatory	Huntington Library, Art Collections, and Botanical Gardens	RK&A	2006
107_1	Hunters of the Sky	SMM	Perry	1996
115_1	Secrets of Circles	Children's Discovery Museum of San Jose	Allen & Associates	2007
153 & 411	Teams III	multiple small museums	Inverness Research Associates	2008
21_1	Amazing Plants	Brooklyn Botanic Garden and Brooklyn Children's Museum	RK&A	1997
21_2	Discovery Garden	Brooklyn Botanic Garden and BCM	RK&A	1997
57_1	Cell Lab	SMM	RK&A	2003
73_4	The Human Body	Maryland Science Center	RMC Research Corp.	2003