The Lemelson Center for the Study of Invention and Innovation
Smithsonian Institution
National Museum of American History

Invention at Play

Summative Evaluation

Randi Korn & Associates, Inc.

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SUMMARY AND DISCUSSION

This report presents the findings of a summative evaluation of *Invention at Play*, conducted by Randi Korn & Associates, Inc. (RK&A), for the Lemelson Center for the Study of Invention and Innovation at the Smithsonian Institution's National Museum of American History. *Invention at Play* is a traveling exhibition developed by the Lemelson Center in partnership with the Science Museum of Minnesota and is funded by The Lemelson Foundation and the National Science Foundation.

Data collection took place at two venues: in December 2002 at the National Museum of American History in Washington, D.C., (NMAH) and in April 2003 at the Museum of Science in Boston, Massachusetts (MOS). The evaluation documents the scope of the exhibition's impact and effectiveness at two different sites using timing and tracking observations, stationed observations, exit interviews, and telephone interviews two months after the visit.

Only selected highlights of the study are included in this summary. Readers are urged to consult the body of the report for a detailed account of the findings.

METHODOLOGY

Timing and Tracking Observations

A total of 100 drop-in visitors, ages six years and older, were observed (50 at NMAH and 50 at MOS). RK&A recorded the total time spent and the total stops made in the exhibition. Additionally, data for each exhibit were collected: the percentage of visitors that stopped, the median time, and the frequency of select behaviors (which were based on the objectives of the exhibits).

Stationed Observations

RK&A observed 428 visitors at three Playhouse activities—98 at Magnetic Racetrack, 171 at Rocky Blocks, and 159 at Whirligigs—noting visitors' ages, genders, and familial relationships and writing a detailed description of their actions and conversations. These activities were selected because they were intended to foster multigenerational interactions.

Exit Interviews

RK&A conducted open-ended interviews with visitors immediately after their visit to *Invention at Play* at NMAH and MOS. In all, 56 interviews were conducted with 93 visitors—63 adults and 30 children.

Telephone Interviews

RK&A conducted open-ended interviews with visitors two months after they visited *Invention at Play*. In all, 68 visitors who recalled *Invention at Play* were contacted within the timeframe and interviewed—46 visitors from NMAH, and 23 visitors from MOS. Telephone numbers were collected by systematically intercepting visitors as they exited NMAH and MOS. The evaluator showed visitors a list of exhibitions and they identified which ones they had visited. If they

indicated they had visited *Invention at Play*, they were asked to participate in an interview about the Museum. Visitors were not told that they would be interviewed about *Invention at Play* to avoid cueing them to remember their experiences in the exhibition and biasing the data.

DISCUSSION OF FINDINGS

Visitors' Responses to the Exhibition

Overall, visitors enjoyed and were enriched by their experiences in *Invention at Play*. Observed visitors spent ample time in the exhibition—longer than at comparable exhibitions (Serrell, 1998)—and actively engaged with exhibits. Adults and children played and conversed at activities and, in some cases, visitors who did not know each other worked together, too. Interviewees described the exhibition as fun, informative, interactive, and a worthwhile museum experience for children. Specifically, they praised the unique, open-ended activities and the insights that the inventors' stories provided—such as appreciating inventors as contemporary and varied people. Some interviewees noted that they had visited *Invention at Play* more than once, and one-third of telephone interviewees said they recommended the exhibition to others.

Comparison of Findings to Exhibition Goals

Invention at Play was extremely successful in achieving the Lemelson Center's stated outcomes (see Tables A and B). Visitors used the exhibition comprehensively—72 percent of visitors stopped in two of the three main sections. Additionally, visitors were drawn to inventor-related exhibits and activities. Ninety-six percent of visitors stopped in one or more Inventor Case Studies sub-sections, and 86 percent stopped at one or more activities. Even two months after their visit, many interviewees recalled activities and inventors' stories.

Table A
Correlation of *Invention at Play* Outcomes and Observation Findings

Behavioral Outcomes	Outcome Achieved*	Supporting Findings
Visitors will be drawn to the hands-on activities and feel motivated to use them.	Yes	86 percent of observed visitors stopped at one or more activities.
Visitors will play with at least one activity in the Playhouse.	Somewhat	47 percent of observed visitors used one or more Playhouse activities.
Multigenerational groups will use the hands-on activities together.	Yes	62 percent of observed multigenerational groups used activities together.
Visitors will spend more time than average using some of the hands-on activities.	Yes	Observed visitors used activities longer than at other exhibits evaluated by RK&A.
Visitors will visit at least one Inventor Case-Study.	Yes	96 percent of observed visitors stopped at one or more Inventor Case-Study.
Visitors will visit at least two of the three sections of the exhibition.	Yes	72 percent of observed visitors stopped in two or more sections.

*In general in quantitative museum evaluations, if one-half or more of visitors behave as intended, the outcome is considered to be achieved.

Table B
Correlation of *Invention at Play* Outcomes and Interview Findings

Experiential Outcomes	Outcome Achieved*	Supporting Findings
Visitors will be able to describe one or more of the ways in which play and the approaches many inventors take to their work are related (e.g., exploratory play/experimentation and tinkering).	Yes	Many exit interviewees, most who used the Playhouse activities and/or read inventors' stories, discussed how play is connected with the invention process.
Visitors will recall how they played in the exhibition and describe how it is connected to the invention process.	Yes	Many exit interviewees referenced the invention process (e.g., tinkering, brainstorming) when talking about how they used the Playhouse activities.
Visitors will express more confidence in their creativity and inventiveness skills (as compared to the front-end studies).	Somewhat	Some exit interviewees felt connected with the invention process, attributing creativity and inventiveness skills to themselves or their children.
Visitors will describe how their or others' playing with the interactives demonstrated using imagination and problem solving in different ways.	Yes	Nearly all exit interviewees said the Playhouse activities gave visitors an opportunity to invent or engage in inventive thinking.
Visitors will describe how curiosity, imagination, and problem solving underlie creativity and invention.	Yes	Nearly all telephone interviewees readily connected play, invention, and creativity.
Visitors will describe connections between play and how at least one of the inventors in the Case Studies approached their inventive work.	Yes	Many exit interviewees said the inventors' stories enhanced their understanding of the role of play in the invention process.
Visitors will be doing something different in their lives that they believe is a result of their experience in *Invention at Play* (e.g., creative problem solving, increased interest in inventors and inventing).	Somewhat	Telephone interviewees were evenly divided between those who said the exhibition made them think about invention and play in a new way and those who said it did not. However, many telephone and exit interviewees said they connected with the invention process on a daily basis—for example, by creative problem solving at home and encouraging their children to play creatively.

*In general in qualitative museum evaluations, if many visitors respond as intended, the outcome is considered to be achieved.

Three aspects of *Invention at Play*—responses to activities; perceptions of inventors; and connections between creativity, play, and invention—are discussed in greater depth to illustrate the exhibition's success in attaining its stated goals.

Responses to Activities

Activities were a peak experience for many visitors. Visitors used a median of 3 activities of 10 available—meaning they used a greater percentage of activities than any other exhibit type.

Corroborating the appeal of activities is the finding that 6 of the 10 exhibits with the highest attraction power (as measured by the number of visitors that stopped at each) were activities. Visitors also spent considerable time at activities—a median time of nearly four minutes. Again, 6 of the 10 exhibits with the highest holding times were activities. As shown in Table C, visitors spent about the same time at *Invention at Play* activities compared with another Science Museum of Minnesota exhibition (RK&A, 2002a). However, compared with interactives at science centers (RK&A, 2000; 2002b) and a recent study of *Within These Walls* at NMAH (RK&A, 2003), visitors spent much more time at *Invention at Play* activities.

Visitors not only spent considerable time at activities but also actively engaged with them. The most commonly observed behaviors in the tracking observations were activity-related: watching other visitors do activities and doing the activities themselves. Specifically, in terms of Playhouse activities, nearly one-half of visitors used one or more of them. In addition, activities encouraged multigenerational interactions—62 percent of family groups used activities together.

Table C
Median Time Spent at Interactive Exhibits: Findings from Several Studies

Exhibition	***Exhibition Developer***	***Median Time***
Playing with Time	Science Museum of Minnesota	3 min., 59 sec.
Invention at Play	**Lemelson Center and Science Museum of Minnesota**	**3 min., 46 sec.**
Innovation	The Tech Museum of Innovation	2 min., 20 sec.
Exploration	The Tech Museum of Innovation	2 min., 17 sec.
MarsQuest	Jeff Kennedy Associates	1 min., 3 sec.
Within These Walls	National Museum of American History	39 sec.

The other data sets also support positive findings about activities. During the stationed observations at Magnetic Racetrack, Rocky Blocks, and Whirligigs, nearly all visitors immediately understood how to use the activities and spent the majority of time tinkering with them purposefully. Visitors frequently tested new combinations and reasoned possible adjustments, analyzed the properties of and discovered new ways to use parts, discussed and executed plans, as well as experimented with multiple iterations before and after attaining success. Visitors engaged in some social play at each of the three activities; however, Rocky Blocks was particularly successful in encouraging adults and children to work together. During the exit and telephone interviews, visitors complimented the hands-on activities and noted they worked well for adults and children. Notably many telephone interviewees readily recalled using activities in *Invention at Play* two months after their visit.

Perceptions of Inventors

In general, exit and telephone interviewees in this summative evaluation expressed more comprehensive ideas about inventors and invention compared with visitors in the front-end study

(Pekarik and Dreibelbis, 2000). Most visitors in the front-end study perceived inventors as having special, innate talents. Inventors were also often thought of stereotypically, such as the lone genius. Those who participated in the front-end evaluation also associated "inventor" with famous historical figures such as Edison. They thought of the invention process as focused, goal-oriented work that, in some cases, was directly related to problem solving.

In contrast, most interviewees in this summative evaluation said *Invention at Play* enhanced their understanding of inventors as people. Many said the inventors' stories helped them think of inventors as everyday people. The story of Stephanie Kwolek, in particular, impressed many visitors; she was often referenced in the interviews. Some perceived inventors to be uniquely gifted individuals—which were similar to the front-end responses. However, others noted that the exhibition demonstrated how anyone could be an inventor—by looking at everyday things in a creative way. In other words, *Invention at Play* demystified inventors for some interviewees. Additionally, the diversity of inventors—including age, gender, race, and fields of study—included in the exhibition helped broaden interviewees' definition of "inventor." A few were also amazed that inventors began inventing as children.

Summative evaluation interviewees also left the exhibition with an expanded understanding of the invention process. Many were impressed by the different ways that inventors invent. While some discussed the importance of perseverance—an aspect of invention that also emerged in the front-end study—others were impressed that inventors have so many different sources of inspiration—from nature and the built environment, to learning from mistakes, to open-ended play. Throughout the summative interviews, visitors spoke of the importance of play to invention—something that never surfaced in the front-end evaluation.

Most interviewees in the summative evaluation, like the front-end study, were reluctant to call themselves inventors. However, many said the activities encouraged them to think like inventors or to be inventive. In particular, most interviewees who used the Playhouse activities said they were included in *Invention at Play* to give visitors the opportunity to invent or to emulate inventors' playful perspectives. Additionally, some interviewees noted that they are inventive at work or at home. Based on how summative evaluation interviewees' talked about inventors, their hesitance to call themselves inventors is likely out of respect for those featured in the exhibition, and not because they felt disconnected to the content. It is also likely that for many visitors the concept that inventors are people who invent for a profession is deeply ingrained—as was suggested in the front-end study.

Connections Among Creativity, Play, and Invention

As exit and telephone interviewees discussed the exhibition's main idea, their responses were remarkably similar. One-half of visitors in each set of interviews said that the exhibition was about the invention process, either stating specifically that the exhibition demonstrated how inventors work or alluding to creative thinking and other playful strategies inventors employ. One-quarter viewed *Invention at Play* as a more standard invention exhibition, showing various inventions and their impact on society. Another one-quarter—mostly children or adults who did not use any activities—did not perceive the exhibition to be about invention. Rather, they gave nonspecific responses, stating that the exhibition was about science, history, or simply a fun, hands-on experience.

Most interviewees intuitively connected creativity, play, and invention. However, only adults who actively engaged with Playhouse activities and inventors' stories articulated concrete examples of how the exhibition demonstrated this relationship. For example, many of these interviewees said the Playhouse activities gave them the opportunity to invent or engage in inventive thinking—that is, to imitate inventors. Additionally, when asked specifically about play, some reasoned that play enables inventors to think outside the box and be open to many different sources of inspiration, while others said play activates creative thinking which, in turn, begets inventions. Interestingly, both exit and telephone interviewees responded similarly to the question about the relationship among creativity, play, and invention, suggesting that the ideas visitors develop during their visit to *Invention at Play* stay with them months afterward.

During telephone interviews, RK&A asked visitors whether *Invention at Play* encouraged them to think about invention and play in a different way. Some said the exhibition strengthened ideas they already had about the importance of open-ended play for children, while a few others said it made them re-evaluate the role of undirected play in the development of a child's creativity. A few adults said the exhibition encouraged them to do creative activities. Others said their ideas about play and invention were not changed. However, when responses in the front-end study were compared with how visitors talked about inventors in the summative evaluation, the difference suggests that *Invention at Play* heightened visitors' awareness of the importance of play in the invention process.

RK&A was somewhat surprised that more parents did not perceive the parenting messages stressing the importance of open-ended play for children. One reason may be that the parent information was not as attractive to visitors as activities and other types of exhibits. For example, the Play Wall was the least-visited main section of the exhibition. The *Invention at Play* videos were used by 7 percent of visitors and the Playhouse reading boards were not used by any. A second reason may be that parents do not expect parenting information in exhibitions. For example, RK&A (2001) evaluated an exhibition in a children's museum designed to redefine parents' concepts of math and encourage parents to do math activities with their children. The exhibition included specially written labels directed to parents and a parent gallery guide; however, many parents did not realize the intended message, because the concept of parent education in a museum was outside their realm of experience. This may also be the case for *Invention at Play*. To help parents realize that museums can be a source of parenting information, venues featuring *Invention at Play* should be encouraged to conduct family workshops and programs like those that the Lemelson Center conducted when the exhibition was at NMAH.

Comparison of NMAH and MOS Venues

In the timing and tracking observations and both sets of interviews, RK&A found that visitors at NMAH had deeper experiences in *Invention at Play* than those at MOS. Visitors observed at NMAH consistently made more stops and displayed more exhibit-related behaviors than did those at MOS. Interviewees at NMAH were more effusive about the hands-on quality of *Invention at Play*, more impressed with its overall look and feel, and more appreciative of facilitators than were those at MOS. More NMAH visitors recommended the exhibition to others than did MOS visitors. For visitors at NMAH, *Invention at Play* stood out among the

other exhibitions at the Museum, likely because its interactivity was a pleasant surprise for visitors at NMAH—visitors at MOS are accustomed to and expect interactive exhibits.

Visitors at NMAH also had heightened cognitive experiences compared with those at MOS. More interviewees at NMAH grasped the exhibition's main idea and made more specific connections among play, creativity, and innovation. Conversely, more interviewees at MOS said the exhibition was about science or gave other generic responses. As discussed later, compared with visitors at MOS, those at NMAH used more panels and activities—which likely worked together to convey main messages. Moreover, an exhibition about invention may have seemed too disconnected for visitors at MOS compared with the phenomenon-based exhibits typical of science centers.

To ascertain whether the differences found in the observations were influenced by the venue or other variables, RK&A conducted a step-wise multiple regression analysis to identify which combination of variables (e.g., site, gender) best predicts or explains each finding. While it would be impossible to test every potential variable, four variables were deemed particularly important to test and appropriate for the sample size: venue, visiting the exhibition with children, gender, and age group. Because the regression model tests one variable at a time, this statistical procedure enables the evaluator to isolate which variables influence the results and remove any confounding effects that other variables might have on the findings.

As presented in Table D (on the next page), of the four variables tested, venue influenced most of the findings: visitors at NMAH stopped at more exhibits overall, more wall-mounted panels, more rail panels, and more cases/props than did those at MOS. They also noticed more panels, used more activities, and read aloud/talked about content at exhibits more often than did MOS visitors. Furthermore, visitors at NMAH used more activities as a multigenerational group than did those at MOS. In other words, something unique about the experience at NMAH influenced visitors' behavior. No demographic or group composition characteristics could account for these findings. In two cases, venue and another variable both influence findings. NMAH visitors and those with children tended to stop at more activities. NMAH visitors and males tended to have more object-based behaviors.

Clearly, an exhibition's context—the museum in which it is featured—is important. At MOS, *Invention at Play* was viewed as a comparable exhibition. It met visitors' expectations of interactive exhibitions featured in science centers but was also appreciated on other levels. Compared with other NMAH exhibitions, visitors found *Invention at Play* unique and engaging, and took full advantage of the exhibition, relishing their experiences. Parents, in particular, appreciated the interactive experiences offered, describing the exhibition as a high point in their visit to NMAH. The summative evaluation suggests that visitors at NMAH are eager for experiences like those provided in *Invention at Play*. The diversity of exhibits, in general, as well as specifically interactive exhibits and touchable props, a cheerful environment, and facilitators are all aspects of *Invention at Play* that NMAH should consider exploring in its future exhibitions.

Table D
Variables that Affect Visitor Experience: Findings from Multiple Regression Analyses

	Significant Predictor Variables			
Finding	**Venue**	**Group Composition**	**Gender**	**Age Group**
Differences in the Number of Stops Made				
Stopped at more exhibits overall	NMAH	----	----	----
Stopped in more exhibition sections	----	With children	----	----
Stopped at more wall-mounted panels	NMAH	----	----	----
Stopped at more rail panels	NMAH	----	----	----
Stopped at more activities	NMAH	With children	----	----
Stopped at more cases/props	NMAH	----	----	----
Differences in Time Spent at Exhibits				
Spent more time in the exhibition overall	----	----	----	----
Spent more time at wall-mounted panels	----	Without children	----	----
Spent more time at moveable panels	----	Without children	----	----
Spent more time at cases/props	----	----	Male	----
Differences in Behaviors				
Noticed more panels	NMAH	----	----	----
Touched more props/other object-based behaviors*	NMAH	----	Male	----
Used more activities	NMAH	----	----	----
Used more activities as a multigenerational group	NMAH	----	----	----
Read aloud/talked about content at more exhibits	NMAH	----	----	----

*Other object-based behaviors include: using magnifiers, lifting ropes or vests, sitting in the canoe, playing with the puppets, and writing in the "What Was/Is Your Favorite Toy?" book.

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INTRODUCTION

This report presents the findings of a summative evaluation of *Invention at Play*, conducted by Randi Korn & Associates, Inc. (RK&A), for the Lemelson Center for the Study of Invention and Innovation at the Smithsonian Institution's National Museum of American History. *Invention at Play* is a traveling exhibition developed by the Lemelson Center in partnership with the Science Museum of Minnesota and is funded by The Lemelson Foundation and the National Science Foundation.

Data collection took place at two venues: in December 2002 at the National Museum of American History in Washington, D.C., (NMAH) and in April 2003 at the Museum of Science in Boston, Massachusetts (MOS). The evaluation documents the scope of the traveling exhibition's impact and effectiveness at two different sites. The evaluation's specific objectives were to determine:

- How well did the exhibition achieve its goals and objectives? (see Appendix A for exhibition goals and objectives);
- What meaning did visitors construct from their experiences?;
- What did visitors do?;
- What did visitors experience affectively?;
- What did visitors experience cognitively? (i.e., what did visitors learn?);
- Did the exhibition change visitors' perception/understanding of invention and play?;
- What is the quality of creative play in the exhibition?;
- What do visitors understand about inventors' playful processes?;
- What quantitative and qualitative differences emerge from visitors' experiences at two different museum venues?

METHODOLOGY

RK&A used three data collection strategies to assess visitors' experiences in *Invention at Play*: timing and tracking observations, uncued exit interviews, and telephone interviews.

Timing and Tracking Observations

Visitors are often observed to provide an objective and quantitative account of how visitors behave and react to exhibition components. Observational data indicate how much time visitors spend within an exhibition and suggest the range of visitor behaviors.

All visitors six years of age and older were eligible to be unobtrusively observed in the exhibition. The observed visitors were selected using a continuous random sampling method. In accordance with this method, the observer was stationed at the entrance of the exhibition, and the first eligible visitor to enter was observed. The observer followed the selected visitor through the exhibition, recording the exhibits used, select behaviors, and total time spent in the exhibition (see Appendix B for the observation forms). When the visitor completed his or her visit, the observer returned to the entrance to await the next eligible visitor to enter the exhibition.

Stationed Observations

To provide a more detailed analysis of experiences at specific activities, RK&A conducted stationed observations at three exhibits: Whirligig, Rocky Blocks, and Magnetic Racetrack. During stationed observations, the evaluator watched as visitors used the activity, writing a detailed description (called "thick description" in the anthropology field) about what they were doing and how they were interacting with other visitors. In addition to the exhibited behaviors, the observer also noted the approximate ages and genders of observed visitors.

The evaluator watched visitors at each exhibit for 10 hours (5 hours at NMAH and 5 hours at MOS). The evaluator positioned herself unobtrusively and observed visitors in such a way as to not impact visitors' experiences at the exhibits.

Exit Interviews

Open-ended interviews encourage and motivate interviewees to describe their experiences, express their opinions and feelings, and share with the interviewer the meaning they constructed from an experience. Open-ended interviews produce data rich in information because interviewees talk about their experiences from a personal perspective.

Upon exiting the exhibition, visitors 9 years of age and older were eligible to be selected (following a continuous random sampling method, as described above) to answer several questions about their experiences (see Appendix C for the exit interview guide). The interview guide was intentionally open-ended to allow interviewees the freedom to discuss what they felt was meaningful. All interviews were tape-recorded with participants' permission and transcribed to facilitate analysis.

Telephone Interviews

Post-visit telephone interviews were conducted with visitors two months after their visit to determine longer-term effects of their visit to *Invention at Play*. Phone numbers were collected by systematically intercepting visitors as they exited the Museum. The evaluator showed visitors a list of museum exhibitions, and they identified which ones they had visited. If they indicated they had visited *Invention at Play*, they were asked to participate in an interview about the Museum. Visitors were not told that they would be interviewed about *Invention at Play* to avoid cueing them to remember their experiences in the exhibition and biasing the data.

If visitors had visited *Invention at Play* and were willing to receive a telephone call in two months, their telephone number was collected. If they had not visited *Invention at Play* or were unwilling to provide a telephone number, they were thanked for their time and the data collector intercepted the next eligible visitor.

Only visitors 18 years of age and older were approached for a telephone interview. Again, the telephone interview guide was open-ended to allow individuals to express what was meaningful to them about their visit (see Appendix D for the telephone interview guide). All interviews were tape-recorded with participants' permission and transcribed to facilitate analysis.

DATA ANALYSIS

Quantitative Analysis

The observational data were quantitative, and were entered into a computer to be analyzed statistically using SPSS/PC+, a statistical package for personal computers. Frequency distributions were calculated for all categorical variables (e.g., gender, age group). To examine the relationship between two categorical variables (e.g., use of an exhibit and age group), cross-tabulation tables were computed to show the joint frequency distribution of the two variables, and the chi-square statistic (X^2) was used to test the significance of the relationship.

Summary statistics, including the mean (average), median (data point at which half the responses fall above and half fall below), and standard deviation (spread of scores: "±" in tables), were calculated for the time data.[1] To compare the means of two or more groups, an analysis of variance (ANOVA) was performed. Multiple regression analysis was also used to develop models that identify and explain relationships among a set of variables. In regression analysis, a group of *predictor variables* (e.g., characteristics such as gender, venue) are tested to find the combination of variables that best predicts or explains a particular *outcome variable* (e.g., time spent in the exhibition). The models in this report were developed using a forward stepwise method of regression, in which predictor variables are added to the model one by one until every predictor variable that makes a significant contribution to the model has been included. The variable that makes the largest contribution to explaining the variance of the outcome variable is entered first. Of the variables remaining, the one that makes the largest contribution to explaining the variance of the test score is entered next. This process continues until there is no variable remaining outside the model that meets the significance level established for inclusion in the model. The resulting model represents the combination of variables that best predicts or explains the outcome variable.

The level of significance was set at 0.05 because of the moderate sample size. When the level of significance is set to $p = 0.05$, any relationship that exists at a probability (p-value) of ≤ 0.05 is termed "significant." When a relationship has a p-value of 0.05, there is a 95 percent probability that the relationship being explored truly exists; that is, in 95 out of 100 cases, there really would be a relationship between the two variables (e.g., gender and preferences for visiting). Conversely, there is a 5 percent probability that the relationship does not really exist; in other words, in 5 out of 100 cases, a relationship would appear purely by chance. Within the body of the report, only statistically significant results are discussed. Appendix E lists all of the statistical procedures run on the data and all data recodes.

[1] For the most part, medians rather than means are reported in this document because, as is typical, the number of components used and the time spent by visitors were distributed unevenly across the range. For example, whereas most visitors spent a relatively brief time with exhibition components, a few spent an unusually long time. When a distribution of scores is extremely asymmetrical (i.e., "lopsided"), the mean is strongly affected by the extreme scores and, consequently, falls further away from the distribution's central area. In such cases, the median is the preferred measurement because it is not sensitive to the values of scores above and below it—only to the number of such scores.

Qualitative Analysis

Visitors' behaviors during stationed observations and responses to interview questions were analyzed qualitatively, meaning the evaluator studied the data for meaningful patterns, and as patterns and trends emerged, grouped together similar responses or behaviors. Each grouping was then assigned a name or category that conveys the meaning the data embody.

The behaviors recorded during the stationed observations were examined within the framework of creativity skills (such as, experimentation and tinkering, social play) that inventors employ. The type and quality of the social interactions were also analyzed. The stationed observations and both sets of interviews were also examined by site to determine whether there were qualitative differences between visitors' behaviors and responses at NMAH and MOS.

Quotations in this report illustrate interviewees' thoughts and ideas as fully as possible. The quotations give the reader the flavor of visitors' experiences.

METHOD OF REPORTING

The data in this report are both quantitative and qualitative. For the quantitative data, tables and graphs display the information. Percentages within tables may not always equal 100 owing to rounding. The findings within each topic are presented in descending order, starting with the most frequently occurring.

The stationed observations and interview data are presented in narrative. Interviewees' verbatim quotations (edited for clarity) are included for the exit and telephone interviews. Within quotations, an asterisk (*) signifies the start of a different speaker's comments. The interviewer's remarks appear in parentheses. Trends and themes in the stationed observation and interview data are also presented from most- to least-frequently occurring.

Findings in each report are presented in four main sections as follows:

I. Timing and Tracking Observations
II. Stationed Observations
III. Exit Interviews
IV. Telephone Interviews

I. PRINCIPAL FINDINGS: TIMING AND TRACKING OBSERVATIONS

Data were collected at the National Museum of American History (NMAH) and the Museum of Science, Boston (MOS). The evaluators observed a total of 100 drop-in visitors, ages 6 years and older (50 at NMAH and 50 at MOS).

Throughout the observation report, data for the total sample (100 observations) are presented. Data for each venue—NMAH and MOS—are only shown when the relationship is statistically significant.

DATA COLLECTION CONDITIONS

At NMAH, observers timed and tracked visitors for nine days during the Washington D.C. Public School System's winter break in December 2002. At MOS, observations were collected over eight days during the Boston Public School System's spring break in April 2003. Because data collection took place over school holidays, most of the observations were conducted on weekdays (81 percent) (see Table 1).

Table 1
Data Collection Day
(*n* = 100)

Day	Total %
Weekday	80.6
Weekend day	19.4

Nearly one-half of observations in the total sample were conducted during moderate visitation conditions (48 percent) (see Table 2). There was a statistically significant relationship between level of crowding and the venue. During the observations, NMAH tended to be less crowded than MOS.

Table 2
Level of Crowding During the Observations
(NMAH *n* = 50, MOS *n* = 50)

Crowding Level*	NMAH %	MOS %	Total %
Low	52.0	20.0	36.0
Moderate	40.0	56.0	48.0
High	8.0	24.0	16.0

*x^2=12.444; *df*=2; *p*= 0.00

VISITOR DEMOGRAPHICS

As shown in Table 3, the total sample of visitors observed included slightly more males than females (55 percent and 45 percent, respectively). Two-thirds of visitors (68 percent) were adults (16 years of age and older) and one-third were children (32 percent).

Table 3
Visitor Demographics
(*n* = 100)

Characteristic	Total %
Gender*	
Male	55.0
Female	45.0
Age Group	
6 to 8 years old	3.0
9 to 11	14.0
12 to 15	15.0
16 to 24	16.0
25 to 44	36.0
45 to 64	14.0
65 years or older	2.0

*Smithsonian Institutional Studies Office data show higher female than male visitation at NMAH.[6] However, SI data is only for adults. RK&A observations included children in the sample.

[6] Institutional Studies Office, Smithsonian Institution, "*Visitors to History*: A Report based on the *1994-95 National Museum of American History Visitor Study*," unpublished manuscript, ISO.

More children were observed at MOS than at NMAH. Conversely, more visitors 45 years of age and older were observed at NMAH than at MOS (see Table 4).

Table 4
Differences in Ages of Visitors at the Two Venues
(NMAH *n* = 50, MOS *n* = 50)

Age Group*	NMAH %	MOS %	Total %
15 years and younger	22.0	42.0	32.0
16 to 44	54.0	50.0	52.0
45 years and older	24.0	8.0	16.0

*x^2=7.202; *df*=2; *p*=0.03

As presented in Table 5, the majority of visitors in the sample were in groups of both adults and children (65 percent).

Table 5
Group Composition
(*n* = 100)

Group Composition (*n* = 125)	Total %
Adults and children	65.0
Adults only	19.0
Alone	12.0
Children only	4.0

More multigenerational groups were observed at MOS than at NMAH (see Table 6).

Table 6
Differences in Visiting with Children at the Two Venues
(NMAH *n* = 50, MOS *n* = 50)

Visiting with Children	NMAH %	MOS %	Total %
With children	54.0	88.0	71.0
Without children	46.0	12.0	29.0

*x^2=14.036; *df*=1; *p*=0.00

OVERALL VISITATION PATTERNS

Total Time Spent in the Exhibition

Visitors spent a median of 10 minutes in *Invention at Play* (see Table 7). The shortest time a visitor spent in the exhibition was 13 seconds and the longest time was over 1 hour. When the total time spent in the exhibition was compared by venue and demographic characteristics, no statistically significant relationships emerged.

Table 7
Total Time Spent in *Invention at Play*
(*n* = 100)

Median	Minimum	Maximum	Mean	±
10 min.,11 sec.	13 sec.	1 hr.,13 min., 22 sec.	12 min.,56 sec.	14 min.,9 sec.

To further compare the total time spent in *Invention at Play*, RK&A used Serrell's "Sweep Rate Index" (SRI).[7] The SRI is one measure for comparing exhibitions across the museum field.

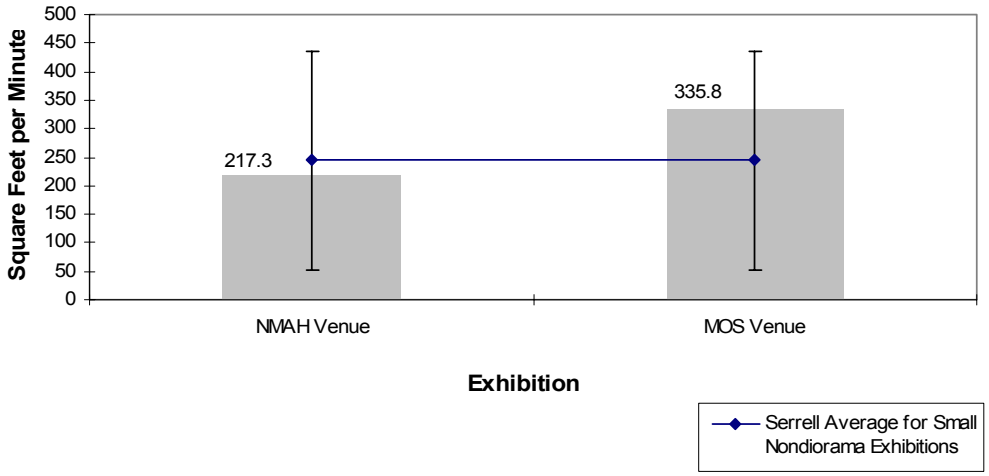
The SRI is calculated by dividing the exhibition's square footage[8] by the average total time spent in the exhibition.[9] The lower the SRI, the more time visitors spent per square foot of space. As indicated in Figure 1, the SRI for *Invention at Play* at NMAH is 217 square feet per minute and at MOS is 336 square feet per minute.

The SRI of *Invention at Play* at NMAH is lower than Serrell's average SRI for small nondiorama exhibitions.[10] This means NMAH visitors in *Invention at Play* are moving slower than visitors in exhibitions of similar size.

In contrast, the SRI of *Invention at Play* at MOS is higher than Serrell's average SRI for small nondiorama exhibitions. MOS visitors are traveling at a somewhat higher rate (i.e., faster), yet still within one standard deviation of Serrell's average SRI. The vertical lines dissecting each bar indicate the standard deviation for Serrell's average SRI.

[7] Serrell, B., "Paying Attention: Visitors and Museum Exhibitions," Washington, DC, American Association of Museums, 1998.
[8] The Taylor Gallery at NMAH is 3,227 square feet. The temporary exhibition hall at MOS is 3,700 square feet.
[9] The average total times were used in the SRI calculation in accordance with Serrell's methods. Throughout the rest of the report, median times are reported, as the median is standard for time data unevenly distributed across its range.
[10] Serrell reports an average SRI of 244.3 (±104.8) for small (<3,900 square feet) nondiorama exhibitions.

Figure 1
***Innvention at Play* Sweep Rate Index by Venue**



Total Number of Exhibits Stopped At

Invention at Play included 83 exhibits at which visitors could stop.[11] **For this evaluation, a "stop" was defined as a visitor standing for three seconds or longer in front of a component. If a visitor returned to a component at which s/he had previously stopped, this return was not counted as an additional stop, but the amount of time spent was included in the total time spent at the component.**

Visitors stopped at between 1 and 36 exhibits in *Invention at Play* (see Table 8). Visitors stopped at a median of 8 exhibits.

Table 8
Total Number of Exhibits Stopped at in *Invention at Play*
(*n* = 100)

Median	Minimum	Maximum	Mean	±
8.0	1.0	36.0	10.3	8.4

Visitors made an average of 13 stops in *Invention at Play* at the NMAH venue and 7 stops at the MOS venue (see Table 9). A stepwise multiple regression model was created to determine which variables, including demographic characteristics, visiting with children, and site, influenced the total number of exhibits stopped at in the exhibition. No variable other than site could explain the difference. In other words, visitors at NMAH were more likely to stop at more exhibits in *Invention at Play* than were those at MOS.

Table 9
Total Stops in the NMAH and the MOS Venues
(NMAH *n* = 50, MOS *n* = 50)

Venue*	Mean Number of Stops	±
NMAH	13.2	10.2
MOS	7.2	4.5

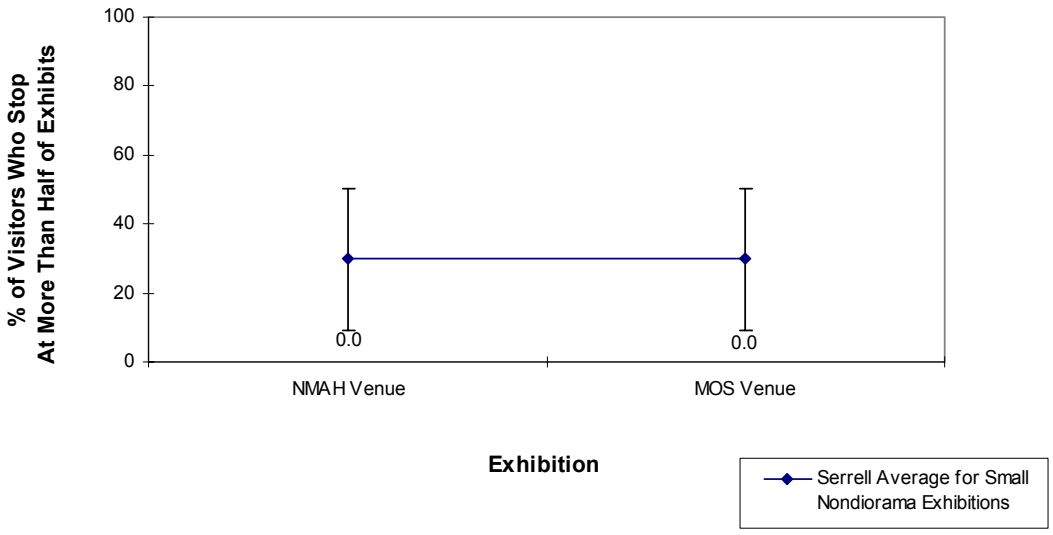
*$F = 14.099$; $df = 1, 98$; $p = 0.00$

[11] At NMAH there were 82 exhibits at which visitors could stop as Curlybots was not present.

To compare the number of stops made in *Invention at Play* with those of exhibitions of similar size, RK&A used Serrell's "Percentage Diligent Visitor Index" (%DV).[12] The %DV is obtained by calculating the percentage of visitors that stopped at more than one-half of the exhibits. The higher the %DV, the more thoroughly the exhibition was used.

The %DV for *Invention at Play* at NMAH and MOS is 0 percent—that is, no visitors stopped at more than one-half of the exhibits. The %DV for *Invention at Play* is much lower than Serrell's average %DV for small nondiorama exhibitions[13] (see Figure 2). This means visitors stopped at fewer exhibits in *Invention at Play* compared to exhibitions of similar size.

Figure 2
***Invention at Play* Percentage Diligent Visitor Index by Venue**



Some developers object to Serrell's %DV model, which bases the success of an exhibition on quantity of exhibits stopped at versus the quality of an individual experience. That is, other developers, such as the Science Museum of Minnesota, are more interested in promoting high dwell times at individual components than a large percent of components used. As noted later, visitors in *Invention at Play* tended to use a few components for an extended time, matching the behavioral objectives of the development team but resulting in a low %DV.

[12] Serrell, B., "Paying Attention: Visitors and Museum Exhibitions," Washington, D.C., American Association of Museums, 1998.
[13] Serrell reports an average %DV of 29.7 percent (±22.8) for small (<3,900 square feet) nondiorama exhibitions.

Behaviors Observed in Invention at Play

Summary of Behaviors

Observers noted nine behaviors. Total incidences of each behavior are provided in Table 10. Detailed information about behaviors at individual exhibits is provided in Appendix F.

As presented in Table 10, about three-quarters of visitors watched others do activities and two-thirds actually used the activity themselves (74 percent and 66 percent, respectively). More than one-half read aloud or talked about exhibit content and coached or were coached at activities (58 percent and 54 percent, respectively). The fewest number of visitors used snoops (17 percent).

Table 10
Percentage of Visitors who Exhibited Behaviors in *Invention at Play*
(*n* = 100)

Behavior (*n* = 100)	Total %
Watched others do activities	74.0
Did activities	66.0
Read aloud/talked about content at any exhibits	58.0
Coached or were coached at activities	54.0
Touched props and other object-based behaviors*	50.0
Noticed any panels**	45.0
Listened to audio at any exhibits	30.0
Interacted with facilitators at activities	28.0
Used snoops	17.0

*Other object-based behaviors include using magnifiers, lifting ropes or vests, sitting in the canoe, playing with the puppets, writing in "What Was/Is Your Favorite Toy?" book.

**Museum visitors often glance at panels to ascertain the title of an exhibit or the identification of an object, rather than stopping for seconds or longer to read them. For this evaluation, a "notice" was defined as looking at a panel for less than 3 seconds.

As indicated in Table 11, visitors used a median of three activities. Visitors watched or coached others at two activities each. They also exhibited object-based behaviors or talked about content at two exhibits each. Visitors listened to audio, interacted with facilitators at activities, used snoops, and noticed panels at one activity each.

Table 11
Total Number of Behaviors Exhibited in *Invention at Play*

Behavior	Number Available	*n*	Median	Minimum	Maximum	Mean	±
Used activities	11	66	3.0	1.0	8.0	3.0	2.0
Watched others use activities*	11	74	2.0	1.0	8.0	2.4	1.6
Coached/were coached at activities	11	54	2.0	1.0	7.0	2.2	1.7
Exhibited object-based behaviors	12	50	2.0	1.0	6.0	2.3	1.2
Read aloud/talked about exhibits	79	58	2.0	1.0	12.0	3.4	3.1
Listened to audio	16	30	1.0	1.0	5.0	1.5	1.0
Interacted with facilitators at activities	11	28	1.0	1.0	3.0	1.3	0.6
Used snoops	3	17	1.0	1.0	2.0	1.1	0.3
Noticed panels	41	45	1.0	1.0	6.0	2.0	1.4

*Watching others use activities is considered an active behavior. As visitors watch others, they may learn how to use the exhibit or they may simply enjoy mentally engaging with the activity before physically doing so.

Visitors at NMAH noticed more panels, touched more props, used more activities, and read aloud/talked about more exhibits than did visitors at MOS (see Table 12). Additionally, males touched more props than did females.

Table 12
Differences in Behaviors by Site

Behavior	Predictor Variable	Mean	±
Panels noticed	Site[1]:		
	NMAH	1.3	1.6
	MOS	0.4	0.8
Touched props and other object-based behaviors	Site[2]:		
	NMAH	2.8	1.4
	MOS	1.6	0.6
	Gender[3]:		
	Male	2.6	1.3
	Female	1.6	0.8
Total activities used	Site[4]:		
	NMAH	3.6	2.4
	MOS	2.3	1.3
Exhibits read aloud or talked about	Site[5]:		
	NMAH	4.4	3.4
	MOS	2.2	2.3

[1] $F = 13.344$; $df = 1, 98$; $p = 0.00$
[2] $F = 12.252$; $df = 1, 48$; $p = 0.00$
[3] $F = 10.161$; $df = 2, 47$; $p = 0.00$
[4] $F = 5.136$; $df = 1, 60$; $p = 0.03$
[5] $F = 8.040$; $df = 1, 56$; $p = 0.01$

Use of Activities as a Multigenerational Group

Of the 71 visitors attending the exhibition in a multigenerational group, 62 percent used activities together (see Table 13). Thirty-eight percent did not use the activities as a family; rather, children used them as parents watched, or children and parents visited exhibits on their own without interacting with each other.

Table 13
Percentage of Visitors Using Activities as a Multigenerational Group
(*n* = 71)

Use of Activities	Total %
As a multigenerational group	62.0
Not as a multigenerational group	38.0

As shown in Table 14, more visitors at NMAH used activities as a multigenerational group than did those at MOS. It is worth noting that more family groups were at MOS than at NMAH (as shown in Table 6, on page 7).

Table 14
Differences in Use of Activities as Multigenerational Group by Site

Behavior	Predictor Variable	Mean	±
Activities used as multigenerational group	Site*:		
	NMAH	3.4	1.8
	MOS	1.8	1.0

*$F = 13.692$; $df = 1, 43$; $p = 0.01$

Behaviors in the Playhouse

Of the 11 activities, 7 were located in the Playhouse (Play a New Way With the Everyday) section.[14] As shown in Table 15, slightly less than one-half of visitors used one or more Playhouse activities (47 percent).

Table 15
Percentage of Visitors who Used Playhouse Activities
(*n* = 100)

Use of Playhouse Activities	Total %
Did not use any Playhouse activities	53.0
Used one or more Playhouse activities	47.0

Visitors used a median of two activities in the Playhouse (see Table 16).

Table 16
Total Number of Playhouse Activities Used
(*n* = 47)

Median	Minimum	Maximum	Mean	±
2.0	1.0	6.0	2.1	1.3

[14] One Playhouse activity, Curlybots, was only available at MOS. Thus only, six Playhouse activities were available during the NMAH evaluation.

VISITATION TO EACH EXHIBITION SECTION

Invention at Play included three main sections: Inventor Case Studies (including the Introduction, Borrow from Nature, Many Heads Are Better Than One, Jump the Tracks, Recognize the Unusual, and Keep Making It Better); Playhouse (Play a New Way with the Everyday); and the Play Wall (Shape Your Thinking Through Play) (see Appendix B for the timing and tracking form).[15]

Total Number of Sections Visited

Visitors stopped in a median of two sections while in *Invention at Play* (see Table 17). Nearly three-quarters of visitors stopped at two or more exhibition sections (72 percent; not shown in table).

Table 17
Total Number of Sections Visited in *Invention at Play*
(*n* = 100)

Median	Minimum	Maximum	Mean	±
2.0	1.0	3.0	2.1	0.8

When the number of sections visitors stopped in was compared by site and demographic characteristics, one statistically significant relationship emerged (see Table 18). Visitors with children stopped at more sections than did those without children.

Table 18
Differences in Total Number of Sections Visited by Visiting with Children

Visiting with Children*	Mean Number of Sections Visited	±
Yes	2.2	0.7
No	1.7	0.8

*$F = 8.3099$; $df = 1, 98$; $p = 0.01$

[15]At MOS, there was no Introduction; rather, its components were dispersed throughout the exhibition.

Time Spent in Each Section or Sub-section

In terms of the main sections, visitors spent the most time in the Playhouse (median time of about 6 minutes), followed by the Inventor Case Studies (median time of about 4 minutes) (see Table 19).

For the Inventor Case Studies sub-sections, visitors spent the most time in Keep Making It Better, which included the Windsurfer (median time of about 2 minutes). Visitors spent the least time in the Introduction (median time of 15 seconds).

Table 19
Time Spent in Each Section and Sub-section

Section	Number of Visitors that Stopped	Median Time
Playhouse (Play a New Way with the Everyday)	60	5 min., 53 sec.
Inventor Case Studies	96	3 min., 42 sec.
Keep Making It Better	66	1 min., 54 sec.
Borrow from Nature	59	1 min.
Recognize the Unusual	73	1 min.
Jump the Tracks	23	41 sec.
Many Heads Are Better Than One	40	35 sec.
Introduction*	45	15 sec.
Play Wall (Shape Your Thinking Through Play)	49	1 min., 10 sec.

*Data for the Introduction area only from NMAH (n = 50).

Stops Made in Each Section

As presented in Table 20, nearly all visitors stopped in the Inventor Case Studies (96 percent). More than one-half stopped in the Playhouse and nearly one-half stopped at the Play Wall (60 percent and 49 percent, respectively). Visitors made a median of three stops each in the Inventor Case Studies and the Playhouse. They stopped a median of two times at the Play Wall.

For the Inventor Case Studies sub-sections, the most visitors stopped in Recognize the Unusual, which discussed Kevlar (73 percent). More than one-half stopped in Keep Making It Better and Borrow from Nature (66 percent and 59 percent, respectively). The fewest visitors stopped in Jump the Tracks (23 percent).

Table 20
Stops Made in Each Section
(*n* = 100)

Section	% of Visitors that Stopped	Median Number of Stops
Inventor Case Studies	96.0	3.0
Recognize the Unusual	73.0	2.0
Keep Making It Better	66.0	1.0
Borrow from Nature	59.0	2.0
Introduction*	45.0	1.0
Many Heads Are Better Than One	40.0	2.0
Jump the Tracks	23.0	1.0
Playhouse (Play a New Way with the Everyday)	60.0	3.0
Play Wall (Shape Your Thinking Through Play)	49.0	2.0

*Data for the Introduction area only from NMAH (*n* = 50).

When the percentage of visitors who stopped in each section and sub-section was compared by site and demographic characteristics, one statistically significant relationship emerged (see Table 21). More visitors with children than those without children stopped in the Playhouse.

Table 21
Differences in Visitation of the Playhouse by Visiting with Children

Visitation to Playhouse*	With Children %	Without Children %	Total %
Stopped in Playhouse	70.4	34.5	60.0
Did not stop in Playhouse	29.6	65.5	40.0

*x^2=11.081; df=1; p=0.001

VISITATION OF EACH EXHIBIT TYPE

The exhibition included eight main exhibit types: headers, wall-mounted panels, rail panels, moveable panels, reading boards, activities, cases/props, and videos.

Time Spent at Each Exhibit Type

As presented in Table 22, visitors spent the most time at activities (median time of about 4 minutes). Visitors spent about one minute at videos and cases/props (median times of 50 seconds and 49 seconds, respectively). They spent the least time at rail panels and reading boards (median times of 19 seconds and 12 seconds, respectively).

Table 22
Time Spent at Each Exhibit Type

Exhibit Type	Number of Exhibits Available	Number of Visitors that Stopped	Median Time
Activities	11	86	3 min., 46 sec.
Videos	4	25	50 sec.
Cases/props	16	85	49 sec.
Wall-mounted panels	28	60	40 sec.
Moveable panels	7	47	37 sec.
Headers	7	2	29 sec.
Rail panels	7	45	19 sec.
Reading boards (sets)	4	3	12 sec.

When the time spent at each exhibit type was examined among venues and demographic characteristics, three statistically significant relationships emerged (see Table 23). Visitors without children spent more time than those with children at wall-mounted panels and moveable panels. Males spent more time than females at cases/props.

Table 23
Differences in Time Spent at Each Exhibit Type by Demographic Characteristics

Exhibit Type	Significant Variable	Mean Time	±
Wall-mounted panels	Visiting with child[1]:		
	No	3 min., 3 sec.	5 min., 3 sec.
	Yes	57 sec.	1 min., 4 sec.
Moveable panels	Visiting with child[2]:		
	No	5 min., 42 sec.	10 min., 8 sec.
	Yes	1 min., 17 sec.	2 min., 29 sec.
Cases/props	Gender[3]:		
	Male	2 min., 13 sec.	2 min., 4 sec.
	Female	1 min., 5 sec.	1 min., 2 sec.

[1] $F = 6.612$; $df = 1, 58$; $p = 0.01$ [2] $F = 5.548$; $df = 1, 44$; $p = 0.02$ [3] $F = 5.362$; $df = 1, 81$; $p = 0.02$

Stops at Each Exhibit Type

As shown in Table 24, more than three-quarters of visitors stopped at activities and cases/props (86 percent and 85 percent, respectively). More than one-half stopped at wall-mounted panels (60 percent). The fewest visitors stopped at reading boards and headers (3 percent and 2 percent, respectively).

In terms of the number of stops visitors made at each exhibit type, visitors made the most stops at activities (median of 3 stops), followed by cases/props and wall-mounted panels (each a median of 2 stops). Visitors stopped at moveable panels, rail panels, videos, reading boards, and headers a median of one time.

Table 24
Stops Made at Each Exhibit Type
(*n* = 100)

Exhibit Type	Number of Exhibits Available	% of Visitors that Stopped	Median Number of Stops
Activities	10	86.0	3.0
Cases/props	16	85.0	2.0
Wall-mounted panels	28	60.0	2.0
Moveable panels	7	47.0	1.0
Rail panels	7	45.0	1.0
Videos	4	25.0	1.0
Reading boards (sets)	4	3.0	1.0
Headers	7	2.0	1.0

When the number of stops made at each exhibit type was examined using a multiple regression model to determine which variables—including demographic characteristics, visiting with children, and site—influenced the total number of stops made at each exhibit type, several statistically significant relationships emerged (see Table 25). Visitors at NMAH stopped at more wall-mounted panels, rail panels, activities, and cases/props than did visitors at MOS. Additionally, visitors with children stopped at more interactives than did those visiting without children.

Table 25
Differences in Number of Stops Made at Each Exhibit Type by Demographic Characteristics

Exhibit Type	Significant Variable	Mean Number of Stops	±
Wall-mounted panels	Site[1]:		
	NMAH	4.0	3.5
	MOS	2.0	1.3
Rail panels	Site[2]:		
	NMAH	1.5	0.8
	MOS	1.1	0.2
Activities	Site[3]:		
	NMAH	5.4	4.1
	MOS	2.9	1.8
	Visiting with child[4]:		
	Yes	4.5	3.5
	No	3.4	3.1
Cases/props	Site[5]:		
	NMAH	3.7	2.7
	MOS	2.4	1.4

[1] $F = 7.329$; $df = 1, 57$; $p = 0.01$
[2] $F = 5.985$; $df = 1, 42$; $p = 0.02$
[3] $F = 10.703$; $df = 1, 79$; $p = 0.00$
[4] $F = 10.519$; $df = 2, 78$; $p = 0.00$
[5] $F = 7.660$; $df = 1, 83$; $p = 0.01$

VISITATION OF INDIVIDUAL EXHIBITS

RK&A recorded the time visitors spent at each exhibit in *Invention at Play*. The Science Museum of Minnesota, the design team working with the Lemelson Center on *Invention at Play*, develops exhibitions with the intention of holding visitors for four minutes or longer at one or more exhibits.

As shown in Table 26, one-third of visitors spent four minutes or longer at one or more exhibits (34 percent).

Table 26
Visitors Spending Four Minutes or Longer at an Exhibit
(*n* = 100)

Time Spent	%
Did not spend four minutes or longer at any exhibits	66.0
Spent four minutes or longer at one or more exhibits	34.0

Visitors who spent four minutes or longer at one or more exhibits did so an average of twice at NMAH and once at MOS (see Table 27).

Table 27
Total Number of Exhibits at which Visitors Spent Four Minutes or Longer by Venue
(NMAH *n* = 20, MOS *n* = 14; Total *n* = 34)

Venue*	Mean Number of Exhibits at which Visitors Spent Four Minutes or Longer	±
NMAH	2.1	1.3
MOS	1.1	0.4
Total	1.7	1.1

*$F = 7.204$; $df = 1, 33$; $p = 0.01$

Time Spent at Each Exhibit

As shown in Table 28, visitors spent the most time at the Windsurfer (median time of 2 minutes, 25 seconds). Visitors also spent considerable time at the Magnetic Racetrack (median time of 2 minutes, 9 seconds).

Table 28
Exhibits at which Visitors Spent Longer than 30 Seconds

Exhibit Name	Number of Visitors that Stopped	Median Time (Seconds)
Windsurfer activity*	53	145.00
Magnetic Racetrack activity	30	129.0
Curlybots activity**	19	92.0
Tesselation Puzzle activity	26	91.5
Darby video	6	91.5
Rocky Blocks activity	34	87.0
MIT video	13	70.0
Whirligig activity	37	61.0
Fry, Spencer, Sherman, and Greatbatch flipbook	13	61.0
Nature's Lessons rail panel	2	53.5
Phonoautograph activity	45	53.0
McLurkin video	6	49.5
What Was/Is Your Favorite Toy? panel	8	46.0
Edison, Hirschberg, and Torvalds flipbook	7	43.0
Magnetic Name activity	12	40.0
Musical Digits activity	18	32.0
Vest-comparisons case	30	32.0
Nature Mural doors	25	31.0

*The Windsurfer was broken during 9 of the observations (n = 91)
**Curlybots was only available at MOS (n = 50)

There were 33 exhibits at which visitors spent a median time of between 30 and 15 seconds (see Table 29).

Table 29
Exhibits at which Visitors Spent Between 30 and 15 Seconds

Exhibit Name	Number of Visitors that Stopped	Median Time (Seconds)
Bell Telephone Inventor panel	11	30.0
Darby As A Young Man rail panel	3	30.0
Ropes prop	40	27.5
Telephone Prototypes case	15	27.0
Many Heads Are Better Than One header	1	26.0
Experiments with Flight rail panel	4	25.5
IDEO Products case	24	25.5
Under the Sea activity	16	25.0
McLurkin Robotic Ants Inventor panel	8	23.5
Edison Teamwork photograph panel	3	22.0
Kwolek Kevlar Inventor panel	21	22.0
Large Bell photograph panel	6	21.0
McLukin's Big Plans panel	7	21.0
Play a New Way With the Everyday header	1	20.0
Play—Past, Present, and Future panel	1	20.0
Kwolek As A Child flipbook	14	20.0
Observe panel	9	19.0
Invention at Play videos	7	19.0
IDEO As Children rail panel	5	18.0
Magnetic Faces activity	11	18.0
Hoberman, Fabel, Morse, and Head flipbook	13	18.0
Past Toy cases and props	26	18.0
Visualize panel	12	17.5
Understand panel	10	17.0
Dragon Soapbox photograph panel	2	17.0
Toy Drawers	6	16.5
IDEO Innovative Product Design Team panel	11	16.0
Jump the Tracks case	7	16.0
Kevlar props	36	16.0
Implement panel with stroller prop	12	15.5
Bell As a Young Man panel	11	15.0
Kwolek's Curious Solution panel	5	15.0

As shown in Table 30, the three exhibits at which visitors spent the least time were panels: Darby Sailboard Inventor panel, Kwolek introduction panel, and Strollers Protect and Comfort rail panel (median times of 6 seconds, 5 seconds, and 3 seconds, respectively).

Table 30
Exhibits at which Visitors Spent Less than 15 Seconds*

Exhibit Name	Number of Visitors that Stopped	Median Time (Seconds)
Ganson sculpture case	25	14.0
The First Sailboard rail panel	20	14.0
McLurkin As a Child flipbook	6	13.5
Motorcycle prop	12	13.5
Stroller Designs rail panel	5	13.0
Stroller Prototype case	9	13.0
Thinking Outside the Box panel	3	13.0
Daggerboard rail case	5	13.0
Is This Really like Windsurfing? rail panel	19	13.0
MIT Non-interactive Toys cases	11	12.0
Keep Making It Better reading boards	3	12.0
Darby's Lifelong Passion panel	6	11.5
Ear Diagram panel	3	11.0
Evaluate and Refine panel	9	11.0
International Space Station panel	1	11.0
McLurkin introduction panel	27	10.0
Bell's Inspired Nature panel	7	9.0
Past Toy spinning panels	7	9.0
Title panel	3	8.0
Darby introduction panel	1	7.0
Darby's Sailboard	5	7.0
Darby Sailboard Inventor panel	3	6.0
Kwolek introduction panel	4	5.5
Strollers Protect and Comfort rail panel	1	3.0

*No visitors spent time at the Borrow from Nature header, Jump the Tracks header, Shape Your Thinking Through Play header, Recognize the Unusual header, Keep Making It Better header, Borrow from Nature reading boards, Playhouse reading boards, Find Opportunities in Obstacles reading boards, or Apache Helicopter panel.

Stops Made at Each Exhibit

Visitors could stop at 83 exhibits.[16] As presented in Table 31, the most visitors stopped at the Windsurfer, Phonoautograph, and Ropes (53 percent, 45 percent, and 40 percent, respectively).

Table 31
Exhibits at which More than 20 Percent of Visitors Stopped
(*n* = 100)

Exhibit Name	% Stopped
Windsurfer activity*	53.0
Phonoautograph activity	45.0
Ropes prop	40.0
Curlybots activity**	38.0
Whirligig activity	37.0
Kevlar props	36.0
Rocky Blocks activity	34.0
Magnetic Racetrack activity	30.0
Vest-comparisons case	30.0
McLurkin introduction panel	27.0
Tesselation Puzzle activity	26.0
Past Toy cases and props	26.0
Ganson sculpture case	25.0
Nature Mural doors	25.0
IDEO Products case	24.0
Kwolek Kevlar Inventor panel	21.0

*The Windsurfer was broken during nine of the observations (*n* = 91)
**Curlybots was only available at the MOS venue (*n* = 50)

As shown in Table 32 (on the next page) there were 41 exhibits at which 20 to 10 percent of visitors stopped.

[16]For this evaluation, a "stop" was defined as a visitor standing for three seconds or longer in front of a given exhibit. The area header panels were eligible for either a "stop" or "notice/study." If visitors spent more than three seconds at an area header panels, this was considered a "stop" rather than a "study/notice."

Table 32
Exhibits at which 20 to 10 Percent of Visitors Stopped
(*n* = 100)

Exhibit Name	% Stopped
The First Sailboard rail panel	20.0
Is This Really like Windsurfing? rail panel	19.0
Musical Digits activity	18.0
Under the Sea activity	16.0
Telephone Prototypes case	15.0
Kwolek As A Child flipbook	14.0
Hoberman, Fabel, Morse, and Head flipbook	13.0
MIT video	13.0
Fry, Spencer, Sherman, and Greatbatch flipbook	13.0
Visualize panel	12.0
Implement panel with stroller prop	12.0
Magnetic Name activity	12.0
Motorcycle prop	12.0
Bell Telephone Inventor panel	11.0
Bell As a Young Man panel	11.0
IDEO Innovative Product Design Team panel	11.0
Magnetic Faces activity	11.0
MIT Non-interactive Toys cases	11.0
Understand panel	10.0
Observe panel	9.0
Stroller Prototype case	9.0
Evaluate and Refine panel	9.0
McLurkin Robotic Ants Inventor panel	8.0
What Was/Is Your Favorite Toy? panel	8.0
Bell's Inspired Nature panel	7.0
Edison, Hirschberg, and Torvalds flipbook	7.0
Jump the Tracks case	7.0
McLukin's Big Plans panel	7.0
Past Toy spinning panels	7.0
Invention at Play videos	7.0
Large Bell photograph panel	6.0
McLurkin video	6.0
McLurkin As a Child flipbook	6.0
Toy Drawers	6.0
Darby video	6.0
Darby's Lifelong Passion panel	6.0
IDEO As Children rail panel	5.0
Stroller Designs rail panel	5.0
Kwolek's Curious Solution panel	5.0
Daggerboard rail case	5.0
Darby's Sailboard	5.0

As presented in Table 33, the fewest visitors stopped at the Darby introduction panel, Strollers Protect and Comfort rail panel, Play—Past, Present, and Future panel, International Space Station panel, Many Heads Are Better Than One header, and Play a New Way With the Everyday header (each 1 percent). No visitors stopped at five headers, three reading board areas, and one panel.

Table 33
Exhibits at which Less than 5 Percent of Visitors Stopped
(*n* = 100)

Exhibit Name	% Stopped
Kwolek introduction panel	4.0
Experiments with Flight rail panel	4.0
Title panel	3.0
Ear Diagram panel	3.0
Edison Teamwork photograph panel	3.0
Thinking Outside the Box panel	3.0
Darby Sailboard Inventor panel	3.0
Darby As A Young Man rail panel	3.0
Keep Making It Better reading boards	3.0
Dragon Soapbox photograph panel	2.0
Nature's Lessons rail panel	2.0
Darby introduction panel	1.0
Play—Past, Present, and Future panel	1.0
International Space Station panel	1.0
Strollers Protect and Comfort rail panel	1.0
Many Heads Are Better Than One header	1.0
Play a New Way With the Everyday header	1.0
Apache Helicopter panel	0.0
Borrow from Nature header	0.0
Jump the Tracks header	0.0
Shape Your Thinking Through Play header	0.0
Recognize the Unusual header	0.0
Keep Making It Better header	0.0
Borrow from Nature reading boards	0.0
Playhouse reading boards	0.0
Find Opportunities in Obstacles reading boards	0.0

II. PRINCIPAL FINDINGS: STATIONED OBSERVATIONS

The Playhouse activities were designed for multigenerational appeal and were intended to promote creative play behaviors associated with the inventors' stories (see Appendix A for the *Invention at Play* goals). To provide a detailed account of how visitors used the Playhouse activities, RK&A observed visitors at three of the most frequently used activities: Magnetic Racetrack, Rocky Blocks, and Whirligigs.

The evaluator stationed herself at one activity and observed visitors as they used the activity. She noted visitors' ages, genders, and familial relationships (if she was able to determine them) and wrote a detailed description of their actions and conversations.

RK&A observed visitors at each activity for 10 hours (5 hours at NMAH and 5 hours at MOS). A total of 428 visitors were observed.

MAGNETIC RACETRACK

While children were the primary users of the Magnetic Racetrack, a few parents and other adults used the activity, too. Visitors tended to modify existing mazes, trying multiple combinations and arrangements of utensils. Some carefully selected utensils for their physical properties; others had serendipitous discoveries. A few children played with the balls or engaged in pretend play with the utensils rather than build a maze.

Mazes generally were individual creations. However, some parents provided logistical, emotional, and cognitive support to their children during the activity.

Demographics

RK&A observed 98 visitors at the Magnetic Racetrack. Fifty-two percent were male and 48 percent were female. About three-quarters of visitors observed were children (under 16 years of age) and one-quarter were adults (73 percent and 27 percent, respectively).

Many of the children ranged between 9 and 11 years of age (36 percent), followed closely by 6 to 8 year olds (29 percent). Nearly all adults were between 25 and 44 years of age (81 percent). For a complete breakdown of ages for visitors at the Magnetic Racetrack, see Appendix G, Table 45.

How Visitors Used the Activity

Children were drawn to the Magnetic Racetrack, often separating from their parents who stayed at other exhibits. Most parents who accompanied their children to the Magnetic Racetrack stood off to the side, watching their children use the activity or talking with other parents. However, a few parents and other adults used the activity.

All adults and children 9 years of age or older immediately understood how to use the Magnetic Racetrack either by reading the instructional title or watching others use it. Some children 8 years of age or younger asked the adult accompanying them or facilitators, "What do I do here?" After the activity was explained, several children needed to be shown how to begin making a maze. Other young children played with the ping-pong balls without making a maze (e.g., watched the balls go through the preset maze behind the Plexiglas at the bottom of the track) or engaged in imaginary play with the utensils (e.g., played house, pretended to cook). One child listened to the audio before using the activity.

Most visitors rearranged mazes left by other visitors; others cleared off the track and started from scratch. As they created mazes, many tried multiple variations, adding or subtracting utensils, experimenting with new combinations of utensils, tinkering with the placement of utensils, etc. About one-half of these visitors selected and placed utensils in a very deliberate manner, thinking about the utensils' physical characteristics, testing the utensils' magnetic properties before placing them into their maze, and sometimes hypothesizing aloud the desired effect of their choice. For example, two girls talked about stacking spatulas on top of each other to create a taller wall to better contain the ball as it moved through the maze. The other one-half of visitors placed utensils randomly, making serendipitous discoveries. For example, two boys placed a funnel in their maze and when they tested it, the ball rolled into the funnel, tipped it over, and then continued on its way. The boys expressed surprise at the result and worked to repeat it in other iterations of their maze.

Most visitors tried multiple combinations until they made a maze that guided the ball into the hole. Even after creating a successful maze, some visitors continued to make different mazes to achieve success in different ways. A few children were pulled away from the Magnetic Racetrack by parents before they were able to get the ball in the hole. A few others made one maze, tried it, and when the ball did not make it into the hole, left without making further alterations.

Some visitors did not create a maze, but rather treated the Magnetic Racetrack as a sport. Several took turns repeatedly dropping balls into existing, proven mazes, celebrating their success. Others tried running the balls through the maze in different ways to attain success—that is, they changed how they threw the ball rather than altering the maze. A few played hockey with the balls and utensils or other games not intended by designers and were redirected by facilitators.

Occasionally, the balls would get stuck in the preset mazes behind Plexiglas on either end of the track. A few children and parents would free the balls by using utensils to push them through the maze or by banging on the Plexiglas.

Group Dynamics

Most often one child exercised control over each ramp, either creating and testing a maze by him/herself or directing others to do so. As such, the maze was usually the creation of one individual rather than a collaborative effort. Ownership of the maze was often determined by possession of the ping-pong balls, causing some visitors' attention to turn away from making a

maze to jockeying for the balls. Parents often resolved the issue by making children share the balls, suggesting they use the second track, and managing turn-taking at each track. Additional disputes occasionally broke out between children when one moved utensils in the maze or attempted to run a ball through the maze when another was working on it. This happened both between visitors who did not know each other and among siblings.

In contrast, several groups of visitors—two children or an adult and child pair—created mazes together. They talked about what kind of maze to make, how to go about creating the maze, and tried different iterations. Group work happened most often when few visitors were in the exhibition.

As findings above suggest, many of the parents' interactions with their children at the Magnetic Racetrack were behavior management. That was not surprising, considering the high visitation to the exhibit, strong sense of ownership users developed over their mazes, and considerable time some visitors spent creating mazes.

Some parents coached or praised their children as they used the activity. Responses ranged from simple "good job" comments, to critiques about what would and would not work, to goal-oriented suggestions. For example, one parent recommended that his child try a longer utensil in his maze, while another directed her child to think about where the ball jumped the maze and what might prevent that from happening.

ROCKY BLOCKS

Rocky Blocks appealed to children and adults. Most visitors engaged in experimental play as they tested the wobbliness of the tabletop, attempted to balance the table using different combinations of blocks, and stacked different shapes of blocks to find the sturdiest formation. When their structures fell, visitors tended to try again with a different strategy. A few children played in an exploratory manner, watching blocks tip off the tabletop or building with blocks on the floor.

Groups of visitors—usually multigenerational—created structures together. Adults from within families and strangers coached and encouraged children.

Demographics

RK&A observed 171 visitors at Rocky Blocks. One-half were male and one-half were female (50 percent and 50 percent, respectively). More than one-half of visitors observed were children (under 16 years of age) and less than one-half were adults (60 percent and 40 percent, respectively).

One-third of the children ranged between 6 and 8 years of age (34 percent). Nearly another one-third were under 6 years of age (30 percent). More than one-half of adults were between 25 and 44 years of age (59 percent). For a complete breakdown of ages for visitors at Rocky Blocks, see Appendix G, Table 46.

How Visitors Used the Activity

Both adults and children were attracted to Rocky Blocks—some by the noise of falling blocks, others by the unexpected wobbly tabletop, and others by the impressive structures some visitors made. Children, parents, and other adults all sat around the tabletop using the activity.

Parents were frequently overheard reading the instructional title to their children; some other adults and children were observed reading it. Some adults and children played with the wobbly top and figured out how to use Rocky Blocks, while others learned how to use it by watching. Facilitators helped a few children use the activity. A few other children younger than 6 years of age played with the blocks on the floor, ignoring the wobbly tabletop. Two children listened to the audio before using the activity.

Adults and children often practiced with the wobbly tabletop before beginning to build a structure. For example, some would place blocks all over the tabletop, tinkering with balancing it. Others stacked different kinds of blocks, trying to ascertain which made the sturdiest structures. A few also examined the underside of the tabletop to figure out how it worked. After such experimental play, visitors would tip the tabletop to clear the surface and begin building. Most added blocks slowly and deliberately, careful to use a light touch so as to not disturb their structure. In fact, several adults and children were overhead saying, “Let’s make a plan,” and then discussed how to go about building a tower. In addition, most took turns adding blocks, often in a symmetrical pattern, shifting the weight to balance the tabletop. Some children placed

blocks haphazardly, without coordinating with other visitors or thinking about how their actions would affect the structure being built. For example, one child placed a rectangular block on the tabletop adjacent to the structure that he and others had been building.

All adults and many children made one large tower in the center of the tabletop. Several children made multiple towers, while a few made horizontal structures that covered most of the tabletop surface. When their structures fell, most visitors tried again, often articulating why the other one fell and trying to correct for that. Some did not try again, leaving the exhibit when their tower fell.

A few children did not make a tower, but rather placed blocks on the tabletop and wobbled it until the blocks fell off, making a game of it. A few children under 6 years of age purposely tipped the tabletop while others were building and were chided by their parents, but visitors building the structure were good-natured about it.

Group Dynamics

Most often, adults and children created structures together. Usually, one or two visitors would begin making a structure and then others would ask or be invited to join. Often the adults and children were from multiple family groups or unrelated. For example, it was common to see two family groups comprised of adults and children work on a structure together. A few groups comprised entirely of children or of adults were also observed making structures. There were only four instances when a lone child or adult created his own tower.

Visitors took turns in an orderly fashion, adding blocks and sometimes discussing where to place them. Many parents coached or praised their own child; however, some also encouraged unrelated children. Often, other visitors would be drawn to Rocky Blocks when the tower became tall and would also offer their advice. In a few groups with adults and teens, a friendly competition developed and participants teased each other about being the one to cause the tower to fall.

WHIRLIGIGS

Adults and children used Whirligigs in different ways. Adults and some children tried to make spinning constructions, usually modifying existing ones and experimenting with different parts, and met with varying degrees of success. Other children played with whirligig parts and fans, engaged in pretend play, or used parts to create novel constructions.

Whirligigs tended to be individual creations. Parents mediated ownership disputes and also provided encouragement and constructive suggestions. A few families created whirligigs together.

Demographics

RK&A observed 159 visitors at Whirligigs. Fifty-three percent were male and 47 percent were female. Nearly two-thirds of visitors observed were children (under 16 years of age) and one-third were adults (62 percent and 38 percent, respectively).

Almost one-third of the children ranged between 6 and 8 years of age (30 percent). About one-quarter were 9 to 11 year-olds and another one-quarter were 12 to 15 year-olds (27 percent and 23 percent, respectively). Nearly all adults were between 25 and 44 years of age (81 percent). For a complete breakdown of ages of visitors at Whirligigs, see Appendix G, Table 47.

How Visitors Used the Activity

Both adults and children were attracted to Whirligigs. All adults and some children stationed themselves in front of an existing construction, staking a claim for space and parts to create their whirligig. Some other children played with the fans and whirligig parts without trying to build anything.

Some adults and children intuitively started to build when they sat down at the exhibit. Some children younger than 6 years of age did not seem to understand how to use Whirligigs and were content to play with existing constructions (such as blowing on pinwheels to make them spin or turning them with their fingers) or engage in imaginary play (such as pretending they were airplanes). A few parents were overheard reading the instructional titles to their children. One child listened to the audio before beginning.

Most adults and children modified whirligigs other visitors had made. They added or removed parts, never removing the stem from the posthole. In fact, when whirligigs fell apart as visitors modified them, a few adults and children acted concerned, as if they did not realize all of the parts were intended to come apart and that the stems were made to be removed from their holders.

Some other adults and children created their own constructions. They pieced parts together, then placed their construction in a posthole and modified it, trying to get it to spin. They added different elements, experimenting with different types of spinning devices to see what would

happen. Some deliberately tried to make constructions that spun horizontally with vanes. Others haphazardly added and subtracted elements trying to get any part of it to spin.

Overall, about one-quarter of visitors—an even mix of adults and children—who attempted to make spinning constructions accomplished their goal. The rest had varying degrees of success. Some had constructions that spun but the spinning elements had come from a previous visitor's or facilitator's construction. Others made a construction that spun but not in the way they had planned (e.g., one child placed four pinwheels on her construction, but only one spun). A few adults expressed embarrassment and a few children expressed frustration that their constructions did not spin.

In contrast, several children used the stems and connectors like Tinker Toys, creating elaborate constructions that did not have any whirligig parts on them and did not spin. For example, one child made a car that rolled using stem connectors as wheels.

Those adults and children who did not build or modify any constructions often held Whirligig parts in front of the fans to see how they would respond. Some also moved the fans to see how the existing structures would behave. A few children had fun speaking into the fans and listening to their altered voices. A few children also were seen misusing Whirligig parts. For example, a few girls hit each other with vanes, and two toddlers put windsocks in their mouths.

Group Dynamics

Most adults and children used the Whirligigs alone—even members of family groups. In fact, visitors tended to ignore others at the exhibit, instead making their own constructions or playing with whirligig parts on their own. Visitors often expressed ownership about a particular construction, part, or even posthole. A few children left the activity because others were not sharing the whirligig parts or there was no space to put their construction. A few others became upset when other visitors dismantled their creations, and some parents had to mediate disputes. Parents also offered encouragement or a few suggestions. For example, one parent told her child to point her whirligig toward the fans. Another informed his child that the connector he was using would not spin and recommended he use a different one.

A few parents and children worked on constructions together. They shared ideas about what parts to add and discussed how the construction might spin. In such groups, both parents and children actively added and removed parts from the construction. Parents often led the construction process but children tried ideas they generated, too.

III. PRINCIPAL FINDINGS: EXIT INTERVIEWS

RK&A evaluators conducted open-ended interviews with visitors immediately after their visit to *Invention at Play* at the National Museum of American History (NMAH) and at the Museum of Science, Boston, (MOS) to gather information about their perceptions, opinions, and understanding of the exhibition. In all, 56 interviews were conducted with 93 visitors—63 adults and 30 children. Of all the visitor groups that were approached and asked to participate in the study, 15 declined to do so, making the refusal rate 21 percent.

Slightly more than one-half of adults were female and slightly less than one-half of adults were male, with a median age of 40 years. About one-half of children were male and one-half were female, with a median age of 10 years. Thirty-seven percent of interviewees were local to either Boston or Washington, D.C. Eight percent had previously visited the exhibition at NMAH, and 18 percent had previously visited the exhibition at MOS.[28]

OVERALL REACTIONS TO *INVENTION AT PLAY*

Interviewees at NMAH and MOS indicated that they enjoyed *Invention at Play*. Most interviewees, especially parents, commented positively about the exhibition's design and its inclusion of hands-on activities. Those few interviewees who offered critical comments said that the exhibition was too complex for young children.

Overall, interviewees said they enjoyed their visit to *Invention at Play* at NMAH and MOS. Most interviewees found the exhibition's design to be interactive, pleasing, and unique, and several enjoyed handling the props in the open display cases (see the first two quotations below). Moreover, all of the adults who visited with children said the lively displays and hands-on activities kept their children engaged (see the third quotation), and many wanted to see more activities added to the exhibition (see the fourth quotation).

> I think [the exhibition] is great. It is not static and it is not passive as most museum exhibitions are. This is really modern. . . . [This exhibition] is three-dimensional. [NMAH; Female, 67]

> I like that some of the stuff—like the sports equipment—is right [in front of you and] is not behind a glass case. . . . I did touch the glasscutters. [MOS; Female, 52]

> I like the way [the exhibition] is very colorful and it entertains [my daughter]. [NMAH; Female, 26]

> [*Invention at Play*] was really a lot of fun. I would like to see it expanded with more hands-on activities. Going to a museum with [my son] is great, but he has to have the opportunity to do something in order to enjoy the day. [NMAH; Female, 33]

[28] For information about exit interviewees, please refer to Appendix H.

Interviewees made a few critical comments about *Invention at Play*'s content. A few interviewees initially questioned whether the exhibition was for adults, later saying they changed their minds (see the first quotation below). A few others said the exhibition's content was too complex for children (see the second quotation).

> I have a feeling that if people do not have children they [would be] reluctant to come in here. . . . They have to be encouraged. [NMAH; Female, 67]

> I do not see that a kid can understand a lot of these things. I think for younger kids, they just do not know why you did this—I think you have to be much older to appreciate invention. If you are older, you understand the need to solve a particular problem, but for kids, they do not care about this problem, they just want to see something interesting. . . . You need to present it differently or maybe have a comparison or some other approach. [NMAH; Male, 35]

EXPERIENCES AT INTERACTIVE EXHIBITS

Evaluators asked interviewees a series of questions about their use of the Windsurfer, Phonoautograph, and Playhouse activities to see how the invention process informed their experiences at each exhibit. Less than one-half of interviewees used the Windsurfer, and slightly more than one-half of interviewees reported using the Phonoautograph. None of the interviewees' responses indicated they reflected on their experience using either activity.

In contrast, when describing how they used the Playhouse activities, most interviewees' responses referenced the invention process—most said they tinkered with the activities, and a few talked about a plan they devised before they began using the activities. Moreover, when asked, interviewees offered a range of ideas about the particular skills and abilities that the Playhouse activities required, and trends emerged when comparing ages of children using the activities. Additionally, trends using the Playhouse activities varied between the two sites, probably because more NMAH interviewees visited with toddlers, whereas more MOS interviewees visited with older children.

Experiences Using the Windsurfer

The evaluators asked interviewees whether they used the Windsurfer. If they did use it, the evaluators asked interviewees what they were thinking about as they used it to determine whether their thoughts touched on the invention process in any way.

Over one-half of the interviewees said they did not use the Windsurfer, but it was broken while several interviews were conducted at NMAH.[29] Most interviewees who did not use the Windsurfer said they were intimidated by the perceived level of athleticism and coordination needed to operate it (see the quotation below). A couple wanted to do the Windsurfer, but they

[29] More interviewees from MOS reported using the Windsurfer; however, it is not possible to compare use between the two sites because the element was broken while several interviewees were visiting NMAH.

did not because the line was too long. Others said the activity was too physically advanced for their young children.

> I did not use [the Windsufer], but I saw people use it. All the people were really struggling with it, and I did not want to try [it] because I knew that I would fall off. [MOS; Male, 10]

Most interviewees who used the Windsurfer described it as challenging, fun, and exciting. Some interviewees said they concentrated on keeping their balance, maneuvering their bodies, and trying not to fall. Several others said they thought about manipulating the windsurfer—such as holding the sail upright or keeping the top of the sail from hitting the side of the Windsurfer frame (see the quotation below). A couple interviewees said they visualized themselves actually windsurfing.

> (What were you thinking about as you were using the windsurfer?) I did not really see it at first, but [a label] said, 'Don't hit the ring.' So then I tried not to hit the ring. [MOS; Male, 7]

Experiences Using the Phonoautograph

Slightly more than one-half of interviewees said they used the Phonoautograph—about the same number from both NMAH and MOS. Evaluators asked interviewees to discuss their thoughts while using the activity, and most said they enjoyed watching how the visual output of the mechanism changed as they altered their voices (see the first quotation below). Several interviewees had superficial experiences with the activity, often only describing it as "cool" (see the second quotation). A couple of others enjoyed entertaining their children with the Phonoautograph. One interviewee said he thought about creating a method of recording the visual output (see the third quotation).

> I liked [using the Phonoautograph]. I saw different waves it made based on how deep or how high your voice was. *We were trying to figure out how we could make the waves more dramatic . . . with the different voices we had. [MOS; Male, 36, and Female, 37]

> (What were you both thinking of as you were using the Phonoautograph?) [I was thinking it was] pretty cool. *I do not know. . . . Trying not to pop my eardrums. [MOS; Male, 7, and Female, 49]

> I was thinking about how it would be neat to capture [the visual output] in other forms. . . . As you go, you [would be able to] draw your own picture of your own voice. . . . [and] explain yourself using different formats. [NMAH; Male, 36]

Experiences Using the Playhouse Activities

RK&A asked interviewees a series of questions to determine their use of the Playhouse activities and what they were thinking about as they used them. Additionally, evaluators questioned interviewees about what skills or abilities they used.

How Visitors Used the Playhouse Activities

In contrast to how interviewees described using the Windsurfer and Phonoautograph, interviewees gave more detailed responses about their thoughts while using the Playhouse activities. For example, most interviewees described tinkering with the components of the activity to achieve the desired goal—such as changing constructions at the Whirligig, piece by piece (see the first quotation below), or testing different kitchen utensils at the Magnetic Racetrack to get the ball from the top to the bottom of the ramp (see the second quotation). Some interviewees reported that they only thought about how much fun they were having while doing the activities; one child stated, "I do not know what I was doing. I was just having fun." Finally, a few interviewees discussed how they formulated a plan to achieve an activity's goal *before* they began using it—such as laying out the utensils at Magnetic Names to predetermine a course of action (see the third quotation) or deciding to position blocks around the perimeter of the Rocky Blocks table to stabilize it (see the fourth quotation).

> I started with putting one wheel thing, [then another] wheel thing, and [another] wheel thing. [I kept] adding on to see how much weight [the Whirligig] could hold and so all of them would stay up correctly. [MOS; Female, 11]

> The maze thing [Magnetic Racetrack]—I would build a little and test it, then go further and fix what did not work, or if it did work, I would just keep going. [MOS; Female, 13]

> First I put all of the implements out [at the Magnetic Name activity] and decided which ones I would use for each letter, because I was trying to make my name. After that I just started to use my imagination and put it together in a way that it would [make it] look like [my name]. [NMAH; Male, 10]

> I sort of had a plan when I was trying to build a tower [at Rocky Blocks]. . . . I had to plan how the foundation would be so that it would not tip over. [NMAH; Female, 40]

Skills and Abilities Used in Playhouse Activities

When asked about the skills they used in the Playhouse activities, interviewees offered a range of ideas, however, those who participated in the activities were much more articulate in their responses. Additionally, adult interviewees' responses tended to reflect the age of the children with whom they were visiting the exhibition. For example, adult interviewees visiting with toddlers emphasized their children's use of motor skills such as dropping balls down the Magnetic Racetrack tracks (see the first quotation below), visual abilities like watching the Whirligig fans (see the second quotation), and mimicking patterns with the Curlybots.

> [The Magnetic Racetrack], he just put the ball in the hole and watched it roll down [the ramp]. He did not try to build the path. [NMAH; Male, 33, with Male, 3]
>
> I think [the skills she used were] mainly visual—you know, looking to see which [Whirligig] might produce the most motion. [MOS; Male, 31, with Female, 2]

In contrast, adult interviewees visiting with early school-age and older children talked about their children using more advanced skills, such as experimenting, imagination, creativity, reasoning, problem solving, understanding weights and balances, and teamwork (see the first quotation below). Moreover, children, ages 11 and older said the activities required "thinking" and math skills (see the second quotation), hand-eye coordination, and imagination (see the third quotation).

> By the end, [my son] was working collaboratively with four other kids, which was very nice. They were total strangers. That is how it happens in the lab sometimes when you are working on one thing and your colleagues get together and you start working on something together. . . . He would try something, and then another kid would try something. When it did not work, they would try a different way. [NMAH; Female, 43, with Male, 7]
>
> I used math . . . subconsciously. I used different angles on the [Magnetic Racetrack] so that I could get [the ball] into the hole without having it fall down. I made the lines [with the utensils] at different angles. [MOS; Male, 14]
>
> The [Tessellation activity] with the mirrors, the patterns are not [obvious]. You use some of your imagination to think of the pattern. [MOS; Male, 13]

More interviewees at NMAH visited the exhibition with younger children, whereas more interviewees at MOS visited with older children. It follows, then, that more NMAH interviewees discussed their children using motor skills and visual abilities, whereas more interviewees at MOS said they or their children used more advanced skills, such as creativity, experimenting, and thinking skills.

EXPERIENCES AT INVENTORS' STORIES

Most of the interviewees reported reading one or more of the inventors' stories, and many said the stories helped them come to a new understanding about inventors. Many interviewees reported that they enjoyed learning about inventors' characteristics and personal histories, and also said the stories gave them insight into the invention process. A few others said the stories gave them a greater appreciation for the inventions.

The evaluators asked interviewees whether they read any of the inventors' stories scattered throughout the exhibition, and, if so, what they found most interesting about them.

Most interviewees said they read one or more of inventor's stories in the exhibition, most often citing Stephanie Kwolek, followed by Alexander Graham Bell and Newman Darby. Interviewees also mentioned Marjorie Stewart Joyner, the IDEO team, James McLurkin, Art Fry, Patsy Sherman, John Fabel, Chuck Hoberman, Ann Moore, and Lydia O'Leary. Several interviewees said they did not read any of the inventors' stories in the exhibition—often saying they did not have time or that visiting with children made it difficult for them to read in the exhibition.

Of those who read, many interviewees said the stories enhanced their understanding of inventors as people, and several added that they found them inspirational. While some said the stories portrayed the inventors as having unique qualities—such as an innate motivation to invent (see the first quotation below)—others said the stories showed that they are really everyday people (see the second quotation). A few interviewees said they were impressed by the inventors' diversity—including their ages, genders, races, and fields of study. A few others said they were amazed that the inventors began inventing as children (see the third quotation).

> [The inventors] did not feel limitations, [and] they did not feel parameters. They did not feel constrained by what had been developed before [or] think [what] has already been done is the best that can be done—that's the inventor's mind. [NMAH; Female, 67]

> Marjorie Joyner, the African-American lady who developed hair curlers—I have heard the stories about that era for the African Americans, but I never heard of this lady before. She sounded like a very average person who did something very extraordinary, as are a lot of these folks here [in the exhibition]. . . . I think that is really exciting, it gives a regular focus to some extraordinary things. I like that. [NMAH; Male, 36]

> Stephanie Kwolek and the other [inventors] seemed to be extremely interested in inventing even from childhood very early on—they did not come upon these things late in life. They always had a love for it. [NMAH; Male, 17]

Many interviewees also said the inventors' stories enhanced their understanding of the invention process. Some said they learned the importance of perseverance and continually working to make things better (see the first quotation below). Others were impressed with the inventors' sweeping perspective that allows them to draw upon different sources for inspiration—such as nature and a bridge (see the second and third quotations)—and see opportunity in mistakes, as in the case of Stephanie Kwolek. A few interviewees said the stories discussed how the inventors' process mirrors that of play (see the fourth quotation).

> I thought it was interesting that the characteristic of an inventor is that they try and then they fail at first, but they keep trying again. . . . It is amazing how [an invention] starts from a simple idea until [the inventors] have perfected it. It can take a long time, but they are very interested and they persevere. They accomplish what they set out to do. [NMAH; Female, 37]

> The thing that struck me the most is the one [inventor who] borrowed from nature. I really love nature, so to me it is just amazing what they came up with [by] just watching animals and . . . observing . . . nature. [NMAH; Female, 50]

> [I enjoyed learning about] the simple [solution] with the backpack. . . . He saw the bridge . . . and put the same thing on the backpack. That was brilliant. [NMAH; Female, 33]

> A lot of the stories that I saw talked about the relationship between inventing something new and play. . . . work and play—[the inventors] were doing that—they were playing and discovering new things. [MOS; Male, 46]

Finally, a few interviewees said the inventors' stories gave them a greater appreciation of the inventors' inventions. For example, one interviewee discussed how learning about Kwolek helped her understand the significance of Kevlar (see the quotation below).

> (What struck you about the inventors' stories?) How [Kwolek] changed the bulletproof vest from . . . how it was. It [used to] weigh a lot and now it does not. That is pretty cool. [NMAH; Female, 24]

There were no differences in responses between NMAH and MOS interviewees regarding whether they read the inventors' stories and what they found interesting about them.

MAIN IDEA OF *INVENTION AT PLAY*

When asked, many interviewees said *Invention at Play* was about the invention process or something related to it, and some others said the exhibition was strictly about inventions. By comparison, some interviewees—most of those who did not use the Playhouse activities—did not give invention-related responses.

Over one-half of the interviewees said that the exhibition was about the invention process or something related to it. Many of these said *Invention at Play* encouraged visitors to invent (see the first quotation below), and a few added that the exhibition showed how inventors use play in their creative process (see the second quotation). Many others discussed some aspect of the invention process, though they did not specifically talk about invention. For example, several said the exhibition encouraged visitors to think creatively (see the third quotation).

> I think [the exhibition] is inspirational—that regular people can invent things. That is how I felt [when I read] about the lady [who invented] Kevlar [Stephanie Kwolek]. [NMAH; Female, 42]

> It seems that the basic thrust is trying to show people that . . . you have to play with these things until something presents itself. . . . It seems like very few really innovative inventions came from a person directed at solving a specific problem. Usually, they fiddle around with something until they find something interesting and then find an application for it. [MOS; Female, 52]

> [The exhibition shows] that there are many ways of thinking. [Instead of using] a preconceived notion of thinking and doing things in a certain way, you can do it many other ways. It gives you an idea that there are many other ways to do it. [NMAH; Female, 50]

About one-quarter of interviewees said the exhibition primarily showed visitors information about various inventions or their impact on society, though they did not directly discuss the invention process (see the quotation below).

> I think [the exhibition] is trying to show there are things we take for granted every day. There is really some cleverness in [the inventions, and] people put some thought into what you see in the inventions. [The exhibition] gives you much more substance [about] some of the things we take for granted. [NMAH; Male, 67]

In contrast, one-quarter of interviewees—mostly those who did not use any activities—did not give invention-related responses. For example, several said the exhibition was about science or history (see the first quotation below). A few other interviewees said the exhibition's main purpose was to provide visitors a hands-on learning experience or a place for families to learn together (see the second quotation).

> [The exhibition] is trying to get kids involved in science [by] letting them know that it is fun. It is not all [about] some boring book somewhere. There are really fun, hands-on things that you can do. [It is] trying to give them opportunities to learn more complex principles with hands-on materials. [NMAH; Female, 33]

> I think [the exhibition] is just trying to show kids how different things work that maybe they haven't even seen or thought about before. Maybe they have been curious about [a certain thing] and now they get more hands-on with it and learn different things that way. [NMAH; Male, 38]

There were no notable differences in responses about the exhibition's main idea from NMAH and MOS interviewees.

RELATIONSHIP AMONG INVENTION PROCESS, INTERACTIVE ACTIVITIES, AND INVENTORS' STORIES

When probed, nearly all interviewees said the Playhouse activities gave visitors an opportunity to invent or engage in inventive thinking; however several interviewees spoke more generally, saying the activities offered educational, hands-on experiences.

When asked, one-half of interviewees said the Playhouse activities and the inventors' stories encouraged visitors to imitate the inventors. In contrast, about one-half of interviewees, mostly children, said they did not see a connection between the Playhouse activities and the inventors' stories.

Purpose of Playhouse Activities

When asked why an exhibition about invention would have activities like those in the Playhouse, the majority of interviewees said the activities gave visitors the opportunity to invent (see the first quotation below). A couple added that the activities encouraged them to look at everyday objects in new ways; as one child said, "You see how you can use things you normally use, and use them for different things." Many of these interviewees also said the activities allowed visitors to experience an element of the invention process, such as formulating new ideas (see the second quotation) or learning through exploration and tinkering (see the third quotation).

> For all ages, it gives them the opportunity to invent themselves. . . . You do have some traditional exhibits, and then you have hands-on [activities] that they can actually be inventing themselves. [NMAH; Female, 50]

> [The Playhouse activities] lets the child explore and play and come up with new ideas. [They] let them learn at their own speed and come up with new ideas—to create on their own. [MOS; Female, 48]

> [The Playhouse activities] show immediate cause and effect. You try out one thing, it does something new. [You] try another [thing], and it does something different. [MOS; Male, 31]

In contrast, several interviewees discussed the general educational value of hands-on activities in an exhibition (see the quotation below). Additionally, a few said the activities allowed visitors to test scientific principles, and a few others—mostly children—said they did not know the activities' purpose.

> I think [hands-on activities] make [the exhibition] more fun than just reading about it or looking at it. You can actually touch the material; you see a little more of what happened to the material. You are not just looking at something, but you are actually touching and feeling [it], and it makes it more interesting. [NMAH; Female, 37]

There were no differences in responses from NMAH and MOS interviewees about why the exhibition included hands-on activities.

Relationship between Playhouse Activities and Inventors' Stories

Interviewees were also asked to discuss the relationship between the inventors' stories and the Playhouse activities. One-half of the interviewees said that in doing the activities, participants acted like the inventors. Of these, some said the activities and stories encourage participants to emulate the inventors' playful perspectives (see the first quotation below), and a couple added

that they encouraged visitors to think of how everyday materials could be used to invent something new (see the second quotation). Some interviewees said the activities mimic the inventors' early discoveries (see the third quotation). Finally, a couple of others said the activities inspired children to become like the inventors in the stories (see the fourth quotation). In contrast, about one-half—mostly children—said the stories and the activities were not connected in any way.

> [The inventors] started out trying something and they kept doing it over and over again, and they found something they could do [well]. (And how does that relates to the Playhouse activities?) You have fun and you get into something that may work or may make a difference. [MOS; Female, 44]

> They [the inventors] are everyday people and that they were not intentionally looking to come with something that they applied what knowledge they had within their everyday stuff and just came up with something that seemed to work for them. [MOS; Female, 37]

> The blocks where you are trying to figure out how to build something and not get it to slide off of the wobbly top—when architects and others were trying to figure out how to build the first ten-story building, they probably thought a lot about how deep the foundation had to be. These are basic, but they probably cut at the very core of some of the things the early inventors were thinking about to try to figure out how to get things done. [NMAH; Male, 17]

> I think that the inventors would want to inspire the children . . . and take invention to another level. This is the next generation of inventors and they are playing with things like the other [inventors] did. You hope that they get inspired to do the same thing and make new things that we need now. [MOS; Female, 68]

Interviewees at NMAH and MOS offered similar responses about the relationship between the Playhouse activities and the inventors' stories.

CONNECTING WITH THE INVENTION PROCESS

Many interviewees—most who used the Playhouse activities and/or read the inventors' stories—discussed how play somehow enhances the invention process. Some, mostly from NMAH, said that playing or tinkering with objects helps people learn new applications of the objects, and some others said that inventors have a playful approach to inventing. Several interviewees said that play utilizes creative thinking.

When asked, many interviewees said they felt connected to the invention process in some way. Some—mostly from NMAH—said they must think creatively for their job or at home when problems arise, and some others—mostly from MOS—said they use inventions or know an inventor. A few said they often invent in their leisure time or play creatively with their children, and a couple of interviewees at MOS said they felt connected to the invention process because inventors are everyday people.

Relationship Among Play, Invention, and Creativity

About two-thirds of interviewees said that play directly informs the invention process in one way or another. For example, some interviewees—mostly at NMAH—discussed play as tinkering with objects to learn about them and discover inventive applications for them (see the first quotation below). Some others said that inventors have a playful perspective that influences their approach to inventing (see the second quotation). Several interviewees said that play activates creative thinking, which, in turn, begets inventions (see the third quotation), and a few—mostly at MOS—stipulated that inventing requires people to consciously act on their creative ideas (see the fourth quotation).

> There is a very strong connection, which is what inventing is all about. [You] take parts and play with them, see how they work, and how they work together. Try things and change things, and see what will work and what will not. That is how most of our inventions have come about. [NMAH; Female, 39]

> Most inventors are curious by nature and that can often come out as play. If someone does not have the childlike desire to do things over and over . . . to really accomplish something, you'd have to go time and time again—which is a childlike aspect and probably often comes out of just playful curiosity. [NMAH; Male, 31]

> If you cannot think outside of the box—you are stuck in the rut of what you have always had and you do not want to try to improve something—you are never going to invent. So playing uses that creative part of your mind, which leads to invention. [MOS; Male, 28]

> Everyone, when they play, comes up with great ideas. But most people . . . do not go forward to make that idea come to life and inventors actually do. Anyone can be an inventor, you just have to make the decision to . . . [make] the idea come to life. [NMAH; Male, 37]

In contrast, about one-third of interviewees—mostly children and adults who did not participate in the activities or read the inventors' stories—said that play, invention, and creativity are related, but did not reflect on how play influences the creative process of inventing (see the quotation below).

> [The relationship between play, invention, and creativity] is all looped. Play can be inspired from the creativity or the other way [around]. It can go back and forth with one another and be an inspiration for [invention]. [NMAH; Female, 42]

Personal Connections with Inventors or the Invention Process

RK&A evaluators asked interviewees about how they relate to inventions or the invention process every day. Many interviewees reported using or thinking about the invention process daily. Some interviewees, mostly from NMAH, said they use inventive thinking at work or at home (see the first quotation below). Some interviewees, mostly from MOS, said they felt connected to the invention process because they regularly use inventions or know an inventor (see the second quotation). A few people said they or their children regularly engage in inventive play or thinking (see the third quotation), and a couple of interviewees at MOS said they felt connected to the invention process because everyday people created inventions (see the fourth quotation). In contrast, several interviewees said they were not connected to inventors or the invention process in any way.

> I think every person creates and invents in some way. I create and invent programs. I do not do that with physical things, but I work with knowledge systems. I am an educator so I create curriculum. [MOS; Female, 68]

> Right now, in my life, I am primarily connected to [the invention process] as a consumer. [I use] the end product [that] finally hits the market. [MOS; Female, 42]

> [My sons] are both big fans of Legos. They invent new machines with Legos all the time, every day. I also like to play with them. [MOS; Male, 46]

> We [the inventors and people like myself] are tied together in the sense that [the inventors] are everyday people and then they came upon these inventions. . . . Any of us could invent anything. *[The inventors] just use ordinary things and invent these better things that lots of people use. [MOS; Female, 37, and Female, 11]

IV. PRINCIPAL FINDINGS: TELEPHONE INTERVIEWS

Evaluators conducted open-ended interviews with visitors two months after they visited *Invention at Play* at NMAH and MOS. The interview guide explored several issues: visitors' characteristics; overall experiences visiting the exhibition and using the exhibits; recall of the main idea; perceptions of the connection among play, invention, and creativity; and general impressions of *Invention at Play*.

Of visitors who were approached and asked to participate in the study, 195 refused to do so. This 44 percent refusal rate was relatively high for museum studies, but less than the 52 percent refusal rate for telephone interviews experienced by RK&A during another summative evaluation.[30] In comparison, the refusal rate for non-telephone evaluation studies conducted at NMAH ranged from 22 to 28 percent.[31,32]

In all, 75 visitors were contacted and interviewed. However, seven interviewees who thought they recalled visiting *Invention at Play* discussed other exhibitions, and their interviews were subsequently thrown out. In all, 68 visitors who recalled *Invention at Play* were interviewed—46 visitors to NMAH and 23 visitors to MOS. More than one-half of the interviewees were female (63 percent) and less than one-half were male (37 percent), with a median age of 41 years. Almost three-quarters of interviewees held a college degree or higher (74 percent).

RK&A asked additional questions to place NMAH visitors in context with the general NMAH audience.[33] Nearly one-half of NMAH interviewees (44 percent) for this study were from the D.C. metropolitan area, compared with NMAH's general visiting population, of which 19 percent live in the local area. Sixty-nine percent of NMAH interviewees visited *Invention at Play* with children, compared with 20 percent of the general NMAH audience. About one-half of interviewees had visited NMAH within the past 12 months, and about one-half of the general visiting population has also previously visited the Museum within the past 12 months. [34]

OVERALL PERCEPTIONS OF *INVENTION AT PLAY*

When asked what exhibitions they visited at the host museum, some interviewees—mostly those who visited NMAH—immediately recalled visiting *Invention at Play*, and others remembered visiting after the interviewer recounted the exhibition's highlights. Nearly all

[30] Randi Korn & Associates, Inc. (2000). "Whole Museum Experiences: Findings from Exit Interviews, Surveys, and Post-visit Telephone Interviews." Unpublished manuscript. San Jose, CA: The Tech Museum of Innovation.
[31] Randi Korn & Associates, Inc. (2001). "The National Museum of American History, *Preserving the Star-Spangled Banner: The Flag that Inspired the National Anthem*, Summative Evaluation." Unpublished manuscript. Washington, DC: National Museum of American History.
[32] Randi Korn & Associates, Inc. (2002). "Lemelson Center for the Study of Invention and Innovation, National Museum of American History, Smithsonian Institution, *Invention at Play*, Remedial Evaluation." Unpublished manuscript. Washington, DC: National Museum of American History.
[33] To see additional information about MOS and NMAH interviewees, please refer to Appendix I.
[34] Institutional Studies Office, Smithsonian Institution, "*Visitors to History*, A Report based on the *1994-95 National Museum of American History Visitor Study*." Unpublished manuscript, ISO.

interviewees had positive recollections of the exhibition, and one-third, mostly from NMAH, said that they recommended it to others.

Most visitors to NMAH said that *Invention at Play* was more interactive and appropriate for children than other exhibitions at the Museum, though many MOS visitors said that it was comparable to other exhibitions at MOS.

Some interviewees said the exhibition was intended for adults and children, though others said that it was most appropriate for children.

Recollection of Exhibition and General Opinion

Evaluators asked interviewees from NMAH and MOS which exhibitions they visited at the host museum. Once they recalled visiting *Invention at Play*, interviewees discussed their overall opinions of the exhibition and whether they recommended the exhibition to anyone.

When asked to discuss the exhibitions they remembered visiting, one-half of interviewees—mostly visitors to NMAH—immediately recalled visiting *Invention at Play*, meaning that, without cues from the interviewer, they discussed the exhibition.[35] In contrast, others—mostly visitors to MOS—remembered visiting *Invention at Play* after the interviewer reminded them of the exhibition's details. Overall, most interviewees spoke at length about their experiences visiting *Invention at Play*, though several were unable to recall enough about the exhibition to give meaningful responses.

Almost all interviewees offered positive perceptions of *Invention at Play*, calling it fun, informative, interactive, and a worthwhile museum experience for children. Several added that they revisited the exhibition. Several others expressed regret that the exhibition was not permanent, and a few praised the helpful and friendly staff. However, several interviewees complained about crowding in the exhibition, and a few suggested modifying the text so that children could read without an adult's assistance (see the quotation below). A few others indicated that it did not have enough interactive elements, and a couple of NMAH interviewees complained that many components looked worn or were broken.

> [I would add] some narration or explanation that children could read themselves . . . so they could have some understanding of the purpose independently. [NMAH; Female, 36]

One-third of the interviewees—most from NMAH—said they recommended the exhibition to others (see the first quotation below). Several of those who did not recommend *Invention at Play* said they did not know anyone in the local area (see the second quotation).

> Yes. I have [recommended the exhibition] to several people who were coming that way. I [also] have friends who are schoolteachers and I [said to them], 'Be sure to go by and

[35]Museum evaluators intercepted visitors at the host museum, asking them which exhibitions they visited. If *Invention at Play* was cited as an exhibition they visited, visitors were invited to participate in the study and were asked for their phone number. Therefore, visitors were unaware that they were going to be asked specifically about *Invention at Play* when they agreed to be interviewed.

> see [*Invention at Play*] because you can get a lot of good ideas for class. [NMAH; Male, 62]
>
> No. [I did not recommend *Invention at Play* to anyone]. I did not [know] anybody who was going to Washington, D.C. It is hard to recommend things in Washington, D.C., to people in Boston when they are not going [there]. [NMAH; Female, 39]

Comparison of Invention at Play *to Other Exhibitions*

Evaluators asked interviewees how *Invention at Play* compared to other exhibitions at its host museum.

Interviewees who visited *Invention at Play* at NMAH said the exhibition was more interactive and more appropriate for children than other exhibitions in the Museum (see the first quotation below), and some called it the "highlight" of their visit. In contrast, MOS interviewees tended to say the exhibition was comparable to others at the Museum, though a few said their children did not enjoy it as much as other exhibitions (see the second quotation).

> [*Invention at Play*] was much more geared toward children [than other exhibitions at NMAH]. . . . It was one of the more interactive exhibitions where it was hands-on and you could participate. [NMAH; Female, 22]
>
> Looking at [*Invention at Play*] from my kids' point of view, they were not as excited about it as they were about some of the other exhibitions. [MOS; Female, 43]

Target Audience

RK&A asked interviewees who they believed was the exhibition's intended audience and whether *Invention at Play* worked well for them and their visiting group.

About one-half of interviewees said they believed *Invention at Play* worked well for adults and children (see the first quotation below), though the other one-half said the exhibition was intended for a specific audience. Many said it was appropriate for children of all ages (see the second quotation), a few said the exhibition worked best for teens, and a few others said it worked best for children ages 6 and younger.

> I do not think [the exhibition] was geared for any age group in particular. I think it was one of those things that you could mess with if you were 6 or 60. It seemed to have that kind of appeal to it. [NMAH; Female, 39]
>
> I think [the exhibition] was mostly targeted at kids, but it certainly had a broad age appeal. I tried a lot of [the activities] and had fun learning, but it seemed that it was targeted at a younger audience. . . . All in all it was for kids of all ages. [MOS; Female, 48]

EXPERIENCES USING THE EXHIBITS

Many interviewees said they spent most of their time in the Playhouse, followed by the Windsurfer activity. About-one quarter of interviewees said they spent most of their time using one or more of the inventors' stories, saying they were drawn to the exhibits about the inventors because of an interest in his/her invention, though they did not linger because their children preferred the hands-on activities.

When asked how they spent their time using the interactive activities, many interviewees played with the activities, or watched their children using the exhibits. Slightly more NMAH interviewees recalled using the Playhouse activities, while slightly more MOS interviewees recalled using the Windsurfer,[36] though there were no notable differences in why they spent time at these exhibits.

In contrast, fewer interviewees—most who visited *Invention at Play* at NMAH—recalled reading stories about the inventors. When asked what they recalled about the stories, several said that inventors are everyday people and several others discussed the inventors' unique approaches to inventing.

When asked to discuss how the inventors' stories related to the other exhibits, many interviewees said they provided additional information about the inventions displayed, and slightly fewer said they encouraged visitors to invent or think like an inventor.

Reported Use of the Exhibits

RK&A asked interviewees which exhibit they spent the most time at and why they spent the most time there.

Nearly three-quarters of interviewees could remember visiting a particular area in *Invention at Play*. Many of these recalled using at least one of the following interactive activities—the Playhouse activities, the Windsurfer, or the Phonoautograph. About one-quarter recalled spending most of their time using an inventors' story. Many who read about the inventors added that they were attracted to the stories because of an interest in the inventions (see the quotation below), and wanted to spend more time reading, but their children preferred doing the hands-on activities.

> I liked looking at the exhibit about how they [the IDEO team] created a better baby stroller. I remember that one was interesting to me because I used strollers for my two kids. [NMAH; Female, 49]

<u>Reported Use of Interactive Activities</u>

Many interviewees—proportionately more from NMAH—said they spent most of their time in the Playhouse because they could play with the activities (see the first quotation below) or because their children were drawn to the area (see the second quotation). The most often

[36] The Windsurfer was broken during several NMAH interviewees' visits to the exhibition.

mentioned activity was Whirligigs, followed by Rocky Blocks, Magnetic Racetrack, Tessellations, and Magnetic Faces and Names.

> [I enjoyed the Whirligigs] because you could manipulate [the fans] a zillion different ways. The possibilities were endless, and the same goes for the one where you [could use] the kitchen gadgets and the balls [on the Magnetic Racetrack]—you could manipulate [those objects] a zillion different ways. . . . You could try and try and try [the activities] again. [NMAH; Female, 43]

> We spent most of our time in the interactive area [doing the Playhouse activities]. . . . A 5- or 6-year old does not want to read things. [He will] look at [text panels] once or twice and then move on. But if there is something where you have a ball and you drop it and rearrange [kitchen utensils], it [is] interactive and more fun [for him]. [NMAH; Male, 29]

Some interviewees—mostly from MOS—recalled spending most of their time at the Windsurfer. Several of these noted that it took time to master the activity (see the quotation below).

> (Why did you spend most of your time at the Windsurfer?) Because it took so long to figure out the right thing to do [to get the activity to work]. [MOS; Female, 34]

Several interviewees spent most of their time using the Phonoautograph. A few interviewees enjoyed watching the visual output of their voices, or liked that the exhibit was easy to use (see the quotation below). Several other interviewees spent time at the Playwall, and a few discussed playing with Curlybots.

> [I enjoyed the Phonoautograph] because it was not something that you just sat down and . . . read. You could [do] it without reading anything. [NMAH; Female, 37]

Experiences Using Inventors' Stories

The evaluators asked interviewees whether they recalled reading the inventors' stories during their visit, and, if so, what they remembered. Additionally, evaluators asked interviewees to discuss how the inventors' stories related to the other exhibits in *Invention at Play*.

Reactions to Inventors' Stories

When asked, about one-half of NMAH interviewees, and one-quarter of MOS interviewees said they read the inventors' stories in the exhibition, and nearly all recalled the inventions—not the inventors' names. Most interviewees who read the inventors' stories read about "the lady who invented Kevlar." Some of these reported spending most of their time at the Kevlar exhibit and mentioned that their children enjoyed touching the props on display. Several read about "the inventor of the sailboard," and several others discussed the IDEO design team. A few recalled reading about Thomas Edison and Alexander Graham Bell (the only inventors mentioned by name), and a few others made idiosyncratic responses about the inventors of Scotchgard, Velcro, the boat shoe, robotic ants, and Post-It Notes.

Several interviewees said the narratives portrayed the inventors as everyday people with good ideas (see the first quotation below), and a couple discussed how the inventors were a variety of ages and races, and included men and women. Several others recalled reading about the inventors' unique processes—for example, continually working to make something better, observing nature, or using unexpected opportunities (see the second and third quotations). There were no differences in responses from NMAH interviewees and MOS interviewees when asked what they remembered about the inventors from reading their stories.

> What struck me most [about the inventors' stories] was that a lot of them were just ordinary people who had a stroke of brilliance that they acted upon and actually produced something viable. [NMAH; Male, 55]

> [The inventors] have a particular way of approaching things. . . . They will find an issue and keep chewing on it until they solve that particular problem. [NMAH; Male, 42]

> I guess the common theme [shared by the inventors' stories is] that they stumbled upon these products when they were not really looking for them. They were working on something else and it just happened to jump out and they said, 'Hmm, what is this and how can we use it?' [MOS; Male, 63]

Connection between Inventors' Stories and Other Exhibits

Over one-third of the interviewees who read the inventors' stories said that the exhibits displayed the inventions discussed in the narratives (see the quotation below).

> It was a one-to-one relationship where . . . you read the story and they you got to see the finished product. [NMAH; Male, 55]

Slightly less than one-third of interviewees from NMAH and MOS who read the inventors' stories said the stories and other exhibits encouraged visitors to think like an inventor (see the first quotation below). A couple added that both the stories and exhibits showed visitors that everyday things are important inventions (see the second quotation).

> Some of the exhibits were a display of things that inventors [invented] . . . and the activities gave [visitors] a taste of what the inventors went through when they were inventing something. [They help] the people who were participating [with the hands-on activities] think outside of the box and look at everyday things and how they could be used [for something other than] what they were designed for. [NMAH; Female, 34]

> [The inventors' stories and other exhibits show that] you can always do something new and it does not have to be earth-changing. It does not have to be front-page headline news to be successful and useful. [NMAH; Male, 49]

In contrast, about one-third of interviewees who read the inventors' stories said they did not remember a connection between them and the other exhibits in *Invention at Play*.

RECOLLECTION OF MAIN IDEA

When asked about the exhibition's main message, many of interviewees discussed or alluded to the invention process, and some others said the exhibition was about inventions and their impact on society. In contrast, others did not have invention-related responses.

When comparing responses from visitors to the two sites, NMAH interviewees' invention-related responses were more varied, but MOS interviewees gave proportionately more non-invention-related responses.

About one-half of interviewees discussed the invention process or some aspect of it. While not mentioning invention specifically, some said the exhibition inspired visitors to think creatively or imaginatively (see the first quotation below), and a few others added that the exhibition promoted using everyday things creatively (see the second quotation). However, several interviewees said the exhibition showed how anyone could be an inventor—such as by looking at everyday things as sources for inspiration or learning from mistakes (see the third quotation). A few others added that the exhibition showed how invention infuses play and everyday activities (see the fourth and fifth quotations).

> [The exhibition encouraged visitors] to use their imagination. You can achieve things on your own if you think about them more [creatively]. [MOS; Female, 48]

> [The exhibition meant to] inspire visitors to think outside of the box and to see how ordinary things can be used. Innovation can [occur] with everyday items. [NMAH; Female, 40]

> I got the feeling that anyone could be an inventor, you just have to think outside of the box. . . . I think it helped take some of the mystique out of inventions by showing how they were created and showing the steps—someone did not just come [up] with a ready-made product. There were failures along the way that helped refine the final product. [NMAH; Female, 48]

> [The exhibition] was trying to show a parallel between learning as a form of invention . . . [and] that invention is like play for grown-ups. It is fun and they are learning through experimentation when they are [working on] inventions. [The exhibition also shows] that play is invention for children where they are creating and learning through the same process. [NMAH; Female, 36]

> What I got out of [the exhibition] is that inventions . . . happen by playing and discovering. . . . I can remember talking to my oldest son [about] . . . how people have invented things by playing, thinking, doing things, and then trying something else. [MOS; Female, 43]

One-quarter of interviewees said that *Invention at Play* displayed information about inventions, and most said it showed how inventions affect everyday life, as shown below.

> [The exhibition was] showing that invention is pervasive through[out] society and the most elemental inventions do not have to be scientific or complex [to] have a big impact on society. [NMAH; Male, 33]

In contrast, one-quarter of interviewees did not talk about invention. Some interviewees said the exhibition displayed educational information about science or history (see the quotation below). Additionally, several interviewees said they did not remember enough about the exhibition to comment on its main message, and a couple only recalled the exhibition as a place for their children to play.

> [The exhibition] was taking . . . activities and . . . fun things to do [and providing] an explanation about them. You could do [an activity] and learn what some of the science behind it was. . . . It was making science fun and interesting. [MOS; Female, 20]

An equal number of NMAH interviewees gave responses relating to the invention process, general information about invention, and non-invention-related responses—meaning that NMAH interviewees' responses were more varied, but two-thirds understood the exhibition to be about invention or some aspect of invention. In contrast, proportionately more interviewees from MOS said that *Invention at Play* was about a non-invention-related topic.

CONNECTING WITH THE INVENTION PROCESS

Nearly all interviewees seemed to know intuitively that there is a connection among play, invention, and creativity. Some said play enhances creative thinking, and others discussed how tinkering is an important part of the invention process. However, some others—mostly from MOS—could not explain the relationship.

Many interviewees said they connected with inventors or the invention process daily—some said they use inventions or interact with inventors, and others invent or encourage their children to play creatively.

Interviewees were evenly divided between those who said the exhibition made them think about invention and play in a new way and those who said it did not. However, more interviewees from NMAH said the exhibition changed their perception than those from MOS.

Relationship Among Play, Invention, and Creativity

Evaluators asked interviewees to discuss what relationship—if any—existed among play, invention, and creativity.

One-third of interviewees said play enhances creative thinking or seeing things in a different way (see the first two quotations below). About one-half of these interviewees—mostly those from NMAH—added that play often leads to ideas for new inventions (see the third quotation).

> I think that creative play stimulates your mind, and through play, children can see things that they may not ordinarily see by just looking at something. [NMAH; Female, 43]

> When an individual or children are at play, that is, producing in their mind a sense of thinking outside of a box and being more creative. [MOS; Female, 40]

> I think there is a significant connection that playtime can be a time for letting your mind wander and coming up with brilliant ideas and perhaps applying those brilliant ideas to some kind of invention. . . . It is all interrelated. [NMAH; Male, 55]

About another one-third of interviewees—proportionately more from MOS—discussed play as tinkering with inventions. Most of these interviewees said that tinkering creates an invention (see the first quotation below). A few interviewees added that playing with objects develops important skills that inventors use, such as observation and seeing opportunity in mistakes (see the second quotation). Additionally, one interviewee from NMAH said that inventions come from creative thinking *and* tinkering (see the third quotation).

> Play and creativity are how inventions are made. It is just trial and error. . . . Messing around with stuff until it comes out with something unusual or with something you need or want. [NMAH; Female, 34]

> You are constantly inventing. Even though something might be invented, you are still playing with it [the object] . . . and discovering new opportunities. [NMAH; Male, 38]

> Some of the most ingenious ideas come out of a sort of playful mind—that [is always] questioning things, [asking, for example,] 'What happens next?' [That is the kind of] curiosity that I associate with play and imagination. It is almost childlike, but a person never loses [that perspective]. [They are always saying,] 'What more can be done? Look how you can tweak this to make it better.' . . . I think that [kind of thinking] comes from that curious, childlike play [and a] creative mind. [NMAH; Female, 44]

In contrast, slightly fewer than one-third of interviewees—proportionately more from MOS—said that play, invention, and creativity were connected, though they did not discuss how the relationship informs the invention process (see the quotation below). A couple of interviewees said they did not believe there was a relationship among play, invention, and creativity.

> I think that [play, invention, and creativity] go hand-in-hand, don't you think? I think [they] suit one another. That is how I feel about it. Without one, you cannot have the other. [MOS; Male, 36]

Personal Connections with Inventors or the Invention Process

Evaluators asked interviewees in what ways, if any, they were connected with inventors and the invention process.

More than one-third of interviewees, mostly from NMAH, said they connect with inventors or the invention process because they frequently use an invention or interact with an inventor (see the quotation below).

> I think everyone is connected in some way because we all use the products. [I am] appreciative of what was invented because . . . if it were not invented, [my] life would change. [NMAH; Female, 24]

One-third of interviewees said they think inventively regularly or encourage others to do so. Specifically, some interviewees said that their job or living situation required them to think inventively (see the first quotation below), and a few others said that they do inventive projects in their leisure time (see the second quotation). Additionally, some interviewees said they encourage their children to play creatively, such as allowing them to tinker with objects to learn more about them (see the third quotation).

> [I feel connected to the invention process] in everyday life, especially as a mother, when I am called upon [to] solve some kind of problem. When I don't have the right materials [to solve the problem], I have to look at what I have [around me] and try to be creative and come up with some solution. [MOS; Female, 48]

> I am always inventing new ways to apply current technology, [for example,] taking stuff out of the hardware store and making it look like a tree instead of [like] two-by-fours. [NMAH; Male, 49]

> I try to foster that in my children, in terms of encouraging them to look at alternative approaches to what they are doing and encourage them to play and invent things, even if it is imaginary things. [NMAH; Female, 34]

In contrast, slightly less than one-third of interviewees, proportionately more from MOS, said they do not connect with inventors or the invention process.

Change in Perceptions of Invention and Play

RK&A asked interviewees to discuss how well the exhibition encouraged them to think about invention and play in a different way.

Over one-half of interviewees—proportionately more from MOS—indicated the exhibition did not make them think about invention and play in a different way. However, some said that *Invention at Play* reiterated ideas they already had about invention and play (see the quotation below).

> [The exhibition] strengthened the beliefs I already had—I already believed it is important to encourage children in their creativity and to let them think outside of the box and try new things. [NMAH; Female, 35]

Slightly less than one-half of interviewees—mostly from NMAH—said that the exhibition encouraged them to think about invention and play in a different way. Specifically, a few said that *Invention at Play* made them re-evaluate the role of undirected play in developing a child's creativity (see the first quotation below). Additionally, a couple interviewees said that their personal invention process had changed; for example, one interviewee said she now thinks about an invention in small parts rather than as a whole (see the second quotation). Finally, a couple of others said the exhibition encouraged them to do a creative activity, such as craftwork (see the third quotation).

> [The exhibition] did make me think more about [invention and play]. For instance, my 7 year-old was out in the yard digging a hole. . . . He was playing with a shovel and he was putting something on the handle . . . so it would catapult it in the air. At first I thought, 'I should stop him, he is going to break the shovel.' Then I thought, 'That is how his mind will become creative and think of new things to do.' So I let him break my shovel. [MOS; Female, 43]

> It helped us [me and my children] to see that invention is just [made of] small parts [that] make up a larger part. . . . It is a lot easier [to invent] when you think of it in bits and pieces, and it helps you think, 'Well, I could do this too,' because I can think of small parts. . . . If I put my mind to it. [NMAH; Female, 47]

> After being at that exhibition, [I thought] more about what I could do or maybe invent. . . . After that, I started making bracelets. . . . It [was] starting something on [my] own, art, and creativity all in one. [NMAH; Male, 28]

APPENDICES

Appendix A-E removed for proprietary reasons
Appendix F included

APPENDIX F
Detailed Information about Specific Exhibits

Table 34
Number of Visitors who Used Each Activity

Exhibit Name	Number of Visitors who Stopped	Number who Used Activity
Phonoautograph activity	45	38
Whirligig activity	37	34
Tesselation Puzzle activity	26	23
Rocky Blocks activity	34	22
Magnetic Racetrack activity	30	21
Under the Sea activity	16	15
Windsurfer activity*	53	15
Musical Digits activity	18	13
Magnetic Name activity	12	11
Curlybots activity**	19	7
Magnetic Faces activity	11	7

*The Windsurfer was broken during 9 of the observations.
**Curlybots was only available at MOS.

Table 35
Number of Visitors who Watched Others Use Activities

Exhibit Name	Number of Visitors who Stopped	Number who Watched Others Use Exhibits
Windsurfer activity*	53	52
Phonoautograph activity	45	21
Magnetic Racetrack activity	30	21
Whirligig activity	37	18
Rocky Blocks activity	34	17
Windsurfer activity* (waited in line)	53	14
Curlybots activity**	19	13
Tesselation Puzzle activity	26	10
Musical Digits activity	18	7
Under the Sea activity	16	7
Magnetic Faces activity	11	5
Magnetic Name activity	12	4

*The Windsurfer was broken during 9 of the observations.
**Curlybots was only available at MOS.

Table 36
Number of Visitors who Coached or Were Coached at Each Activity

Exhibit Name	Number of Visitors who Stopped	Number who Coached or Were Coached
Windsurfer activity*	53	21
Magnetic Racetrack activity	30	18
Phonoautograph activity	45	17
Whirligig activity	37	16
Rocky Blocks activity	34	13
Tesselation Puzzle activity	26	11
Curlybots activity**	19	7
Magnetic Name activity	12	6
Under the Sea activity	16	5
Magnetic Faces activity	11	3
Musical Digits activity	18	3

*The Windsurfer was broken during 9of the observations.
**Curlybots was only available at MOS.

Table 37
Number of Visitors who Interacted with Facilitators at Each Activity

Exhibit Name	Number of Visitors who Stopped	Number who Interacted with Facilitators
Windsurfer activity*	53	17
Curlybots activity**	19	7
Whirligig activity	37	4
Magnetic Racetrack activity	30	3
Phonoautograph activity	45	2
Rocky Blocks activity	34	2
Tesselation Puzzle activity	26	1
Magnetic Faces activity	11	0
Magnetic Name activity	12	0
Musical Digits activity	18	0
Under the Sea activity	16	0

*The Windsurfer was broken during 9 of the observations.
**Curlybots was only available at MOS.

Table 38
Number of Visitors who Touched Props and Exhibited Other Object-based Behaviors

Exhibit Name	Number of Visitors who Stopped	Number who Touched Props
Implement panel with stroller prop (touched stroller)	12	6
Implement panel with stroller prop (moved handle)	12	1
Past Toy cases and props (played with puppets)	26	0
Past Toy cases and props (touched toys)	26	1
Toy Drawers (used drawers)	6	6
What Was/Is Your Favorite Toy? Panel (wrote in book)	8	1
Kevlar props (touched props)	36	12
Kevlar props (sat in canoe)	36	4
Vest-comparisons case (lifted vests)	30	24
Vest-comparisons case (used magnifers)	30	14
Motorcycle prop (touched props)	12	5
Ropes prop (lifted ropes)	40	35
The First Sailboard rail panel with prop (touched u-joint)	20	18

Table 39
Number of Visitors who Used Snoops

Exhibit Name	Number of Visitors who Stopped	Number who Used Snoops
Implement panel with stroller prop	12	3
Kevlar props	36	11
Motorcycle prop	12	5

Table 40
Number of Moveable Panels, Toy Drawers, and Videos Used

Exhibit Name	Number of Visitors that Stopped	Median Number of Used
Toy Drawers	6	3.0
Invention at Play videos	7	1.0
Moveable panels (total)	36	3.5
Nature Mural doors	22	2.5
Borrow From Nature reading boards	0	0.0
Edison, Hirshberg, & Torvald flipbook	4	2.5
Play a New Way reading boards	0	0.0
McLurkin As A Child flipbook	0	0.0
Hoberman, Fabel, Morse, and Head flipbook	10	1.0
Past Toys spinning panels	5	3.0
Kwolek As A Child	5	2.0
Fry, Spencer, Sherman, & Greenbatch flipbook	12	3.0
Find Opportunities in Obstacles reading boards	0	0.0
Keep Making It Better reading boards	1	1.0

Table 41
Number of Visitors who Read Aloud or Talked about Content at Each Exhibit

Exhibit Name	Number of Visitors who Stopped	Number who Read Aloud or Talked about Content
Windsurfer	53	22
Phonoautograph activity	45	19
Magnetic Racetrack activity	30	16
Whirligig activity	37	11
Rocky Blocks activity	34	11
Tesselation Puzzle activity	26	10
Kevlar props	36	10
Ropes prop	40	8
Past Toy cases and props	26	7
Nature Mural doors	25	6
Under the Sea activity	16	6
Vest-comparisons case	30	6
IDEO Products case	24	5
Curlybots activity	19	5
Magnetic Name activity	12	5
Musical Digits activity	18	5
Is This Really like Windsurfing? rail panel	19	5
Ganson sculpture case	25	4
Jump the Tracks case	7	4
The First Sailboard rail panel	20	4
McLurkin introduction panel	27	3
Telephone Prototypes case	15	3
Magnetic Faces activity	11	3
Hoberman, Fabel, Morse, and Head flipbook	13	3
Kwolek Kevlar Inventor panel	21	3
McLukin's Big Plans panel	7	2
What Was/Is Your Favorite Toy? panel	8	2
Motorcycle prop	12	2
Bell Telephone Inventor panel	11	1
Bell As a Young Man panel	11	1
Experiments with Flight rail panel	4	1
Large Bell photograph panel	6	1
IDEO Innovative Product Design Team panel	11	1
Implement panel with stroller prop	12	1
Edison, Hirschberg, and Torvalds flipbook	7	1
McLurkin Robotic Ants Inventor panel	8	1
MIT Non-interactive Toys cases	11	1
Toy Drawers	6	1
Kwolek As A Child flipbook	14	1

Exhibit Name	Number of Visitors who Stopped	Number who Read Aloud or Talked about Content
Fry, Spencer, Sherman, and Greatbatch flipbook	13	1
Darby's Sailboard	5	1
Title panel	3	0
Kwolek introduction panel	4	0
Darby introduction panel	1	0
Borrow from Nature header	0	0
Ear Diagram panel	3	0
Bell's Inspired Nature panel	7	0
Borrow from Nature reading boards	0	0
Many Heads Are Better Than One header	1	0
IDEO As Children rail panel	5	0
Understand panel	10	0
Observe panel	9	0
Strollers Protect and Comfort rail panel	1	0
Visualize panel	12	0
Stroller Designs rail panel	5	0
Stroller Prototype case	9	0
Evaluate and Refine panel	9	0
Dragon Soapbox photograph panel	2	0
Edison Teamwork photograph panel	3	0
Play a New Way With the Everyday header	1	0
Playhouse reading boards	0	0
Jump the Tracks header	0	0
McLurkin As a Child flipbook	6	0
Nature's Lessons rail panel	2	0
Shape Your Thinking Through Play header	0	0
Play—Past, Present, and Future panel	1	0
Thinking Outside the Box panel	3	0
Past Toy spinning panels	7	0
Recognize the Unusual header	0	0
International Space Station panel	1	0
Apache Helicopter panel	0	0
Kwolek's Curious Solution panel	5	0
Keep Making It Better header	0	0
Darby's Lifelong Passion panel	6	0
Daggerboard rail case	5	0
Darby Sailboard Inventor panel	3	0
Darby As A Young Man rail panel	3	0
Find Opportunities in Obstacles reading boards	0	0
Keep Making It Better reading boards	3	0

Table 42
Percentage of Visitors who Noticed Each Panel
(*n* = 100)

Panel	% Noticed	Panel	% Noticed
Ear Diagram	7.0	Dragon Soapbox photograph	2.0
Kwolek introduction	6.0	Play a New Way With the Everyday header	2.0
McLurkin introduction	5.0	Nature's Lessons rail	2.0
Bell's Inspired Nature	5.0	Kwolek's Curious Solution	2.0
Darby introduction	4.0	Darby's Lifelong Passion	2.0
Bell As a Young Man	4.0	Experiments with Flight rail	1.0
Stroller Designs rail	4.0	Edison Teamwork photograph	1.0
Observe	3.0	Jump the Tracks header	1.0
Strollers Protect and Comfort rail	3.0	Shape Your Thinking Through Play header	1.0
Evaluate and Refine	3.0	Keep Making It Better header	1.0
McLurkin Robotic Ants Inventor	3.0	The First Sailboard rail	1.0
McLukin's Big Plans	3.0	IDEO As Children rail	0.0
Kwolek Kevlar Inventor	3.0	Darby As A Young Man rail	0.0
Is This Really like Windsurfing? rail	3.0	Visualize	0.0
Title	2.0	Play—Past, Present, and Future	0.0
Borrow from Nature header	2.0	Thinking Outside the Box	0.0
Large Bell photograph	2.0	International Space Station	0.0
Many Heads Are Better Than One header	2.0	Apache Helicopter	0.0
IDEO Innovative Product Design Team	2.0	Darby Sailboard Inventor	0.0
Understand	2.0	Recognize the Unusual header	0.0

Table 43
Number of Visitors who Used Audio

Exhibit Name	Number of Visitors who Stopped	Number who Used Audio
McLurkin introduction panel	27	10
Bell As a Young Man panel	11	4
Telephone Prototypes case	15	4
IDEO As Children rail panel	5	3
Evaluate and Refine panel	9	3
Curlybots activity	19	1
Whirligig activity	37	0
Rocky Blocks activity	34	0
Magnetic Racetrack activity	30	0
McLurkin As a Child flipbook	6	1
Jump the Tracks case	7	3
What Was/Is Your Favorite Toy? panel	8	0
Kwolek As A Child flipbook	14	2
Ropes prop	40	9
Darby As A Young Man rail panel	3	1
Is This Really like Windsurfing? rail panel	19	6

Table 44
Number of Visitors who Watched Video

Exhibit Name	Number of Visitors who Stopped	Number who Watched Part of Video	Number who Watched Entire Video
McLurkin video	6	6	0
MIT video*	13	13	0
Invention at Play videos	7	7	0
Darby video	6	4	2

*Of the 13 visitors who watched the MIT video, 4 glanced up at the birdfeeder while watching the video.

Appendix G
Additional Information about Stationed Observation Visitors

Table 45
Magnetic Racetrack Visitors' Genders and Ages
(*n* = 98)

Characteristic	%
Gender	
Female	52.0
Male	48.0
Age Group Children (*n* = 72)	
Under 6 years of age	16.7
6 to 8	29.2
9 to 11	36.1
12 to 15	18.1
Age Group Adults (*n* = 26)	
16 to 24	7.7
25 to 44	80.8
45 to 64	11.5
65 years and older	0.0

Table 46
Rocky Blocks Visitors' Genders and Ages
(*n* = 171)

Characteristic	%
Gender	
Male	50.3
Female	49.7
Age Group Children (*n* = 101)	
Under 6 years of age	29.7
6 to 8	33.7
9 to 11	14.9
12 to 15	21.8
Age Group Adults (*n* = 70)	
16 to 24	22.9
25 to 44	58.6
45 to 64	18.6
65 years and older	0.0

Table 47
Whirligigs Visitors' Genders and Ages
(*n* = 159)

Characteristic	%
Gender	
Male	52.8
Female	47.2
Age Group Children (*n* = 99)	
Under 6 years of age	19.2
6 to 8	30.3
9 to 11	27.3
12 to 15	23.2
Age Group Adults (*n* = 60)	
16 to 24	6.7
25 to 44	76.7
45 to 64	15.0
65 years and older	1.7

Appendix H
Additional Information about Exit Interviewees

Table 48
Genders and Ages
(*n* = 93)

Characteristic	%
Gender	
Female	53.8
Male	46.2
Age Group	
6 to 8 years of age	10.8
9 to 11	9.7
12 to 15	11.8
16 to 24	4.3
25 to 44	41.9
45 to 64	17.2
65 years and older	4.3

Table 49
Residence
(*n* = 93)

Residence	NMAH %	MOS %	Total %
Tourist	46.3	76.9	63.4
Local	53.7	23.1	36.6

Table 50
Prior Visitation to *Invention at Play*
(*n* = 93)

Characteristic	NMAH %	MOS %	Total %
First Visit	95.1	84.6	89.2
Repeat Visit	4.9	15.4	10.8

Appendix I
Additional Information about Telephone Interviewees

Table 51
Genders and Ages
(*n* = 68)

Characteristic	%
Gender	
Female	63.2
Male	36.8
Age	
18 to 24	7.4
25 to 34	11.7
35 to 44	42.7
45 to 54	25.0
55 to 64	13.2
65 years and older	0.0

Table 52
Education Level
(*n* = 68)

Education	%
Some high school	1.5
High school graduate	7.4
Technical school	1.5
Some college/Associate's degree	16.2
College graduate/Bachelor's degree	30.9
Some graduate work	1.5
Graduate/Professional degree	41.2

Table 53
Residence
(*n* = 68)

Residence	NMAH %	MOS %	Total %
Tourist*	55.6	60.9	57.4
Local**	44.4	39.1	42.6

*See listing of tourist states of residence in Table 48.
**Local refers to residents of DC, MD, and VA for NMAH interviews, and residents of MA for MOS interviews.

Table 54
Tourist States of Residence
(*n* = 39)

Residence	NMAH	MOS
Massachusetts	4	
Texas	3	1
Pennsylvania	3	
California	2	
Michigan	2	
Tennessee	2	
Washington	2	
New York	1	2
Arizona	1	
Florida	1	
Illinois	1	
Louisiana	1	
Montana	1	
Nevada	1	
North Carolina	1	
Oklahoma	1	
Oregon	1	
Wisconsin	1	
Maine		4
Connecticut		2
Maryland		1
New Jersey		1
New Mexico		1
Rhode Island		1
Vermont		1

Table 55
Group Composition

Group Composition (*n* = 65)	NMAH %	MOS %	Total %
Adults and children	69.0	91.3	76.9
Alone or with other adults	28.9	8.7	23.1
Ages of Children (*n* = 50)	**NMAH %**	**MOS %**	**Total %***
5 years or younger	37.9	38.1	38.0
6 to 11 years	75.9	71.4	74.0
12 to 15 years	27.6	42.9	34.0

*Some interviewees visited with children in more than one age group, so total percentage exceeds 100 percent.

Table 56
Prior Visits to Host Museum

Characteristic (*n* = 68)	NMAH %	MOS %	Total %
First Visit	51.1	73.9	58.8
Repeat Visit	48.9	26.1	41.2
Visits in Past 12 Months (Repeat visitors *n* = 28)	**NMAH %**	**MOS %**	**Total %**
1 to 2 times	72.7	83.3	75.0
3 to 4 times	4.5	16.7	7.1
5 times or more	22.7	0.0	17.9