

Science Museum of Minnesota
Playing with Time
Summative Evaluation

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EXECUTIVE SUMMARY

INTRODUCTION

This report presents the findings of a summative evaluation of *Playing with Time*, conducted by Randi Korn & Associates, Inc. (RK&A), for the Science Museum of Minnesota (SMM) in Saint Paul, MN. *Playing with Time* is a traveling exhibition funded by the National Science Foundation. Data collection took place at SMM, the exhibition's first venue, in the spring and summer of 2002. The evaluation documents the scope of the exhibition's impact and effectiveness through timing and tracking observations and exit interviews.

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

I. PRINCIPAL FINDINGS: TIMING AND TRACKING OBSERVATIONS

An observer timed and tracked 111 drop-in visitors, ages 9 and older, for 15 days in the summer of 2002.

Visitor Demographics

- 56 percent of visitors were female and 44 percent were male.
- 38 percent were between 25 and 44 years old.
- 57 percent were visiting in groups of adults and children.

Overall Visitation Patterns

- Visitors spent a median time of 12 minutes in *Playing with Time*.
- Using Serrell's Sweep Rate Index, it was found that visitors are moving more slowly through *Playing with Time* than are visitors in exhibitions of similar size.
- Visitors stopped at a median of 8 exhibits in *Playing with Time*.
- Using Serrell's Percentage Diligent Visitor, it was found that visitors stopped at fewer exhibits in *Playing with Time* than did visitors in exhibitions of similar size.
- 53 percent of visitors noticed or studied at least one exhibit and did so a median of two times.
- Males noticed or studied more exhibits than did females.

Visitation to Each Exhibition Section

- Visitors spent the most time in the Tools area (median time of 4 minutes).
- They spent the least time in the Entry/exit area (median time of 55 seconds).
- The Tools area was visited by 79 percent of visitors and the Life area by 78 percent, making them the two most visited sections of the exhibition.

- Visitors made the most stops in the Life area (median of 3 stops).
- They made the fewest in the Universe area (median of 1 stop).

Visitation of Each Type of Exhibit

- Visitors spent the most time at interactives, followed by multimedia (median times of about 4 minutes each).
- They spent the least time at specimens and panels (median times of 26 seconds and 22 seconds, respectively).
- Children spent more time at interactives than did adults.
- 86 percent of visitors stopped at interactives, making it the most visited exhibit type.
- The fewest visitors stopped at videos and hybrids (46 percent and 35 percent, respectively); however readers should note that there were only two opportunities each to stop at either one.
- Visitors also made the most stops at interactives (median of 3 stops).
- Children stopped at more interactives than did adults.
- Visitors displayed the greatest range of behaviors at interactives (median of 4 behaviors).
- Children were observed doing activities at more interactives than were adults.

Visitation of Individual Exhibits

- 48 percent of visitors spent four minutes or longer at one or more exhibits.
- Visitors spent a median of about 4 minutes at the Cosmic Challenge, making it the exhibit with the highest dwell time.
- They also spent considerable time at Funny Faces and the Popcorn Popper (median times of about 2 minutes each).
- Visitors spent the least time at panels, including the Human Perception and Radio Telescope panels (median times of 6 seconds and 5 seconds, respectively).
- 63 percent of visitors stopped at the Plant Dance, 43 percent at the Rotting Fruit and 42 percent at the Water Dropper, making these the most visited exhibits.
- Visitors stopped at panels least often, and no visitors stopped at the Earth and Tools area header panels.
- 19 percent of visitors noticed the Timescale super graphic panel, making it the most noticed exhibit.
- The Red Sun, Green Sun, and Moving Rocks were the most studied exhibits (7 percent, 6 percent, and 6 percent, respectively).

II. PRINCIPAL FINDINGS: INTERVIEWS

A random sample of visitors was interviewed upon exiting *Playing with Time*. RK&A interviewed 30 visitor groups, comprising 70 visitors (41 adults and 29 children) in April and June 2002.

Overall Opinion of Playing with Time

All interviewees made positive remarks about *Playing with Time*. They praised the exhibition's activities, visuals, and content, suggesting that the exhibition appealed to both adults and children. Many experiences and ideas in the exhibition surprised interviewees, who characterized the exhibition as unique and mind-bending.

Peak Experiences

Overall, interviewees' opinions about the exhibits varied. However, the Water Dropper was often mentioned as both fun and interesting, and Plant Dance and the Strobe Wheel were also mentioned in both categories. Several interviewees characterized Funny Faces as particularly fun, and several others identified Dynamic Planet as most interesting.

Many interviewees did not find any of the exhibits disappointing. A few had difficulty operating the high-speed cameras or complained that popular exhibits should be duplicated to prevent having to wait in line to use them. Others mentioned idiosyncratic concerns or suggestions.

Perceptions of the Main Idea

Most interviewees perceived at least part of the main message, stating that all the exhibition elements worked in concert to convey a single, coherent idea. The five interviewees who used the Timescale super graphic most fully understood the exhibition.

DISCUSSION

How Visitors Responded to Playing with Time

Overall, interviewees highly praised *Playing with Time* for providing diverse, engaging, and compelling experiences. Interactives and multimedia worked well for both adults and children, as shown by the interviewees' comments and the high dwell time observed at these types of exhibits. In particular, adults and children enjoyed open-ended exploration—the Water Dropper and the Strobe Wheel—and cooperative play—the Cosmic Challenge. Teen and adult interviewee comments indicated they were awestruck by the dramatic visuals, such as the Dynamic Planet and the Reflectory video. Some adults also appreciated the whole exhibition's content for being unexpected and thought-provoking.

The fact that *Playing with Time* engaged visitors is further demonstrated by examining the total time and total stops made in the exhibition. Using Serrell's Sweep Rate Index, RK&A determined that visitors moved much slower through *Playing with Time* than did visitors in exhibitions of similar size.¹ Conversely, according to Serrell's Percentage Diligent Visitor calculation, *Playing with Time* visitors stopped at fewer exhibits than did visitors in exhibitions of similar size.² These two figures together demonstrate that visitors spent a long time at select exhibits; that is, individual exhibits were compelling and satisfying enough to hold visitors' attention. Since 48 percent of visitors had a dwell time of four minutes or longer at one or more exhibits, the exhibition development team achieved their goal of developing exhibits with high dwell time.

Other data clearly indicate that *Playing with Time* provided a range of high quality experiences for visitors, enabling them to select exhibits according to their own personal preferences. First, visitors fairly evenly used individual exhibits, meaning that one exhibit did not dominate over the others as far as attracting visitors. Second, more than one-half of visitors stopped in five of the six exhibition sections, demonstrating that a diversity of topics also dispersed visitors. Third, interviewees complimented the variety of exhibits and often had individualistic reasons for selecting an exhibit as the most fun or most interesting. Therefore, the exhibition development team met another goal: to create an exhibition with balanced visitation.

Conveyance of the Main Idea

Playing with Time effectively conveyed the intended main idea. Most interviewees perceived at least part of the main message. Interviewees suggested that all the exhibition elements worked together to convey a coherent idea. The activities, images, and consistent voice reinforced each other and explicitly connected with the main idea, enabling visitors who did not see the Timescale super graphic or read much text to perceive the idea, "everything is changing all the time" and "most things happen too fast or too slow for humans to perceive." The exhibition development team should be commended for their consistent use of language and the discipline to include only exhibits that directly support the main message.

¹ Serrell, B. (1998). *Paying attention: visitors and museum exhibitions*. Washington, D.C., American Association of Museums. See page 6 of this report for a detailed explanation of the Sweep Rate Index.

² *Ibid.* See page 7 of this report for a detailed explanation of the Percentage Diligent Visitor.

One of the means of communicating the main idea, however, was not as successful as it could have been. The Timescale super graphic was not used by the majority of visitors. Those who used it, however, had a richer understanding of the main idea, suggesting that it could play a more prominent role in the exhibition. Suggestions were made in the remedial evaluation to improve its power to attract visitors.

Specific Concerns of the Exhibition Development Team

Exhibition development team members asked specific questions about hybrid exhibits and multimedia games. The hybrid exhibits were not quantitatively different than the other exhibit types (e.g., visitors did not spend more time at hybrids than other types of exhibits, the two hybrids did not have especially long dwell times). However, for some interviewees, the Dynamic Planet was a peak experience. Comments indicated they were intrigued by the images showing global changes over time and were amazed by the changes themselves, especially changes in world population. Few visitors talked about Blocks of Time in the exit interviews and the timing and tracking observations did not support the behavior witnessed during the remedial evaluation—that the act of sequencing the three-dimensional blocks seemed to foster social interactions among visitors. Because only 28 visitors stopped at Blocks of Time, the quantitative analysis that could be undertaken to examine visitor behavior was limited.

The two multimedia games—Cosmic Challenge and Which Took Longer?—had high dwell times. Of all the exhibits, visitors spent the most time at Cosmic Challenge (median time of about 4 minutes), and Which Took Longer? had the fifth highest dwell time (median time of about 2 minutes). In fact, Cosmic Challenge and Which Took Longer? were the only multimedia exhibits included among the exhibits with the top five highest dwell times—the other top five were high-speed camera exhibits. Additionally, during the interviews a few families said the Cosmic Challenge worked well for them because the game format fostered conversations between adults and children.

INTRODUCTION

This report presents the findings of a summative evaluation of *Playing with Time*, conducted by Randi Korn & Associates, Inc. (RK&A), for the Science Museum of Minnesota (SMM) in Saint Paul, MN. *Playing with Time* is a traveling exhibition funded by the National Science Foundation. Data collection took place at SMM, the exhibition's first venue, in the summer of 2002. The evaluation documents the scope of the exhibition's impact and effectiveness via timing and tracking observations and exit interviews. The evaluation's objectives were to determine:

- how much time visitors spend in the exhibition;
- how much time visitors spend in each exhibition section;
- how much time visitors spend at individual exhibits;
- the exhibits at which visitors stop;
- the frequency of select behaviors;
- visitors' cognitive experiences;
- quantitative and qualitative differences in visitors' experiences at each type of exhibit; and
- whether the exhibition development team's goals of creating an exhibition with high dwell time³ and dispersed visitation⁴ were achieved.

METHODOLOGY

Two data collection strategies were employed to assess visitors' experiences in *Playing with Time*: timing and tracking observations and uncued exit interviews.

Timing and Tracking Observations

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

All visitors nine years of age and older were eligible to be unobtrusively observed in the exhibition. Observed visitors were selected following a continuous random sampling method. In accordance with this method, the observer was stationed at the exhibition's entrance, 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 A for the observation form). After that visitor completed his/her visit, the observer returned to the entrance to await the next eligible visitor entering the exhibition.

³ SMM exhibit developers defined "high dwell time" as visitors who spent four or more minutes at one or more exhibits.

⁴ SMM exhibit developers defined "dispersed visitation" as visitors who used all of the sections of the exhibition fairly evenly.

Exit Interviews

Open-ended interviews 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 nine 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 B for the interview guide). The interview guide was intentionally open-ended to allow interviewees to discuss what they felt was meaningful. All interviews were tape-recorded with participants' permission and transcribed to facilitate analysis.

DATA 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.⁵ To compare the means of two visitor subsets (e.g., visitor groups with children and those without children), ANOVA and Mann-Whitney U tests (the nonparametric equivalent to an ANOVA) were computed.

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 “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 would be a relationship between the two variables (e.g., gender and number of interactive exhibits used). Conversely, there is a 5 percent probability that the relationship does not 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. All the statistical analyses run on the observational data in Appendix C.

⁵ 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 visitors 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.

Visitors' responses to interview questions were analyzed qualitatively, meaning that the evaluator studied the responses for meaningful patterns. As patterns and trends emerged, similar responses were grouped together and, in the report, exemplified by verbatim quotations.

METHOD OF REPORTING

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

Interviewees' verbatim quotations (edited for clarity) illustrate major trends in the data and convey visitors' thoughts and feelings as fully as possible. Within quotations, an asterisk (*) signifies the start of a different speaker's comments. The interviewer's remarks appear in parentheses. The gender and age of each interviewee appear in brackets at the end of each quotation.

Findings in each report are presented in two main sections:

- I. Timing and Tracking Observations
- II. Interviews

I. PRINCIPAL FINDINGS: TIMING AND TRACKING OBSERVATIONS

DATA COLLECTION CONDITIONS

The observer timed and tracked visitors for 15 days in the summer of 2002, observing 111 drop-in visitors, ages nine years and older.

The majority of observations were conducted on a weekday afternoon during moderate visitation conditions (see Table 1).

Table 1
Data Collection Conditions
(*n* = 111)

Condition	%
Day	
Weekday	73.0
Weekend	27.0
Time	
AM	40.5
PM	59.5
Level of Crowding	
Low	24.3
Moderate	52.3
High	23.4

VISITOR DEMOGRAPHICS

As Table 2 shows, more than one-half of visitors were female and less than one-half were male (56 percent and 44 percent, respectively). More than one-third of visitors were between 25 and 44 years of age (38 percent).

Table 2
Visitor Demographics
(*n* = 111)

Characteristic	%
Gender	
Female	55.9
Male	44.1
Age Group	
9 to 11 years of age	9.9
12 to 15	6.3
16 to 24	25.2
25 to 44	37.8
45 to 64	15.3
65 years or older	5.4

The majority of visitors were visiting the exhibition in groups of both adults and children (57 percent) (see Table 3).

Table 3
Group Composition
(*n* = 111)

Group Composition	%
Adults and children	56.8
Adults only	27.0
Children only	16.2

OVERALL VISITATION PATTERNS

Total Time Spent in the Exhibition

As Table 4 shows, visitors spent a median of 12 minutes in *Playing with Time*. The shortest time a visitor spent in the exhibition was 23 seconds and the longest time was 1 hour and 25 minutes.

Table 4
Total Time Spent in *Playing with Time*
(n = 111)

Median	Minimum	Maximum	Mean	±
12 minutes, 22 seconds	23 seconds	1 hour, 25 minutes, 21 seconds	15 minutes, 57 seconds	13 minutes, 2 seconds

To compare *Playing with Time* with other exhibitions of similar size, RK&A used Serrell's "Sweep Rate Index" (SRI).⁶ The SRI is calculated by dividing the exhibition's square footage⁷ by the average total time spent in the exhibition.⁸ The lower the SRI, the more time visitors spent per square foot of space. The SRI for *Playing with Time* is 282 square feet per minute.

The SRI for *Playing with Time* is lower than Serrell's average SRI for large nondiorama exhibitions.⁹ This means that visitors in *Playing with Time* are moving slower than visitors in exhibitions of similar size.

⁶ Serrell, B. (1998). *Paying attention: visitors and museum exhibitions*. Washington, D.C., American Association of Museums.

⁷ *Playing with Time* is 4,500 square feet.

⁸ The average total times were used in the SRI calculation in accordance with Serrell's methods. Throughout the rest of the report, the median times are reported, as the median is standard for time data unevenly distributed across its range.

⁹ Serrell reports an average SRI of 400.5 (±191.5) for large (>3,900 square feet) nondiorama exhibitions.

Total Number of Exhibits Stopped At

Playing with Time included 49 exhibits at which visitors could stop.¹⁰ **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 he/she 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.**

As Table 5 presents, visitors stopped at between 1 and 24 exhibits in *Playing with Time*. Visitors stopped at a median of 8 exhibits.

Table 5
Total Number of Exhibits Stopped at in *Playing with Time*
(n = 111)

Median	Minimum	Maximum	Mean	±
8	1	24	8.3	5.1

Comparing *Playing with Time* with exhibitions of similar size, RK&A used Serrell’s “Percentage Diligent Visitor Index” (%DV).¹¹ The %DV is obtained by calculating the percentage of visitors who stopped at more than one-half of the exhibits. The higher the %DV, the more thoroughly the exhibition was used. The %DV for *Playing with Time* is 0 percent, so no visitors stopped at more than one-half of the exhibits in the exhibition.

The %DV for *Playing with Time* is lower than Serrell’s average %DV for large nondiorama exhibitions.¹² This means that visitors stopped at fewer exhibits in *Playing with Time* (i.e., used it less thoroughly) than did visitors in exhibitions of similar size.

¹⁰ See Tables 24 and 25 for a complete list of the exhibits that were eligible for a “stop.”

¹¹ Serrell, B. (1998). *Paying attention: visitors and museum exhibitions*. Washington, D.C., American Association of Museums.

¹² Serrell reports an average %DV of 23.4 percent (±20.4) for large (>3,900 square feet) nondiorama exhibitions.

Total Number of Exhibits Noticed or Studied

In *Playing with Time*, visitors could notice or study 19 exhibits, which were intended to provide quick experiences.¹³ For this evaluation, a “notice” was defined as briefly looking at an image or area header panel. A “study” is defined as focused looking (i.e., paying attention to the exhibit in a more intense manner than simply noticing it).

Fifty-two of the visitors (47 percent) did not notice or study any exhibits. The 59 visitors who noticed or studied at least one exhibit, did so a median of two times (see Table 6).

Table 6
Total Number of Exhibits Noticed or Studied in *Playing with Time*
(n = 59)

Median	Minimum	Maximum	Mean	±
2	1	6	2.0	1.3

When the total number of exhibits noticed or studied was examined among demographic characteristics, one statistically significant relationship emerged (see Table 7). Males notice or studied more exhibits than did females.

Table 7
Differences in Number of Exhibits Noticed or Studied
Among Demographic Characteristics
(n = 111)

Gender*	Mean	±
Male	2.7	1.4
Female	1.6	0.9

*p = 0.00

¹³See Tables 26 and 27 for a complete list of the exhibits eligible for a “study/notice.”

VISITATION TO EACH EXHIBITION SECTION

Playing with Time included five main sections: Entry/exit, Tools, Life, Earth, and Universe (see Appendix A for the timing and tracking form).

Time Spent in Each Section

As shown in Table 8, visitors spent the most time in the Tools area (median time of about 4 minutes), followed by the Life and the Universe areas (median times of about two minutes each). Visitors spent the least time in the Entry/exit area (median time of 55 seconds).

Table 8
Time Spent in Each Section

Section	Number of Visitors who Stopped	Median Time
Tools	88	3 minutes, 58 seconds
Life	87	2 minutes, 30 seconds
Universe	44	2 minutes, 23 seconds
Earth	66	1 minute, 42 seconds
Entry/exit	73	55 seconds

The time spent in each section was also examined in terms of the total time visitors spent in the exhibition (see Table 9). In general, visitors spent one-third of their total exhibition time in the Tools area (33 percent). They spent about one-quarter of their total exhibition time in the Life area (22 percent). They spent a small portion of their exhibition time in the Earth, Universe, and Entry/exit areas (12 percent, 12 percent, and 8 percent, respectively).

Table 9
Percentage of Total Time Spent in Each Section

Section	Number of Visitors who Stopped	Median % of Total Time in the Exhibition
Tools	88	33.5
Life	87	22.2
Earth	66	12.4
Universe	44	11.8
Entry/exit	73	8.3

Stops Made in Each Section

As Table 10 shows, more than three-quarters of visitors stopped in the Tools and Life areas (79 percent and 78 percent, respectively). More than one-half stopped in the Entry/exit and Earth areas (66 percent and 59 percent, respectively). The fewest visitors stopped in the Universe area (40 percent).

In terms of the number of stops visitors made in each section, visitors stopped most often in the Life area (median of 3 stops) and the least often in the Universe area (median of 1 stop).

Table 10
Stops Made in Each Section
(*n* = 111)

Section	% of Visitors who Stopped	Median Number of Stops
Tools	79.3	2.5
Life	78.4	3.0
Entry/exit	65.8	2.0
Earth	59.4	2.5
Universe	39.6	1.0

The number of stops made in each section was also examined in terms of the total number of stops made in the exhibition (see Table 11). In general, visitors made one-third of their stops in the exhibition in the Tools and Life areas (each 33 percent). Visitors made one-quarter of their stops in the exhibition in the Earth and Entry/exit areas (25 percent and 23 percent, respectively). They spent a small portion of their stops in the exhibition in the Universe area (12 percent).

Table 11
Percentage of Total Stops Made in Each Section

Section	Number of Visitors who Stopped	Median % of Total Stops Made in the Exhibition
Tools	88	33.3
Life	87	33.3
Earth	66	25.0
Entry/exit	73	23.1
Universe	44	12.5

VISITATION OF EACH EXHIBIT TYPE

The exhibition included six main exhibit types: panels, interactives, multimedia, specimens, hybrids, and videos (see Appendix D for a list of exhibits by type).

Time Spent at Each Exhibit Type

As Table 12 presents, visitors spent the most time at interactives, followed by multimedia (median times of about 4 minutes each). Visitors spent the least time at specimens and panels (median times of 26 seconds and 22 seconds, respectively).

Table 12
Time Spent at Each Exhibit Type

Exhibit Type	Number Available	Number of Visitors who Stopped	Median Time
Interactive	12	96	3 minutes, 59 seconds
Multimedia	7	75	3 minutes, 39 seconds
Hybrid	2	39	1 minute, 40 seconds
Video	2	50	36 seconds
Specimen	4	63	26 seconds
Panel	19	54	22 seconds

When the time spent at each exhibit type was examined among demographic characteristics, one statistically significant relationship emerged (see Table 13). Children spent more time at interactives than did adults.

Table 13
Differences in Time Spent at Interactives
Among Demographic Characteristics (*n* = 96)

Age Group*	Mean Time	±
Child	8 minutes, 5 seconds	4 minutes, 56 seconds
Adult	4 minutes, 59 seconds	4 minutes, 45 seconds

**p* = 0.02

The time spent at each exhibit type was also examined in terms of the total time visitors spent in the exhibition (see Table 14). In general, visitors spent one-third of their total time in the exhibition at interactives (34 percent). They spent a small portion of their exhibition time at specimens, videos, and panels (4 percent, 4 percent, and 3 percent, respectively).

Table 14
Percentage of Total Time Spent at Each Exhibit Type

Exhibit Type	Number of Visitors who Stopped	Median % of Total Time in the Exhibition
Interactive	96	34.3
Multimedia	75	19.7
Hybrid	39	10.5
Specimen	63	4.4
Video	50	4.3
Panel	54	2.6

Stops at Each Exhibit Type

As shown in Table 15, more than three-quarters of visitors stopped at interactives (86 percent). More than one-half stopped at multimedia and specimens (68 percent and 57 percent, respectively). The fewest visitors stopped at videos and hybrids (46 percent and 35 percent, respectively). However, readers should note that there were only two opportunities each to stop at videos or hybrids.

In terms of the number of stops visitors made in each exhibit type, visitors made the most stops at interactives (median of 3 stops), followed by multimedia (median of 2 stops). Visitors stopped at specimens, panels, videos, and hybrids a median of one time.

Table 15
Stops Made at Each Exhibit Type (*n* = 111)

Exhibit Type	Number Available	% of Visitors who Stopped	Median Number of Stops
Interactive	12	86.5	3.0
Multimedia	7	67.6	2.0
Specimen	4	56.7	1.0
Panel	19	48.6	1.0
Video	2	45.9	1.0
Hybrid	2	35.1	1.0

When the number of stops made at each exhibit type was examined among demographic characteristics, one statistically significant relationship emerged: children stopped at more interactives than did adults (see Table 16).

Table 16
Differences in Stops Made at Interactives
Among Demographic Characteristics
(*n* = 96)

Age Group*	Mean Number of Stops	±
Child	4.6	2.4
Adult	3.2	2.0

**p* = 0.02

The number of stops made at each type of exhibit was also examined in terms of the total number of stops made in the exhibition (see Table 17). In general, visitors made about one-third of their stops in the exhibition at interactives (37 percent). Visitors made about one-quarter of their stops in the exhibition at multimedia (21 percent). They spent a small portion of their stops in the exhibition at the remaining exhibit types.

Table 17
Percentage of Total Stops Made at Each Exhibit Type

Exhibit Type	Number of Visitors who Stopped	Median % of Total Stops Made in the Exhibition
Interactive	96	37.5
Multimedia	75	21.2
Panel	54	16.7
Video	50	14.3
Specimen	63	12.5
Hybrid	39	9.1

Behaviors at Each Exhibit Type

The observer noted six behaviors at interactives, multimedia, and hybrids: doing the activity, watching others, reading, coaching or being coached, talking about content, and interacting with staff.

Overall, visitors displayed the widest variety of behaviors at interactives (median of 4 different behaviors) (see Table 18). Visitors displayed a median of two different behaviors at multimedia and hybrid exhibits.

Table 18
Total Number of Behaviors Observed at Interactives, Multimedia, and Hybrids

Exhibit Type	Number of Visitors who Stopped	Median Number of Behaviors Observed
Interactives	96	4.0
Multimedia	75	2.0
Hybrids	39	2.0

Doing the activity was the most prevalent behavior at interactives, multimedia, and hybrids (82 percent, 65 percent, and 67 percent, respectively) (see Table 19). More than one-half of visitors watched others use these three exhibit types (69 percent, 63 percent, and 54 percent). More than one-half of visitors also read and talked about content at interactives (58 percent and 55 percent, respectively).

Table 19
Specific Behaviors at Interactives, Multimedia, and Hybrids

Behavior	Interactives % (n = 96)	Multimedia % (n = 75)	Hybrids % (n = 39)
Doing the activity	82.3	65.3	66.7
Watching others	69.8	62.7	53.8
Talking about content	55.2	30.7	35.9
Coaching or being coached	46.8	26.7	20.5
Reading	58.3	9.3	10.2
Interacting with staff	7.3	0.0	2.6

When the behaviors at each type of exhibit were examined among demographic characteristics, one statistically significant relationship emerged (see Table 20). Children were observed doing activities at more interactives than were adults.

Table 20
Differences in Behaviors at Interactives
Among Demographic Characteristics
(n = 79)

Age Group*	Mean Times Doing the Activity Were Observed	±
Child	4.1	2.1
Adult	2.3	1.6

*p = 0.00

The observer noted one behavior at videos, specimens, and panels: reading aloud and/or talking about content (see Table 21). Nearly one-half of visitors at specimen exhibits talked about content or read accompanying text aloud (46 percent). Less than one-quarter of visitors talked about content or read aloud at panels or videos (20 percent and 18 percent, respectively).

Table 21
Behaviors at Specimens, Panels, and Videos

Behavior	Specimens % (n = 63)	Panels % (n = 54)	Videos % (n = 50)
Talking about content or reading aloud	46.0	20.3	18.0

VISITATION OF INDIVIDUAL EXHIBITS

The time visitors spent at each exhibit they stopped at was recorded. As shown in Table 22, nearly one-half of visitors spent four minutes or longer at one or more exhibits (48 percent).

Table 22
Percentage of Visitors who Spent Four Minutes or Longer at an Exhibit
(*n* = 111)

Time Spent	%
Did not spend four minutes or longer at any exhibits	52.3
Spent four minutes or longer at one or more exhibits	47.7

Time Spent at Each Exhibit

As shown in Table 23, visitors spent the most time at the Cosmic Challenge (median time of 4 minutes, 17 seconds). Visitors also spent considerable time at Funny Faces and the Popcorn Popper (median times of 2 minutes, 30 seconds each).

Table 23
Exhibits at which Visitors Spent More than One Minute

Exhibit	Number of Visitors who Stopped	Median Time (Seconds)
Cosmic Challenge game multimedia	17	257.0
Funny Faces interactive	33	150.0
Popcorn Popper interactive	17	150.0
Perception Bench interactive	44	126.5
Which Took Longer? game multimedia	24	124.0
Be a Dog Breeder multimedia	20	104.5
Blocks of Time hybrid	28	88.5
Strobe Wheel interactive	35	87.0
Sewing Machine Strobe interactive	30	87.0
Painting with Time multimedia	29	86.0
Exploring Solar Changes multimedia	17	83.0
Big Bang panel	5	78.0
Exploring Human Changes multimedia	24	77.5
Water Dropper interactive	47	69.0
Shakers interactive	30	64.5

As shown in Table 24, the seven exhibits at which visitors spent the least time were panels, and of those visitors spent the least time at the Human Perception and Radio Telescope panels (median times of 6 seconds and 5 seconds, respectively). None stopped at either the Earth or the Tools area header panels.

Table 24
Exhibits at which Visitors Spent Less than One Minute

Exhibit	Number of Visitors who Stopped	Median Time (Seconds)
Dynamic Planet hybrid	21	48.0
Plant Dance whole body experience and panel	70	41.5
Blink Comparator interactive	14	41.0
Web Kiosk	9	40.0
Reflectory video	41	38.0
Muybridge rail panel	2	38.0
Museum Conservation rail panel	6	36.5
Lake Core Bench interactive	32	34.0
Stratograph Art	41	33.0
Bones X-ray interactive	23	32.0
Expanding Universe Plates interactive	17	29.0
Exploring Earth Changes multimedia	19	28.0
Drilling for Ice rail panel	6	25.0
Rotting Fruit specimen	48	23.0
Coral Seismographs panel	2	22.0
Stratograph rail panel	8	19.5
Ice Core photo and panel	9	19.0
Erosion/rust specimen	25	19.0
Fungus rail panel	3	18.0
Industrial Secrets rail panel	19	14.0
Lake Core specimen/flip panel	6	13.5
Coral Core X-ray interactive	10	13.0
Collecting Lake Cores rail panel	1	13.0
Dazzling Images video	15	12.0
Timescale super graphic panel	19	12.0
Reflectory panel	7	11.0
Wolf/Dog Skulls specimen	19	10.0
Public Spaces rail panel	9	9.0
Life area header panel	1	7.0
Universe area header panel	1	7.0
Human Perception panel	2	6.0
Radio Telescope rail panel	5	5.0
Earth area header panel	0	0.0
Tools area header panel	0	0.0

Stops Made at Each Exhibit

Visitors could stop at 49 exhibits.¹⁴ As presented in Table 25, the most visitors stopped at the Plant Dance, followed by the Rotting Fruit and Water Dropper (63 percent, 43 percent, and 42 percent, respectively).

Table 25
Exhibits at which 20 Percent or More of Visitors Stopped
(n = 111)

Exhibit	%
Plant Dance whole body experience and panel	63.1
Rotting Fruit specimen	43.2
Water Dropper interactive	42.3
Perception Bench interactive	39.6
Reflectory video	36.9
Stratograph art	36.9
Strobe Wheel interactive	31.5
Funny Faces interactive	29.7
Lake Core Bench interactive	28.8
Painting with Time multimedia	26.1
Shakers interactive	27.0
Sewing Machine Strobe interactive	27.0
Blocks of Time hybrid	25.2
Erosion/rust specimen	22.5
Exploring Human Changes multimedia	21.6
Which Took Longer? game multimedia	21.6
Bones X-ray interactive	20.7

The eleven exhibits at which the fewest visitors stopped were all panels (see Table 26). Specifically, the fewest visitors stopped at the Collecting Lake Cores rail panel, Life area header panel, and Universe area header panel (each 1 percent). No visitors stopped at the Earth and Tools area header panels.

¹⁴ 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 26
Exhibits at which Less than 20 Percent of Visitors Stopped
(n = 111)

Exhibit	%
Dynamic Planet hybrid	18.9
Be a Dog Breeder multimedia	18.0
Industrial Secrets rail panel	17.1
Exploring Earth Changes multimedia	17.1
Timescale super graphic panel	16.2
Wolf/Dog Skulls specimen	16.2
Exploring Solar Changes multimedia	15.3
Popcorn Popper interactive	15.3
Cosmic Challenge multimedia	15.3
Expanding Universe Plates interactive	15.3
Dazzling Images video	14.4
Blink Comparator interactive	12.6
Ice Core photo and panel	9.0
Coral Core X-ray interactive	9.0
Web Kiosk	8.1
Public Spaces rail panel	8.1
Stratograph rail panel	7.2
Reflectory panel	6.3
Museum Conservation rail panel	5.4
Drilling for Ice rail panel	5.4
Lake Core specimen/flip panel	5.4
Radio Telescope rail panel	4.5
Big Bang panel	4.5
Fungus rail panel	2.7
Human Perception panel	1.8
Muybridge rail panel	1.8
Coral Seismographs panel	1.8
Collecting Lake Cores rail panel	0.9
Life area header panel	0.9
Universe area header panel	0.9
Earth area header panel	0.0
Tools area header panel	0.0

Notices or Studies at Each Exhibit

Visitors could notice 6 exhibits, and notice or study 12 images.¹⁵ Regarding exhibits that visitors could notice, the most visitors noticed the Timescale super-graphic (19 percent) (see Table 27). Few visitors noticed any of the area header panels, and the Earth area header panel was noticed by the fewest (1 percent). Readers may recall from the previous section that few visitors stopped at area header panels.

Table 27
Visitors who Noticed Specific Exhibits
(*n* = 111)

Exhibit	% Noticed
Timescale super graphic panel	18.9
Dazzling Images video	11.7
Title panel	9.9
Tools area header panel	4.5
Universe area header panel	4.5
Life area header panel	2.7
Earth area header panel	0.9

¹⁵ For this evaluation, a “notice” was defined as briefly looking at an image, title panel, or section header panel. A “study” was defined as focused looking (i.e., paying attention to the exhibit in a more intense manner than simply noticing it). Readers will note that the time scale super-graphic and area header panels were eligible for either a “stop” or “notice.” If visitors spent more than three seconds at these panels, this was considered a “stop” rather than a “notice.”

See Table 28 for a list of the images that visitors could notice or study. The most visitors noticed the Wasp image, followed by the Moving Rocks and the Girl with Ball images (7 percent, 5 percent, and 5 percent, respectively). No visitors noticed the Bursting Balloon image.

The most visitors studied the Red Sun, Green Sun, and Moving Rocks images (7 percent, 6 percent, and 6 percent, respectively). No visitors studied the Girl with Ball image.

Table 28
Visitors who Noticed or Studied Each Image
(n = 111)

Exhibit	% Noticed	% Studied
Wasp image	7.2	0.9
Moving Rocks image	5.4	6.3
Girl with Ball image	5.4	0.0
Star Tracks image	3.6	0.9
Popcorn image	2.7	1.8
Red Sun image	2.7	7.2
Racket Ball image	1.8	1.8
Green Sun image	1.8	6.3
Glacier image	0.9	1.8
Mt. St. Helens Eruption image	0.9	0.9
Dynamic Universe image	0.9	0.9
Bursting Balloon image	0.0	0.9

Behaviors at Each Exhibit

As noted earlier, the observer noted six behaviors at interactives, multimedia, and hybrids as well as two unique exhibits (Plant Dance and Web Kiosk): doing the activity, watching others, reading, coaching or being coached, talking about content, and interacting with staff. The observer noted one behavior at videos, specimens, panels, and the Stratograph art: reading aloud and/or talking about content.

In the following sections, tables are provided for each behavior, showing the frequency of that behavior at each exhibit.

Doing the Activity

At 23 exhibits, the observer noted whether visitors did the activity (e.g., sequenced the Blocks of Time, manipulated the water drops at the Water Dropper). As shown in Table 29, most of the visitors who stopped at the Perception Bench, Water Dropper, and Strobe Wheel did the activities at those exhibits.

In contrast, one-third of visitors who stopped at the Plant Dance did the activity. Few visitors who stopped at Exploring Earth Changes and the Coral Core X-ray used the activity.

Table 29
Visitors who Used Exhibit Activities

Exhibit	Number of Visitors who Stopped	Number of Visitors Doing Exhibit Activity
Perception Bench interactive	44	38
Water Dropper interactive	47	32
Strobe Wheel interactive	35	30
Plant Dance whole body experience and panel	70	23
Blocks of Time hybrid	28	20
Sewing Machine Strobe interactive	30	19
Shakers interactive	30	17
Lake Core Bench interactive	32	17
Painting with Time multimedia	29	16
Funny Faces interactive	33	16
Exploring Human Changes multimedia	24	15
Which Took Longer? game multimedia	24	14
Exploring Solar Changes multimedia	17	14
Bones X-ray interactive	23	12
Blink Comparator interactive	14	11
Be a Dog Breeder multimedia	20	10
Dynamic Planet hybrid (use wheel)	21	10
Popcorn Popper interactive	17	9
Cosmic Challenge multimedia	17	9
Expanding Universe Plates interactive	17	9
Web Kiosk	9	6
Exploring Earth Changes multimedia	19	4
Coral Core X-ray interactive	10	2

Watching

At 23 exhibits, the observer noted whether visitors watched others use the exhibit. Many visitors who stopped at the Plant Dance, Water Dropper, and Funny Faces watched others use these exhibits (see Table 30).

Few visitors who stopped at the Web Kiosk, Blink Comparator, Bones X-ray, and Expanding Universe Plates watched others use these exhibits. No visitors who stopped at the Coral Core X-ray watched others use this exhibit.

Table 30
Visitors who Watched Others Use Exhibits

Exhibit	Number of Visitors who Stopped	Number of Visitors Watching Others
Plant Dance whole body experience and panel	70	54
Water Dropper interactive	47	30
Funny Faces interactive	33	25
Painting with Time multimedia	29	19
Perception Bench interactive	44	16
Dynamic Planet hybrid	21	16
Exploring Human Changes multimedia	24	15
Shakers interactive	30	14
Sewing Machine Strobe interactive	30	14
Lake Core Bench interactive	32	14
Exploring Earth Changes multimedia	19	13
Blocks of Time hybrid	28	11
Strobe Wheel interactive	35	10
Popcorn Popper interactive	17	10
Be a Dog Breeder multimedia	20	9
Which Took Longer? game multimedia	24	8
Cosmic Challenge multimedia	17	8
Exploring Solar Changes multimedia	17	4
Web Kiosk	9	2
Blink Comparator interactive	14	2
Bones X-ray interactive	23	1
Expanding Universe Plates interactive	17	1
Coral Core X-ray interactive	10	0

Reading

At 23 exhibits, the observer noted whether visitors read the exhibit text. As presented in Table 31, about one-half of the visitors who stopped at the Perception Bench, Bones X-ray, Expanding Universe, and Coral Core X-ray read exhibit text.

Overall, few visitors read the small text panels accompanying the hybrid and multimedia exhibits. No visitors read text at Painting with Time, Web Kiosk, Which Took Longer?, Dynamic Planet, and Exploring Solar Changes.

Table 31
Visitors who Read at Exhibits

Exhibit	Number of Visitors who Stopped	Number of Visitors Reading
Perception Bench interactive	44	23
Plant Dance whole body experience and panel	70	15
Strobe Wheel interactive	35	13
Bones X-ray interactive	23	13
Water Dropper interactive	47	11
Expanding Universe Plates interactive	17	9
Funny Faces interactive	33	7
Lake Core Bench interactive	32	7
Coral Core X-ray interactive	10	5
Popcorn Popper interactive	17	4
Blocks of Time hybrid	28	4
Exploring Human Changes multimedia	24	4
Shakers interactive	30	3
Blink Comparator interactive	14	2
Sewing Machine Strobe interactive	30	1
Be a Dog Breeder multimedia	20	1
Exploring Earth Changes multimedia	19	1
Cosmic Challenge multimedia	17	1
Painting with Time multimedia	29	0
Web Kiosk	9	0
Which Took Longer? game multimedia	24	0
Dynamic Planet hybrid	21	0
Exploring Solar Changes multimedia	17	0

Coaching

At 23 exhibits, the observer noted whether visitors were coached or coached others as they used the activities. About one-half of the visitors who stopped at Funny Faces or Shakers were coached or coached others at these exhibits (see Table 32).

Overall, coaching occurred infrequently at 9 of the 23 exhibits, and no visitors were coached or coached others at the Coral Core X-ray.

Table 32
Visitors who Were Coached or Coached Others at Exhibits

Exhibit	Number of Visitors who Stopped	Number of Visitors Coaching
Plant Dance whole body experience and panel	70	18
Perception Bench interactive	44	15
Funny Faces interactive	33	15
Shakers interactive	30	14
Strobe Wheel interactive	35	12
Water Dropper interactive	47	11
Sewing Machine Strobe interactive	30	8
Blocks of Time hybrid	28	8
Painting with Time multimedia	29	6
Popcorn Popper interactive	17	6
Lake Core Bench interactive	32	5
Be a Dog Breeder multimedia	20	4
Which Took Longer? game multimedia	24	4
Exploring Human Changes multimedia	24	3
Cosmic Challenge multimedia	17	3
Web Kiosk	9	2
Dynamic Planet hybrid	21	2
Exploring Solar Changes multimedia	17	2
Bones X-ray interactive	23	1
Exploring Earth Changes multimedia	19	1
Expanding Universe Plates interactive	17	1
Blink Comparator interactive	14	1
Coral Core X-ray interactive	10	0

Talking about Exhibit Content

At 23 exhibits, the observer noted whether visitors talked about the content of the exhibits. Nearly one-half of the visitors who stopped at the Water Dropper and Perception Bench talked about their content with other visitors (see Table 33).

Overall, talking about exhibit content occurred infrequently at 21 of the 23 exhibits. No visitors talked about exhibit content at the Coral core X-ray and the Blink Comparator.

Table 33
Visitors who Talked about Exhibit Content

Exhibit	Number of Visitors who Stopped	Number of Visitors Talking about Content
Water Dropper interactive	47	25
Perception Bench interactive	44	19
Plant Dance whole body experience and panel	70	10
Sewing Machine Strobe interactive	30	9
Dynamic Planet hybrid	21	8
Strobe Wheel interactive	35	7
Shakers interactive	30	7
Be a Dog Breeder multimedia	20	7
Blocks of Time hybrid	28	7
Bones X-ray interactive	23	7
Funny Faces interactive	33	6
Which Took Longer? game multimedia	24	6
Popcorn Popper interactive	17	5
Lake Core Bench interactive	32	5
Cosmic Challenge multimedia	17	5
Exploring Solar Changes multimedia	17	4
Exploring Human Changes multimedia	24	3
Exploring Earth Changes multimedia	19	3
Painting with Time multimedia	29	2
Expanding Universe Plates interactive	17	2
Web Kiosk	9	1
Blink Comparator interactive	14	0
Coral Core X-ray interactive	10	0

Interacting with Staff

At 23 exhibits, the observer noted whether visitors interacted with SMM staff at the exhibits. Few visitors interacted with staff at any of the exhibits (see Table 34). No visitor-staff interactions occurred at 18 of the 23 exhibits.

Table 34
Visitors who Interacted with Staff at Exhibits

Exhibit	Number of Visitors who Stopped	Number of Visitors Interacting with Staff
Funny Faces interactive	33	3
Popcorn Popper interactive	17	2
Water Dropper interactive	47	2
Blocks of Time hybrid	28	1
Plant Dance whole body experience and panel	70	1
Perception Bench interactive	44	0
Strobe Wheel interactive	35	0
Lake Core Bench interactive	32	0
Shakers interactive	30	0
Sewing Machine Strobe interactive	30	0
Painting with Time multimedia	29	0
Exploring Human Changes multimedia	24	0
Which Took Longer? game multimedia	24	0
Bones X-ray interactive	23	0
Dynamic Planet hybrid	21	0
Be a Dog Breeder multimedia	20	0
Exploring Earth Changes multimedia	19	0
Cosmic Challenge multimedia	17	0
Expanding Universe Plates interactive	17	0
Exploring Solar Changes multimedia	17	0
Blink Comparator interactive	14	0
Coral Core X-ray interactive	10	0
Web Kiosk	9	0

Reading Aloud and/or Talking About Content (Non-interactive Exhibits)

At 26 non-interactive exhibits (e.g., panels, specimens, videos), the observer noted whether visitors read text aloud or talked about exhibit content. Nearly one-half of the visitors who stopped at the Rotting Fruit exhibit and more than one-third who stopped at the Stratograph Art read text aloud and/or talked about exhibit content (see Table 35). Reading aloud and talking about exhibit content occurred infrequently at 8 exhibits and did not occur at all at 12 exhibits.

Table 35
Number of Visitors that Read Aloud and/or
Talked About Content at Non-interactive Exhibits

Exhibit	Number of Visitors who Stopped	Number of Visitors Reading Aloud/Talking about Content
Rotting Fruit specimen	48	22
Stratograph art	41	15
Erosion/rust specimen	25	8
Reflectory video	41	6
Timescale super graphic panel	18	6
Wolf/Dog Skulls specimen	18	5
Dazzling Images video	16	3
Stratograph rail panel	8	2
Fungus rail panel	3	2
Industrial Secrets rail panel	19	1
Ice Core photo and panel	10	1
Museum Conservation rail panel	6	1
Lake Core specimen/flip panel	6	1
Big Bang panel	5	1
Public Spaces rail panel	9	0
Reflectory panel	7	0
Drilling for Ice rail panel	6	0
Radio Telescope rail panel	5	0
Human Perception panel	2	0
Muybridge rail panel	2	0
Coral Seismographs panel	2	0
Life area header panel	1	0
Collecting Lake Cores rail panel	1	0
Universe area header panel	1	0
Tools area header panel	0	0
Earth area header panel	0	0

II. PRINCIPAL FINDINGS: INTERVIEWS

BACKGROUND INFORMATION

RK&A conducted interviews with a random sample of visitors after they exited *Playing with Time* in April and June 2002.

Thirty visitor groups were interviewed, comprising 70 visitors (41 adults and 29 children). Fifty-one percent of the interviewees were male and 49 percent were female. Adults ranged in age from 19 to 68 years, with the median age being 39 years. Children ranged in age from 7 to 17 years, with the median age being 11 years.

Twenty-four percent of interviewees were visiting the Museum for the first time. Of repeat visitors, 47 percent had visited once or twice in the past 24 months, 38 percent had visited three or more times, and 15 percent had not visited the Museum at all.

None of the interviewees had seen *Playing with Time* before to the day of the interview.

OVERALL OPINION OF *PLAYING WITH TIME*

All interviewees made positive remarks about *Playing with Time*. They praised the exhibit activities, visuals, and content, suggesting that the exhibition appealed to both adults and children. Many experiences and ideas in the exhibition surprised interviewees. They characterized the exhibition as unique and mind-bending.

To begin the conversation, interviewees were asked their overall opinion about *Playing with Time*. Many interviewees complimented the exhibits' hands-on quality. Children said the exhibition was "fun" because it included "stuff you can touch and play with" and "lots of things to mess around with." Adults and teens enjoyed manipulating strobe lights, high-speed cameras, and animations (see the first quotation below). In particular, interviewees said they were amazed by the Dynamic Planet and the Water Dropper (see the second and third quotations). Some adults also enjoyed the time-lapse photography both still and video form (e.g., the Reflectory video, the Blocks of Time, the Racket Ball image). A few parents said the exhibition was educational because of the variety of "working examples" it provided.

*It [the exhibition] was fun. **It had simple directions. (What made the exhibition fun?)
*I think the slow-motion replay cameras and . . . the strobe lights. (What did you like about those?) I think the flexibility of it to do different things. [The devices] are not . . . enclosed in a cage [where] you can't touch them. . . . **Just being able to do different things and use all the stuff yourself is fun. [Male, 27 and Female, 24]

It's [the exhibition was] very interesting. I think it's an excellent thing. (What in particular did you like about it?) I liked everything. It's all new. I liked the biological changes on the Earth—being able to program things in time frames and [watch] the vegetation changes, the

raising [of] the oceans, and that kind of thing. . . . It's interesting to see all those changes. It's a great way to visualize all those changes—to be able to move through time. [Male, 67]

I liked it [the exhibition]. (What did you like about it?) I liked some of the exhibits, like with the strobe light [and] the water dripping. I was showing her how things could go slower or faster. I liked some of those [exhibits that] let you slow down things so you can see what's happening. That really wowed her. *I couldn't believe it. It looked like the water was going back into the [faucet]—backwards. It was really cool. [Female, 44 and Female, 7]

In addition to praising specific exhibits, some adults noted that the exhibition's content was “clever” and unexpected (see the first quotation below). In particular, several were intrigued by the way the exhibition showed changes over time and how technology can be used to make changes beyond human perception visible (see the second and third quotations).

I found it [the exhibition] very interesting. I thought it was different. Very avant guard. I found it to be something that I would not find in a museum. (Was it because of the activities, or the content, or the look of it?) The combination of all three of those things, I found unusual in a museum. The concept itself and the images are beautiful. It's not your typical science museum exhibit. [Female, 45]

*It [the exhibition] was very interesting, seeing the time changes. There's one exhibit that was mixed in with the TV [monitor]. You got to see the changes of atmosphere, of population. **Yeah the population—that was the most interesting. How the population has just exploded over time. It just made [me] think [about] something I'd never thought about—how things change over [long] amounts of time. *And short time [spans], too. It was really interesting. [Female, 12 and Male, 35]

It [the exhibition] was really cool. It's amazing—like with the water that it falls in drops but you can't see [them] until you use the strobe [light] to change your perspective. [Female, 27]

Interviewees were asked how well the exhibition had worked for adults and children in the group. Overall, adults and children enjoyed the activities. Adults and teens said the content was appropriate, although visitors with children younger than ten said the content was somewhat “over the heads” of their children. However, they noted that their children could still have fun at the interactive exhibits even if they did not understand the information. Two quotations below exemplify interviewees' responses.

(The people who made this exhibit wanted it to appeal to both adults and children. How well do you think it accomplished that?) *It was a terrific exhibit, and it was especially fun because of all the interactive portions. It wasn't just looking at something still or animated and reading, but it was actually hands-on which always makes it more fun. Not just for little kids, but the big kids, too. **I think it did that great because . . . a lot of kids [are] enjoying it, and a lot of grown ups. I just like it. *I think both the kids were able to understand it, and as an adult I was able to understand it. And there were some things like the space game over

there too, where the kids and the adults could interact, because it didn't matter what age you were, the questions were generic and you had a chance to see how well you could answer. [Male 45, and Female, 8]

(The people who made this exhibition wanted it to appeal to both adults and children, so for you as an adult, how well did it work for you?) I thought it was very good for adults, although I'm not so sure how far down the line you can go with children. Somebody that's eight, or nine, or ten maybe. My grandson is four, [and] I don't think this would work well for him. (Why is that?) I think it's just a little bit over his head. I mean he'd play with the things, but he really wouldn't know what he's playing with. [Male, 67]

PEAK EXPERIENCES

Overall, interviewees' opinions about the exhibits varied. However, interviewees often said the Water Dropper was both fun and interesting. Some also gave similar praise to the Plant Dance and the Strobe Wheel. Several interviewees characterized Funny Faces as particularly fun, and several others identified Dynamic Planet as most interesting.

Many interviewees did not find any of the exhibits disappointing. A few had difficulty operating the high-speed cameras or complained that popular exhibits should be duplicated to prevent having to wait in line to use them. Others offered idiosyncratic concerns or suggestions.

Most Fun Exhibit

Interviewees were asked to identify the exhibits that they thought were the most fun. Most interviewees characterized several exhibits as fun. Some interviewees said they enjoyed using Funny Faces the most, while several others liked the Water Dropper (see the first two quotations below). The remaining preferences were idiosyncratic. A few said they liked using the touch screen interface at Painting with Time. Others appreciated the open-exploration provided at the Strobe Wheel (see the third quotation). For a few others, no specific exhibit stood out in their minds, but they preferred watching other visitors interact with exhibits. Two interviewees each identified Plant Dance and Be a Dog Breeder as most enjoyable, explaining that the Plant Dance was a fun outlet for children's creative expression and Be a Dog Breeder for posing a challenge.

I liked the slow motion camera. (Any one in particular?) The one where you shoved your face and you taped it. . . . You could move your tongue and ears. It was funny. [Female, 15]

The water one [was the most fun]. (Why is that?) Just making it look like it's freezing and then going back in was really cool. *It was fun to make the water move [in] different [ways]. [Female, 11 and Male, 12]

My favorite was where the thing turned and it got faster and faster, so it didn't look like it was moving at all. (The one with the different lights?) Yes. Where the thing turns and you look through it. (Why was that so fun?) I liked testing all the things that turned around [at]

different speeds. Because I'd start out [and] it would turn and [then] I would move it all the way to this side and then I'd test to see how slow it went. . . . *We tried out a lot of different things to see what [would] happen. [Female, 8 and Male, 20]

Most Interesting Exhibit

Interviewees were asked to identify the exhibits that they thought were most interesting. Many interviewees named multiple exhibits. Some said the Dynamic Planet was most compelling (see the first quotation below), while several others were fascinated by the high-speed camera exhibits (see the second quotation) or the Water Dropper (for reasons similar to those presented in the previous section). The remaining comments varied. A few interviewees each found the Plant Dance, Expanding Universe, Strobe Wheel, Blocks of Time, and Which Took Longer? most interesting. These interviewees were intrigued by the plant movements, the information about the universe, the stroboscopic effect, the morphing images, or the amount of time it took for different events to happen. One interviewee each said the following exhibits were most interesting: Sewing Machine Strobe, Reflectory video, Wolf/dog Skulls, Block of Time, Erosion/rust samples, Rotting Fruit, and Stratograph Art.

I thought the most interesting one was the one . . . where the continents moved, and it showed the oceans moving. I think that was good. It was interesting to see those global changes. [Male, 20]

The one with the camera where you would shake the items, [and it] shows it in slow motion. (Now what was good about that one?) The fact that you could see the slow motion—how cool the effects were. *The other ones were good to—the popcorn and faces. . . . You don't often get to see things slowed down like that. [Male, 42 and Female, 39]

Most Disappointing Exhibit

Interviewees were asked to identify the exhibits they thought were most disappointing. Many did not find any exhibits disappointing. When a follow-up question was asked to determine whether interviewees had difficulty using any exhibits, most said the exhibits were easy to use (see the quotation below).

All the ones we operated, we found quite simple. The directions were very good. It was just a matter of reading the directions before you started, because I think all the directions were very clear. [Female, 45]

A few thought the exhibition should include duplicates of popular exhibits (e.g., Strobe Wheel, Funny Faces), since they had to wait in line to use them. A few others had difficulty operating the high-speed cameras, especially the Popcorn Popper and Funny Faces (see the quotation below).

*We liked pretty much everything. (Some visitors I've talked with have said there have been a couple of exhibits where it didn't turn out the way they wanted.) *We did the

popcorn thing, [but] we didn't capture it on video. So we didn't quite get it right. [We] either didn't push the buttons at the right time. (It's hard.) And . . . it took a long time for it to go through [the cycle], and then we realized that we didn't tape anything. So we tried it again, but we still didn't get to see it on tape. But it was fun to watch it pop anyway. But we didn't see it in slow motion. **Yeah, when it popped the screen turned black. *We had taped it too soon. . . . But I thought the easier exhibit to do was . . . filming yourself shaking the different items and shaking them at a super high speed and you could watch it in slow motion. It was round objects, water, and different things. That [one] was pretty easy, and it was kind of cool. (Why do you think that one worked for you guys?) *It was just simple. . . . It didn't take long. It was two seconds. (And you were able to capture it on film?) *Yeah, exactly. As compared to the popcorn one [which] was a three minute deal, this [one] was . . . five seconds [and] you could do it. [Female, 42 and Female, 9]

Several interviewees had idiosyncratic complaints or problems with exhibits. One said the exhibit instructions were too hard to read, making it difficult for parents to quickly grasp how to use the exhibit to explain it to their children (see the first quotation below). Another interviewee said the Block of Time was hard to complete and made some suggestions for improving it (see the second quotation). A third interviewee said Playing with Time featured "too many computer-based exhibits" and should have more "hands-on exhibits," while another complained that the Stratograph Art piece was broken because "it didn't do anything." A fifth visitor said the explanation provided for the Water Dropper should be "more pronounced" because visitors would not understand what they were seeing unless they read the small text panel. A sixth one was disappointed that, after waiting in line to use it, the Which Took Longer? multimedia was malfunctioning. Another one did not understand the science behind what he observed at the Sewing Machine strobe, and the final one was confused as to what she was supposed to look for in the microscope slides at the Lake Core Bench.

I have a general comment. Perhaps make . . . the wording in the directions a little bit larger so that everyone can read them easier. For me, if I'm standing over a child trying to read them, sometimes it's hard for me to try to give guidance and try to follow directions. Sometimes I have to sit down and cram right in next to them. Making it easier for the adults to assist [their children] would be good. [Female, 39]

I thought it was tough when we had to put the cubes with pictures of a gymnast in order]. The aging woman . . . was the easiest because you could see, but putting the embryo together and putting the gymnast together in the right sequence was tough. That was pretty fun, but it was tough to do. (What do you think they should change to make those easier to order?) Both were [hard to order] because it's a snapshot . . . of a specific motion. . . . It's easier to watch a sequence and then figure out where the blocks go [than using] a snapshot [to] try to put it in [order]. (So what should they change?) Maybe if they gave you a hint as to what specifically might be wrong or something you could change to see . . . the right way [to order the sequence]. Or after you've tried a couple of times and you can't do it, have them show you the right way. Because you couldn't see what this specific exercise was unless you had it right. [Male, 42]

PERCEPTIONS OF THE MAIN IDEA

Most interviewees perceived at least part of the main message, stating that all the exhibition elements worked in concert to convey a single, coherent idea. The five interviewees who used the Timescale super graphic most fully understood the exhibition.

Main Ideas

Interviewees were asked to describe the exhibition's main idea. Many said the exhibition was trying to show visitors that things change all the time and most of these changes are too fast or too slow for humans to perceive (see the first two quotations below). Some thought the exhibition demonstrated that things change all the time, both slowly and quickly (see the third quotation). Others described the intended message as everything changes all the time (see the fourth quotation).

(What do you think the exhibition is trying to get across to visitors?) That some things move fast and others slow, and it's all changing all the time. *And we miss a lot because we can't see it. [Male, 22 and Female, 24]

[The exhibition is trying to convey] the continuity of time, how time changes, nothing stands still, and our perception of time—slow and fast—and how what we see might not be what we see. Like the example of the little red dot [at Perception Bench]. It's one dot, and as you speed it up it looks like a whole solid field of dots. [But] it's one dot just going fast. You can slow it down; it's one dot [again] slowly making its way across the screen. [Male, 45]

[The exhibition is trying to convey] that everything, everything changes over time. Not suddenly, but everything does. Some over long periods of time and other things change fast. [Female, 14]

[The exhibition is trying to convey] how things change over time, what happens. How everything is changing all the time. [Male, 38]

Seven interviewees did not perceive any of the intended messages. Four did not see a central theme for the exhibition but rather experienced the exhibits as separate entities (see the quotation below). The other three said the main idea was, "When you speed up or slow down time, it makes things different visually."

I don't know if there's any specific theme because everything was so different. I mean you have phases of the moon, then you have [Mt.] St. Helens—all these different scientific types of things. But I don't know if there's really a theme. (Did you see any connection between the parts or did you think of them as separate?) I treated them all as separate. [Male, 67]

Exhibits that Conveyed the Main Idea

Interviewees were asked which aspects of the exhibition helped them perceive the main idea. Most said all the exhibition elements—from the activities to the images to the text—worked

together to convey the intended message (see the first quotation below). Several added that the “diversity of topics” covered by the exhibition reinforced the idea that things are changing all the time, while two specifically mentioned the Life and Earth sections by name (see the second and third quotations). In contrast, a few interviewees said the “strobe” and “slow motion” activities conveyed the idea that many changes occur too fast for humans to see.

(What in the exhibition helped you to know that [the main idea]?) The fruit thing [Rotting Fruit] and . . . in there [the Reflectory video]—with the changing of the landscape stuff. (Anything else?) Just everything. The stuff with the strobe—the falling water—the little experiments you could do. [Male, 28]

(What in the exhibition helped you to know that [the main idea]?) Just the variety. . . . It gave like all the way from a really long time to short distances of time. *And everything in between. [Male, 22 and Female, 20]

*I think if you read some of the signs . . . and just looked at the exhibits you’d get that [the main idea]. It’s all connected. (How so?) **The connection for me was seeing that everything changes over time—life on earth, the earth itself, everything changes, so that’s the connection. And they were trying to show you [that] for each of the exhibits. [Male, 14 and Male, 45]

When asked whether they used the Timescale super graphic, most said they glanced at it but did not read it. They said the panel format of the Timescale did not attract their attention, especially in competition with the interactive exhibits (see the quotation below).

*You know we saw it [the Timescale super graphic], but the kids ran past it. I didn’t get a chance to look at it. The kids just wanted to get to the experiments. **There are lots of fun things in here to do so they’re not going to look at something like this. *Something static. [Female, 39 and Male, 42]

Five interviewees read the Timescale and, of those, one used the blue tombstones at individual exhibits. These interviewees said the Timescale provided them with a richer understanding of the exhibition’s main idea (see the two quotations below).

Yes [I noticed the panel]. (Did you look at or kind of pass by it?) We talked about it actually. (What did you say about it?) We looked at the scale, the timeline thing—talked about how most stuff is too fast or too slow for us to see happen. That’s cool. . . . And it helped you know what this was all about. I mean it says it right there, “Everything changes all the time.” [Female, 20]

Yes [I noticed the panel]. We read it. It tells you all about what you’re going to see—about how things change [at] different speeds. (Did you happen to notice a smaller version of the timeline on the panels throughout the exhibition?) Oh, yeah. It was helpful. It told you [at] what speed it was happening—like within human time span or not. [Male, 45]

APPENDICES

APPENDIX A

***Playing with Time* Tracking and Timing Observations**

Removed for proprietary purposes

APPENDIX B
Interview Guide

Removed for proprietary purposes

APPENDIX C

List of Statistical Analyses Run on the Observational Data of *Playing with Time*

ANOVA or Mann-Whitney U Test

Gender		Total time
Adults vs. children	X	Total stops
		Total notices/studies
		Time spent in each section of the exhibition
		Total stops made in each section of the exhibition
		Time spent at each type of exhibit
		Total stops made at each type of exhibit
		Total number of behaviors displayed at each type of exhibit

APPENDIX D
Exhibits by Type

Panel	Interactive	Multimedia	Specimen	Hybrid	Video
Title	Perception Bench	Painting with Time	Wolf/dog Skulls	Blocks of Time	Dazzling Images
Timescale super graphic	Funny Faces	Be a Dog Breeder	Rotting Fruit	Dynamic Planet	Reflectory video
Reflectory panel	Strobe Wheel	Exploring Human Changes	Erosion/rust		
Human Perception	Popcorn Popper	Which Took Longer?	Lake Core		
Industrial Secrets	Water Dropper	Exploring Earth changes			
Radio Telescope	Shakers	Painting with Time			
Public Spaces	Sewing Machine	Be a Dog Breeder			
Museum Conservation	Bones X-ray	Exploring Human Changes			
Tools area header	Coral Core X-ray	Which Took Longer?			
Fungus	Lake Core Bench	Exploring Earth changes			
Life area header	Cosmic Challenge	Painting with Time			
Ice Core	Expanding Universe Plates	Exploring Solar Changes			
Drilling for Ice	Blink Comparator				
Coral Seismographs					
Stratograph					
Collecting Lake Cores					
Earth area header					
Big Bang					
Universe area header					
= 19 exhibits	= 12 exhibits	= 7 exhibits	= 4 exhibits	= 2 exhibits	= 2 exhibits

Three exhibits were unique: Plant Dance whole body experience, Web Kiosk, and Stratograph Art.