Science on the Sphere:
Formative Evaluation for Pacific Science Center

Pacific Science Center, Seattle, WA

Formative Evaluation

New Directions Project

2012-2013

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Executive Summary

This evaluation examines visitor engagement at the "Science On a Sphere" (SOS) exhibit at Pacific Science Center, Seattle, WA. Evaluators varied characteristics of the data presentation—such as topic presented, presence of a question prompt, and image rotation—and measured the resulting visitor engagement for each of the different treatments. Furthermore, the evaluation examined visitors' interest in the SOS exhibit, as well as the extent to which visitors connect the exhibit to surrounding exhibits.

This study examines different treatments to the SOS exhibit to determine the presentation elements that affect visitor engagement and interest with the exhibit without the use of interpreters. The team addressed the following evaluation questions: (1) Which presentation elements engage visitors most effectively? (2) What is the nature of visitor engagement with the SOS and its space during the auto-run program? (3) What are visitors most interested in seeing? (4) To what extent are visitors making a connection between the sphere and the surrounding exhibits/ programs?

The team collected observational data during presentation of twelve playlists on the sphere, each created with different combinations of the variables listed above. Follow-up interviews were used to determine visitors' reported engagement and interest. The reflective map and interviews were used to explore possible connections made by visitors between the SOS exhibit and surround exhibits.

Key findings include

- Question prompts led to increased visitor stay-time and more engagement behaviors
- There is no relationship between the discipline of the dataset (astronomy, oceanography, geography) or anything else. Each dataset stands on its own
- Visitors reported they were interested in colorful, dynamic datasets
- Visitors reported being uninterested due to a lack of interpretation and the datasets playing too long
- Behaviors and stay-times are significantly and positively correlated
- Visitor discussions most frequently focused on explaining the content of the sphere
- 36% visitors who saw the sphere stopped to look at it
- Groups of adults tend to stay longer than groups with more children
- Children influence whether or not groups engagement with the sphere
- The majority of visitors do not make a connection between SOS and surrounding exhibits

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Project Background

Pacific Science Center in Seattle, WA began as the Science Pavilion at the 1962 World's Fair. Following the fair, the pavilion was renamed Pacific Science Center, the first U.S. science and technology museum. Throughout their 50-year history, the museum has sought to inspire creativity, learning, and interest in math, science, and technology. The museum reaches audiences through high levels of engagement and interactivity in both exhibits and programs.

"Science On a Sphere" is six-foot diameter sphere animated with dynamic planetary displays. Science On a Sphere (SOS) was developed by the National Oceanic and Atmospheric Administration (NOAA) to help explain complex environmental processes to people of all ages in a way that is captivating and intuitive. Computers and projectors display information and data on the sphere while a few pillars of information around the edges of the exhibit explain to visitors what the sphere is and what it's doing. Actual data displayed on the sphere relates to astronomy, earth science, and other dynamic phenomena. PSC has the ability to control certain aspects of these datasets, including rotation, orientation, and the addition of captions. The adjacent exhibits in the area (Building 2) are meant to correlate with the displayed content, providing visitors with an additional source for information, which is not interpreted at the Sphere itself. At PSC, visitors can interact with SOS in three different types of presentation:

a) Auto-run: an un-facilitated program generated for the Sphere that automatically cycles through various datasets displaying different Earth and Space 'views' accompanied by minimal on-screen signage.

b) General Interpretation: facilitated by both adult Science Interpreters and PSC Discovery Corps youth, these are small-group interactions between Interpreter and visitors where the Interpreter can be more flexible in their content discussion and presentation and be guided by the visitors' interests.

c) Full Demonstration: facilitated by both adult Science Interpreters and PSC Discovery Corps youth, these are large-group, scripted presentations lasting about 15 minutes about a particular topic (e.g. global warming, currents, earthquakes, etc.).

For this study, we focused on solely evaluating the auto-run sequences to better understand the visitors' current un-facilitated use of SOS. This information will help PSC optimize future displays to effectively convey science and encourage audiences to engage in

inquiry-based learning. There have been no evaluations of SOS at Pacific Science Center since its installation in 2010.

The primary audience for this study was adults and family groups that have visited SOS. Due to the diverse nature of the visitors at PSC, specific demographics (ages, genders, etc.) was not targeted.

Initially funded by the Institute for Museum and Library Services, "*New Directions in Audience Research* is a special initiative of the University of Washington Museology Graduate Program partnering with the Woodland Park Zoo. *New Directions* is designed to train Museology graduate students to understand, support and engage in audience research and evaluation within informal learning settings. A key component of the training is partnering with local museums who serve as learning laboratories where students work to conduct on-site audience research, under the guidance of evaluation mentors and support staff."

Purpose Statement:

The purpose of this study is to evaluate different treatments of Science on a Sphere (SOS) at Pacific Science Center to determine the optimal methods for SOS to present the data/science while engaging visitors without the use of Interpreters. This study is a formative evaluation that creates a base line dataset illuminating the ways visitors interact with the auto-run program. Pacific Science Center can then use these findings to inform future decisions and changes to the program. The Science on a Sphere program is a relatively new technology and the data could also be of use to other science centers as they develop similar programs.

Evaluation Questions:

Our evaluation questions are listed below:

1. Which presentation elements engage visitors most effectively?
2. What is the nature of visitor engagement with the SOS and its space during the auto-run program?
3. What are visitors most interested in seeing?

4 To what extent are visitors making a connection between the sphere and the surrounding exhibits/programs?

Engagement was determined through a combination of observation of behaviors, stay-time, and self-reported behaviors that reflect engagement, such as having conversations about the information on the sphere. Interest was determined by self-reported interest in the content and characteristics of the various datasets by visitors.

Literature Review

A number of evaluations have been conducted at various locations where the Science on a Sphere is on display. These evaluations provided some baseline for comparison for the current study, as well as providing the source of some of our recommendations.

As a part of their summative evaluation of the Science on a Sphere exhibit at several different sites, the Institute for Learning Innovation (ILI) compiled a literature review on data visualization systems and their effects on learning, especially 3-D data visualizations. A number of studies confirm the benefits of science visualizations in reducing the amount of effort needed to solve a scientific problem, help in the construction of mental models, enable visitors to understand complex scientific problems more completely, and help visitors to understand dynamic concepts through the use of animation. However, little research has been done to show how 3-D data visualization aids the learning process (see Haley Goldman et al., 2010). More research on 3-D visualization learning aids should be conducted in order to develop a strategic framework on how to optimize the effectiveness of this platform. It is beyond the scope of this evaluation to determine the effectiveness of the sphere as a 3-D learning aid as compared to other mediums of presentation. However, this study aims to optimize a particular instance of a 3-D visualization program, which may inform future studies.

Several of the evaluations provided information of visitor behavior around the exhibit, including visitor stay-time. Various factors appear to affect stay time, including interpretive

panels or labels, seating, the exhibits surrounding the SOS exhibit, and group dynamics [1]. A front-end evaluation done at the Science Museum of Minnesota in 2006 found that visitors stayed for an average of about 3 minutes to observe the sphere. After providing seating for the space, including more interpretive panels, and adding audio to some datasets, stay-time increased to about 3 minutes and 30 seconds. This is far above the median stay time found in the 2008 Randi Korn evaluation at the Tech Museum of Innovation, which found visitors stayed for an average of about 1 minute. While it is uncertain what caused the differences in stay-time between the two sites, it does indicate the variability of visitor behaviors around the Science on a Sphere exhibit. This may be a result of multiple contextual factors that influence visitor interactions with the exhibit. This evaluation analyzes context dependent variables, such as how information on the sphere relates with surrounding exhibits, and variables that are independent of the surrounding setting by analyzing content and visual characteristics of the datasets.

Furthermore, the evaluations conducted at the Science Museum of Minnesota indicated that visitors made use of the space around the sphere, but were confused where to stand. 63% of visitors were observed to circle at least half the sphere in the front-end evaluation, although only 48% of visitors did so during the formative evaluation [2]. The evaluation at the Maryland Science Center also found that visitors liked being able to walk around the globe, although some visitors wanted a chance to sit down and look at the exhibit [3]. About half of the visitors interviewed during the front-end evaluation did indicate confusion about where to stand while at the exhibit, especially while certain datasets were playing that highlighted a localized event on the globe [4]. Based on these findings, this evaluation compares visitor responses to and interactions with the

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[1] Randi Korn, "Summative Evaluation of Green by Design and View from Space" (Randi Korn and Associates, Inc., May 2008); Amy Grack Nelson, "Science on a Sphere: Formative Evaluation Report" (Science Museum of Minnesota, July 2006).

[2] Nelson, "Science on a Sphere: Formative Evaluation Report"; Amy Grack Nelson and Kirsten Ellenbogen, "Science On a Sphere: Front-End Evaluation Report" (Science Museum of Minnesota, May 25, 2006).

[3] Alice Apley, "Science on a Sphere Front-end Evaluation" (RMC Research Corporation, August 20, 2004).

[4] Nelson and Ellenbogen, "Science On a Sphere: Front-End Evaluation Report."

exhibit while the datasets are stationary and while they are rotating to determine if this is an effective solution.

Several studies addressed visitor reactions to the exhibit and the learning outcomes visitors identified with. Visitors most often commented on realistic and visual nature of the sphere. In the evaluation conducted by ILI, over one-third of the visitors stated that it is the realism of the data on the sphere that stayed with them, and nearly a third said that the sphere helped them visualize specific events [5]. This echoes the findings at the Maryland Science Center, where visitors mentioned that the 3-D presentation of the information made the information more "tangible." They also stated their interest in seeing localized events such as Hurricane Isabel [6]. Many visitors also mentioned that the exhibit helped them to comprehend certain concepts of time and scale [7]. However, these studies do not systematically look at various factors or components of the SOS programs that have an effect on visitor responses to the exhibit. This evaluation will provide information on aspects of the SOS program that lead to a successful learning experience.

A large number of visitors reported learning something from the exhibit. Goldman et al. found that 71% of visitors believed they learned something from the Science on a Sphere exhibit. However, about 88% of visitors who had facilitated experiences with the exhibit reported learning something new, as compared to 66% of those who did not have a facilitated experience[8]. This suggests the effectiveness of facilitated programs over the auto-run experience. The purpose of the current evaluation is to better understand how to increase the effectiveness of the auto-run experience to more closely reflect the effectiveness of the facilitated experience.

Of those who believed they learned something, most reported that they learned process-based information, information about specific events or directly human-related issues, or primarily

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[5] Haley Goldman, Kessler, and Danter, "Science on a Sphere: Cross-site Summative Evaluation."

[6] Apley, "Science on a Sphere Front-end Evaluation."

[7] Ibid.; Haley Goldman, Kessler, and Danter, "Science on a Sphere: Cross-site Summative Evaluation."

[8] Haley Goldman, Kessler, and Danter, "Science on a Sphere: Cross-site Summative Evaluation."

geographic information [9]. Visitors who viewed atmospheric datasets were more likely to report learning something from the exhibit than those who viewed other types of datasets [10]. While the ILI study found that there was no correlation between any other datasets and self-reported learning, the study at the Maryland Science Center found that visitors found the datasets about continental drift, global warming, weather, Earth at night, and Mars datasets most memorable [11]. While the current study does not focus on an analysis of the effectiveness of different information-content between various datasets, the findings of these previous evaluations may help host institutions create playlists for the SOS that further optimize the learning experience with the exhibit.

Some of the responses from visitors indicated areas for improvement on the exhibit. The front-end evaluation at the Science Museum of Minnesota indicated that visitors would like to see temporary labels appear on the exhibit to point out important features or pieces of information [12]. When labels were included, 82% of visitors were observed reading the labels [13]. In both evaluations, visitors mentioned that they were disappointed that they could not see the top of the globe, which was also mentioned in the evaluation at the Maryland Science Center [14]. The Randi Korn & Associates evaluation of the Science on a Sphere exhibit at the Tech Museum of Innovation suggests that a more explicit approach to connecting content on the sphere and the

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[9] Apley, "Science on a Sphere Front-end Evaluation"; Haley Goldman, Kessler, and Danter, "Science on a Sphere: Cross-site Summative Evaluation."

[10] Haley Goldman, Kessler, and Danter, "Science on a Sphere: Cross-site Summative Evaluation."

[11] Apley, "Science on a Sphere Front-end Evaluation"; Haley Goldman, Kessler, and Danter, "Science on a Sphere: Cross-site Summative Evaluation."

[12] Nelson and Ellenbogen, "Science On a Sphere: Front-End Evaluation Report."

[13] Nelson, "Science on a Sphere: Formative Evaluation Report."

[14] Apley, "Science on a Sphere Front-end Evaluation"; Nelson, "Science on a Sphere: Formative Evaluation Report"; Nelson and Ellenbogen, "Science On a Sphere: Front-End Evaluation Report."

surrounding exhibits, as visitors did not seem to comprehend the cohesiveness of the exhibition area [15].

The current evaluation seeks to evaluate the effectiveness of some of the recommendations at the Pacific Science Center. The evaluation will test the effectiveness of questions that appear on each dataset to prompt the visitor to explore important features or ideas brought up in the dataset. Furthermore, the evaluation seeks to understand how visitors connect the information presented on the sphere to surrounding exhibits. This may provide useful information on how to create a more cohesive learning experience with the sphere in the context of the exhibition area around it.

Dataset Selection

For this evaluation, we set up a schedule for testing presentation method variables. An auto-run sequence of Science on a Sphere consists of un-facilitated set of different datasets on different subjects played in sets or playlists for specific amounts of time. The SOS has the capacity to remain static or to rotate during any particular dataset or playlist in an auto-run sequence. It also has the capacity to display information, like questions or legends relating to the datasets playing on the sphere. The datasets used in the playlists, duration or their time on the sphere screen, question, and the rotation of SOS can are all controllable variables. The datasets are produced through open sourcing, so the legend is not always a variable that can be manipulated.

For this study, we used three primary playlists (A, B, and C) with three derivatives each, as indicated below. "R" indicates playlists with rotation, while "Q" indicates playlists with a question. The base playlist does not have questions or rotation. Each playlist was tested with rotation, with a question, with rotation and a question, and tested without rotation or a question. To test the connections visitors made to surround exhibits, datasets were restricted to topics that are discussed somewhere in the museum. The final topic selections were astronomy, earth science (excluding oceans), and oceanography. Dataset playtime duration was kept at the default length of three minutes. No screensavers or interrupting material was played between datasets.

Playlists A and B have the same organization but different datasets while playlist C is a much larger group of datasets, but follows the same organization as A and B. A and B include

[15] Korn, "Summative Evaluation of Green by Design and View from Space."

one dataset on each of the following themes: astronomy, earth science (excluding oceans), and oceanography. Playlist C follows this same organization, but has three on each topic, arranged to create clusters of three datasets on a theme.

All selected datasets needed:

- Some sort of animation (e.g., swirling clouds or solar flares)
- Be easily modified (e.g., meaning it could rotate or be still)
- Include a legend (where applicable)
- Not be covered in too many captions or interpretation
- Be able to have a meaningful question asked about it
- Some connection to PSC programs or exhibits
- An identifying label, such as "Jupiter" (datasets without one built in had a label added)

Figure 1 details which datasets were chosen for each playlist.

Figure 1: Dataset Playlists

Code	**Datasets**
A, A+r, A+q, or A+r+q	Jupiter, Real-time Earthquakes, Ocean Drain
B, B+r, B+q, or B+r+q	X-ray Sun, Carbon Tracker, Ocean Currents
C, C+r, C+q, or C+r+q	Jupiter, X-ray Sun, Polar-orbiting Satellite, Real-time Earthquakes, Carbon Tracker, IR Real Time Weather, Ocean Drain, Ocean Currents, RT SST (Ocean temperature)

The questions developed for the question prompt and displayed on the SOS screen all had a similar structure and age level. These questions had an answer, but were not answerable with a simple "yes/no." They were developed to be answerable given the information presented in the dataset on the sphere; however, no explicit answers were displayed on SOS at any time. The questions were:

Figure 2: Question Prompts

Topic	Dataset	Question
Astronomy	Jupiter	"Where is the worst weather on Jupiter?"
	X-ray Sun	"Where do you think the next solar flare will occur?"
	Polar-orbiting Satellite	"How long does it take for this satellite to cover the earth?"
Earth Science	Real-time Earthquakes	"Where are earthquakes most frequent?"
	Carbon Tracker	"When is there the most carbon?"
	IR Real Time Weather	"Where are the major storm systems happening today?"
Oceanography	Ocean Drain	"Where is the deepest part of the ocean?"
	Ocean Currents	"Where are the fastest moving ocean currents?"
	RT SST (Ocean temperature)	"Where does the ocean temperature change the most?"

Timeline

The timeline for this project was as follows:

- August-September – select projects; assemble team
- 9/25/2012 – meet with stakeholders to determine desires and expectations
- October – refine variables to test; literature review and research of previous SOS evaluations
- November – develop instruments and Evaluation Plan
- 12/02/2012 – Submit final version of Evaluation Plan
- 12/03/2012 - Evaluation Plan presentations to the public
- December-January – pilot testing and instrument revision; collect baseline data
- 2/6/2013 – train first year New Direction's evaluators
- 2/8/2013 – data collection and data entry begins
- 3/8/2013 – data collection ends
- 3/9/2013 – begin data coding and analysis

- 4/28/2013 – data entry complete
- 5/4/2013 – data analysis complete
- 5/28/2013 – present findings to PSC
- 6/3/2013 – finalize VSA poster
- 6/5/2013 – create YouTube digital snapshot of evaluation project
- 6/11/2013 – distribute final report

Collection Schedule

The data collection schedule was designed to work around the first-year data collector's class schedule, as well PSC's evaluation schedule, and our own personal schedules. All playlists were tested in the morning and in the afternoon, and on a weekday and weekend. The following calendar outlines when which playlist was evaluated.

Figure 3: Data Collection Calendar

Jan. 27	28	29	30	31	Feb. 1	2
3	4	5	6 Training 9am—11am	7	8 Data Collection 10a—12p (A) 1p—3p (A + r)	9 Data Collection 10a—12p (A) 1:15p—3:15p (A + r)
10 Data Collection 10a—12p (A+q) 1:15p—3:15p (A+r+q)	11	12	13	14 Data Collection 10a—12p (A+q) 1p—3p (A+r+q)	15 Data Collection 10a—12p (B+r) 1p—3p (B + q)	16 Data Collection 10a—12p (B+q) 1:15p—3:15p (B)
17 Data Collection 10a—12p (B+r+q) 1:15p—3:15p (B + r)	18 Data Collection 10a—12p (B+r+q) 1p—3p (B)	19 Data Collection 10a—12p (C) 1p—3p (C+r+q)	20	21	22 Data Collection 10a—12p (C + r) 1p—3p (C + q)	23 Data Collection 10a—12p (C+r) 1:15p—3:15p (C + q)
24 Data Collection 10a—12p (C+r+q) 1:15p—3:15p (C)	25	26	27	28	Mar. 1	2
3	4 Data Collection *Additional, as needed*	5	6	7	8 Data Collection *Additional, as needed*	9

Methods

The New Directions evaluation team utilized a mixed methods approach to answer the evaluation questions under investigation for this study. Both quantitative and qualitative data were recorded. A critical aspect of our actual evaluation were the controls that we implemented on the programming of the sphere, limiting the scope of our evaluation. Different variables were selected and tested against these controls to determine the level of "success" from each element. The data from our instruments is organized along these guidelines. This information will be explained in more detail elsewhere and informed our suggestions to Pacific Science Center.

The three instruments that were used in the study are:

- Timing and behavior inventory, observing visitors in the SOS exhibit space used for both the duration of the study with team controlled playlists and a baseline study with current auto-run data sets. (See Appendix A)
- Structured interview targeting visitors who interacted with the SOS exhibit. Used as follow-up to timing and behavior inventory. (See Appendix B)
- Reflective mapping instrument asking visitors to recall which areas of Building 2 (exhibits adjacent to SOS) they visited and what they saw and did while there. (See Appendix C)

<u>Sampling Method:</u>

Data collecting days were scheduled to obtain representative sampling of the different groups of visitors on weekends and weekdays. These different groups were analyzed to determine if differences exist between the uses of the space on weekends versus weekdays. The results were compiled to observe universal trends that exist for visitor use of the space. Participants were selected by convenience sampling. Only groups with at least one adult were approached. Only visitors that had entered the area around the sphere were used for the timing and tracking instruments and of these, only visitors engaging in at least one engagement activity while at SOS were approached for the structured interview. Only visitors who had spent time in Building 2 (the space that contains the sphere) were interviewed with the reflective map instrument. School groups, including both the children and adults, were excluded.

Sample Size:

Our target sample size for each instrument was approximately 100-200 responses, allowing for a sampling error of +/- 10%.[16] This number was selected following the guidelines presented in *Practical Evaluation Guide* for a museum with annual visitation of 1,000,000+ visitors. The sample size goal includes: 120-200 timing & behavior instruments, with an additional 30-50 preliminary baseline instruments collected for the current auto-run program; 120 structured interviews which correspond with 120 timing and behavior inventory instruments, to collect a minimum of 10 responses for each of the boxes in the data collection matrix (see Appendix E). Furthermore, we aimed to collect 5-10 more of the timing and behavior inventory instruments without the follow-up interview, bringing the total of this instrument to 180-200. Finally, we wanted to collect 100 reflective mapping exercises.

For all instruments, we met or exceeded our goals. In total we collected 1121 instruments, including the baseline. Please see Results for more information.

Data Collection Plan:

Instrument 1 (A & B): Timing Instrument

This instrument is a short observation instrument to track stay-time at the exhibit while the auto-run program is running. In advance of the collection of data based upon the data sets created for this study, the team conducted a baseline study on playlists already used for the SOS program. This baseline data provided insight into what is currently going on with the auto-run program. To obtain this information the team utilized instrument 1 (detailed below) to track visitor behavior and interaction with SOS under the current auto-run program.

The data collectors used convenience sampling for this instrument. Timing of visitors began once an individual or group of visitors enters into the space around the SOS exhibit, defined by an invisible box of which at each corner sits one of the projector columns. The data collector marked the time on the stopwatch at the end of each dataset that the visitor stays for, and the total time stayed. The data collectors tracked the first individual to enter the space and continue to track their movement and behaviors until the individual leaves the space,

[16] Judy Diamond, Jessica J. Luke, and David H. Uttal, *Practical Evaluation Guide: Tools for Museums and Other Informal Educational Settings*, 2nd ed. (Rowman Altamira, 2009), 48–49.

disregarding any groups or individuals that may enter or exit the area during the time that the current subject is being observed. Data collectors were instructed to continue tracking an individual until the interaction with the space ended, regardless of the engagement with the sphere (e.g., if a visitor sat down on the bench, facing away from the sphere and ate his/her lunch, the data collector still tracked their movements until the visitor left the area); this was done to prevent data collectors from interpreting their own interpretations of what "engagement" meant and excluding visitors we actually did want in this study.

Instrument 1A: Timing and Behavior Inventory

This instrument combines a simple timing and a short checklist of behaviors observed at the Science on a Sphere exhibit. This instrument shows the amount of time a visitor spent at the sphere and any evidence of engagement based on their behavior around the sphere. This data was analyzed to determine how visitors use the space and their overall engagement with the exhibit. Engagement was defined by a set list of behaviors; for a list of these behaviors, please see Appendix A.

The data collectors used convenience sampling of the first adult (not attached to a school group) to pass the invisible boundary of the sphere's area. Tracking followed only one adult visitor at a time, regardless of whether that person was with a group or alone. The data collectors began recording the time and behaviors of the first individual to enter the space and continue to track their behaviors until the individual leaves the space, disregarding any groups or individuals that may have entered or exited the area during the time that the current subject was being observed. The target sample size is 180-200 overall, with 120 corresponding to follow-up interviews.

Instrument 2: Structured Interview (SOS Follow-Up)

The second instrument that used is a short follow-up interview targeting the visitors recorded in Instrument 1. Engagement is defined as having done at least one of the actions on the behavior checklist. The number bar in the top right corner of the instrument was for the visitor number from Instrument 1A to be written in, thereby connecting the two instruments.

Our interviews with visitors provide both qualitative and quantitative data about visitors' interest and level of engagement with the SOS exhibit. It also provides qualitative data about what visitors take away from the exhibit, and to what extent visitors were able to connect the information displayed on the SOS exhibit to information displayed in surrounding exhibits.

The data collectors were instructed to approach all visitors that were tracked in Instrument 1A if, and only if, they engaged in one of the behaviors listed (excluding "sitting on bench facing out"). If a visitor was not approached but engaged in one of the behaviors listed, the data collector was instructed to write down why he/she did not approach the visitor, as the decision was a violation of their instructions. It was meant to be used only in cases where the visitor escaped before the data collector could approach them, or any other factor outside of the collector's control. The data collector engaged the target after the visitor(s) left the space around the SOS exhibit. Only individuals or groups with at least one adult were approached for an interview.

Instrument 3: Reflective Map

The reflective mapping instrument asked visitors to recall which areas of Building 2 they visited and what they saw and did while there. First, visitors were asked to draw their journey on a blank map of the exhibits area, noting aloud and circling any particular areas of interest and where they entered Building 2. Additional follow-up questions were asked once the visitor was done drawing on the map. A data collector wrote down these responses and any addition visitor comments on the side of the instrument with the questions. If the visitor did not circle areas where they stopped, but did say them aloud, the data collector circled the areas on the map. They were also instructed to add an arrow indicating where the visitor started and were headed in Building 2.

Results

Throughout the period of data collection, the research team met our target sample size of each instrument. In total, the team collected:

- Baseline data: 109 instruments
- Behavior tracking: 553

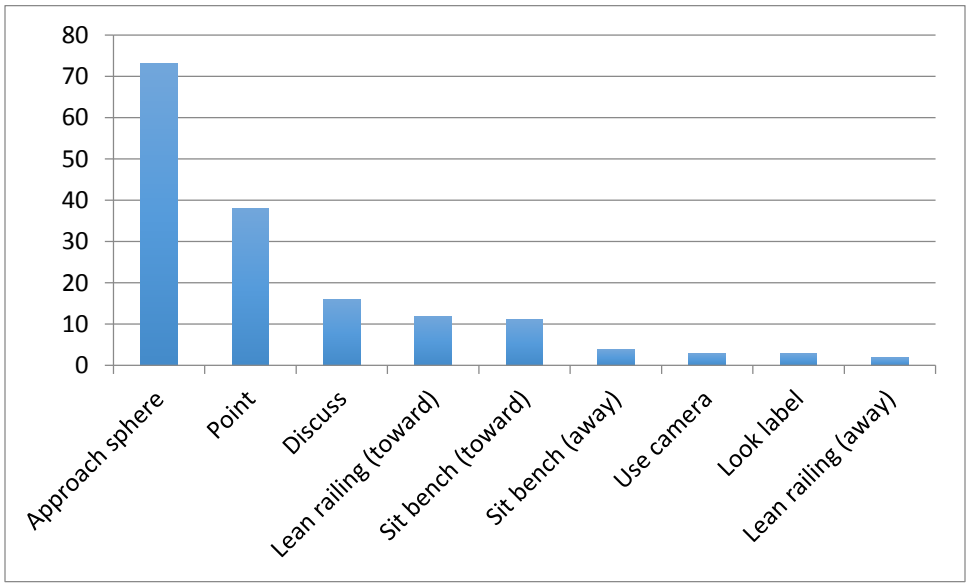
- Behavior tracking follow-up interview: 181
- Reflective mapping: 278

These instruments were entered into Microsoft Access, and analyzed using STATISTICA and Microsoft Excel.

Instrument 1A: Timing & Behavior Checklist (Baseline)

A baseline study was conducted in order to determine visitor engagement and stay-time with the Pacific Science Center's default auto-run sequence on the SOS exhibit before variables were altered for this study. This auto-run sequence included the following datasets: Indian Ocean Tsunami, Static Globe, Ocean Currents, Black Carbon Tracker, Earthquake, IR Real Time Weather, Sea Ice and Snow Cover, and the Static Globe with a logo. Visitors stayed an average of 30.5 seconds around the SOS exhibit while the Pacific Science Center's default auto-run program was playing. The engagement behaviors they most often displayed was approaching the sphere, pointing at the exhibit, and participating in discussions around the sphere (see *figure 4*).

Figure 4: Visitor engagement behaviors (Baseline)



Instrument 1A: Timing & Behavior Checklist (Formative Evaluation)

When examining the data for the timing and behavior checklist, this study found that multiple adults tend to stay slightly longer and show more engagement behaviors at the sphere than groups that had children. Furthermore, the number of engagement behaviors and stay-time

showed a positive and statistically significant correlation, with a ρ-value of 0.45. Therefore, both stay-times and visitor behaviors provided insight into the extent to which visitors engaged with the exhibit.

On average, individuals that were observed engaging with the SOS exhibit stayed at the exhibit for 50 seconds. During the time that visitors were engaged with the sphere, they displayed a number of engagement behaviors. The most common engagement behaviors were pausing to look at the sphere, pointing at the sphere, and engaging in discussion (see *figure 5*). However, both the number of engagement behaviors as well as visitor stay-timed varied when different treatments were applied to the SOS exhibit. During days when a question prompt was projected onto the sphere along with the datasets, engagement behaviors and stay-times were greater than on days when the question was not present (see *figure 6* and *figure 7*). Furthermore, visitors displayed more engagement behaviors and lingered around the sphere longer when specific datasets were being shown. Visitors appeared to be most engaged with the ocean currents, polar-orbiting satellite, and black carbon tracker datasets (see *figure 8* and *figure 9*).

Figure 5: Frequency of Behaviors

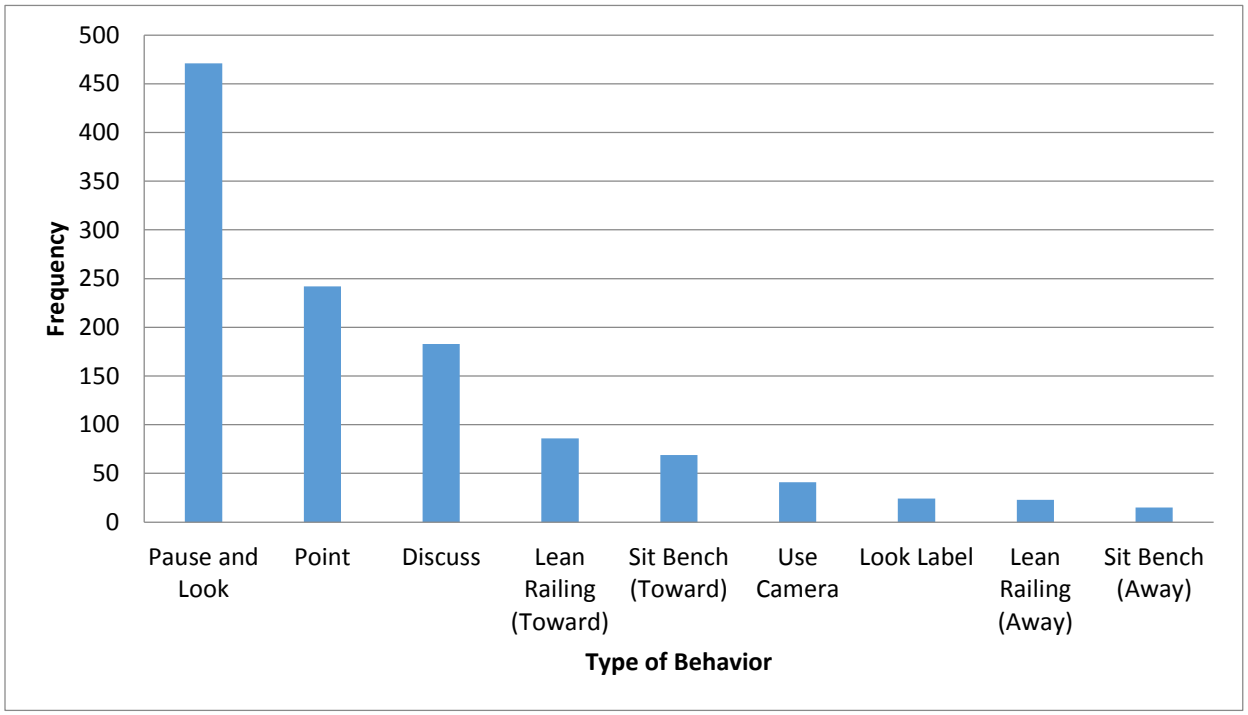


Figure 6: Variables and average number of engagement behaviors

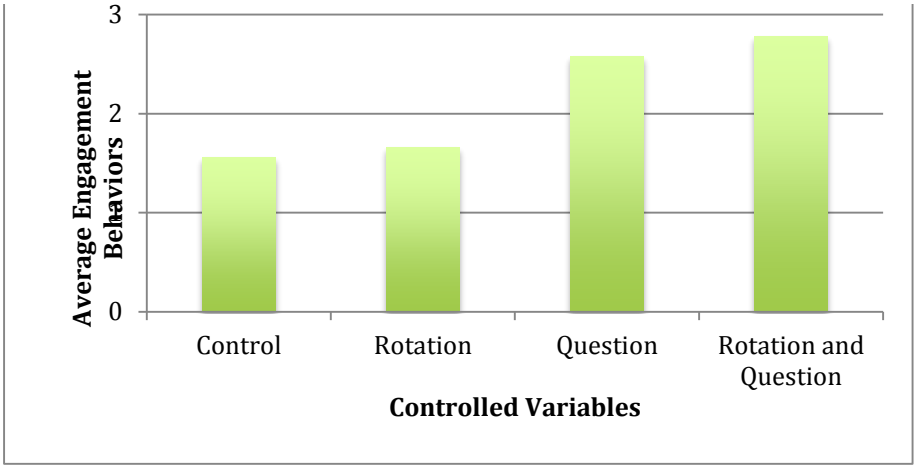


Figure 7: Variables and Average Stay-time

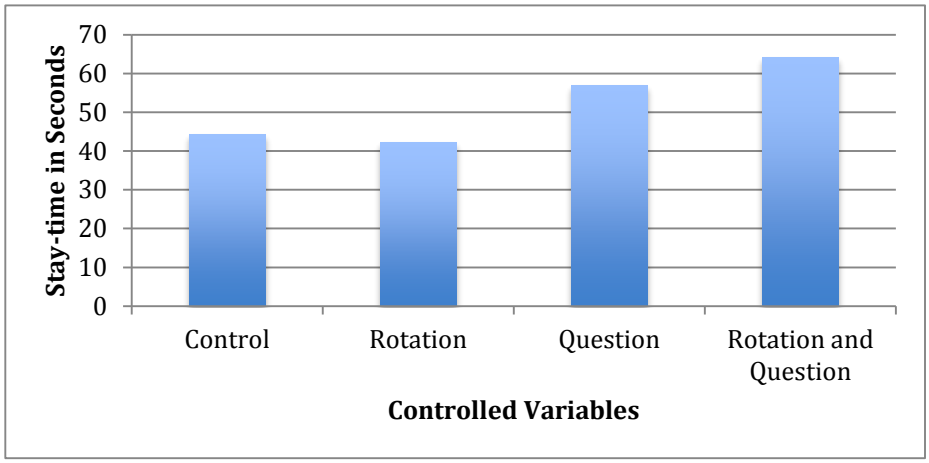


Figure 8: Datasets and Frequency of Engagement Behaviors

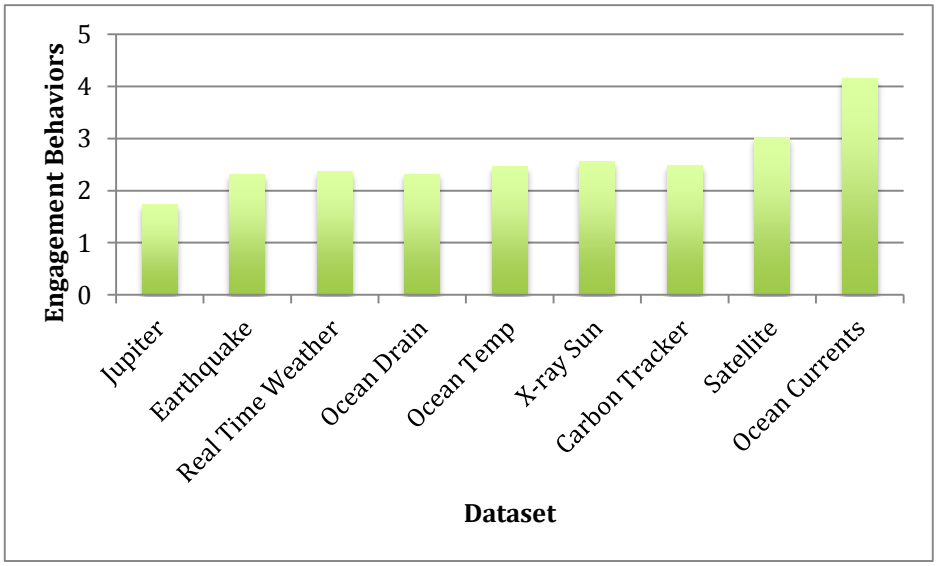
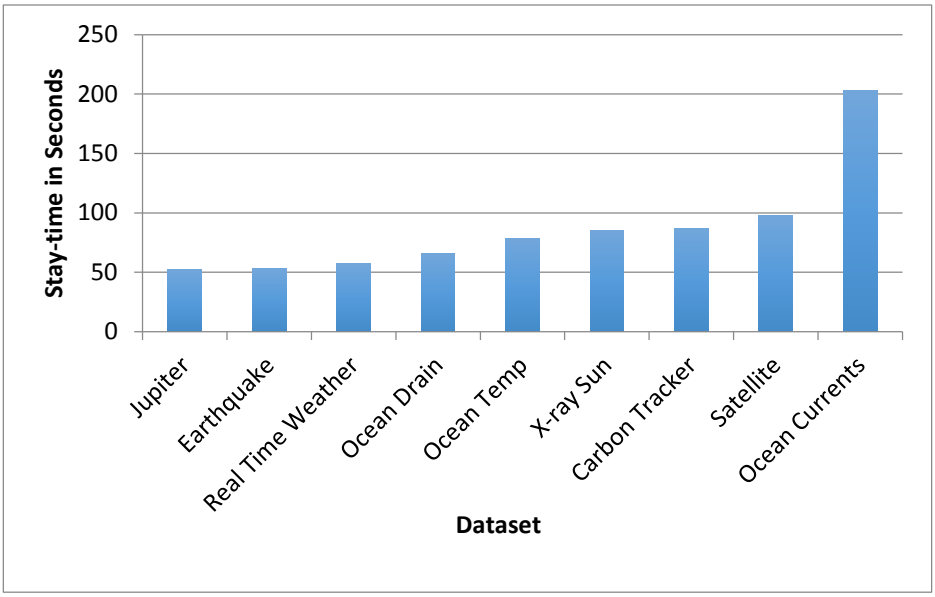


Figure 9: Datasets and Average Stay-time



Instrument 2, SOS Follow-Up Survey Questions (semi-structured)

The results from the survey instrument reveal what was most interesting about the exhibit to visitors, as well as the extent to which they were making a connection between the SOS exhibit and the surrounding exhibits. Participants were also asked to describe 3 things they found on the sphere to be most interesting, as well as 3 things they found to be least interesting (see *figure 10* and *figure 11)*. When visitors were asked what they were most interested in about the exhibit, most visitors mentioned a specific dataset, which was coded as a "direct reference." Visitors also appeared to be most interested in the "static qualities" of the exhibit, such as the way the sphere was hung and how the datasets were projected. Many visitors also reported being interested in the dynamic qualities of the exhibit, such as the colors or movement of some of the datasets displayed on the sphere.

Most visitors said they couldn't think of anything that they were least interested in. However, of the visitors who mentioned something that did not interest them about the exhibit, 28 of the 181 who were interviewed thought that the sphere lacked sufficient interpretive material, such as labels or explanatory text. Several of the visitors were uninterested in the way the material was presented on the sphere. Also, 18 visitors mentioned that they thought the

datasets were displayed too long and wished they would have been able to see the datasets change more often.

Figure 10: What Did Visitors Find Most Interesting?

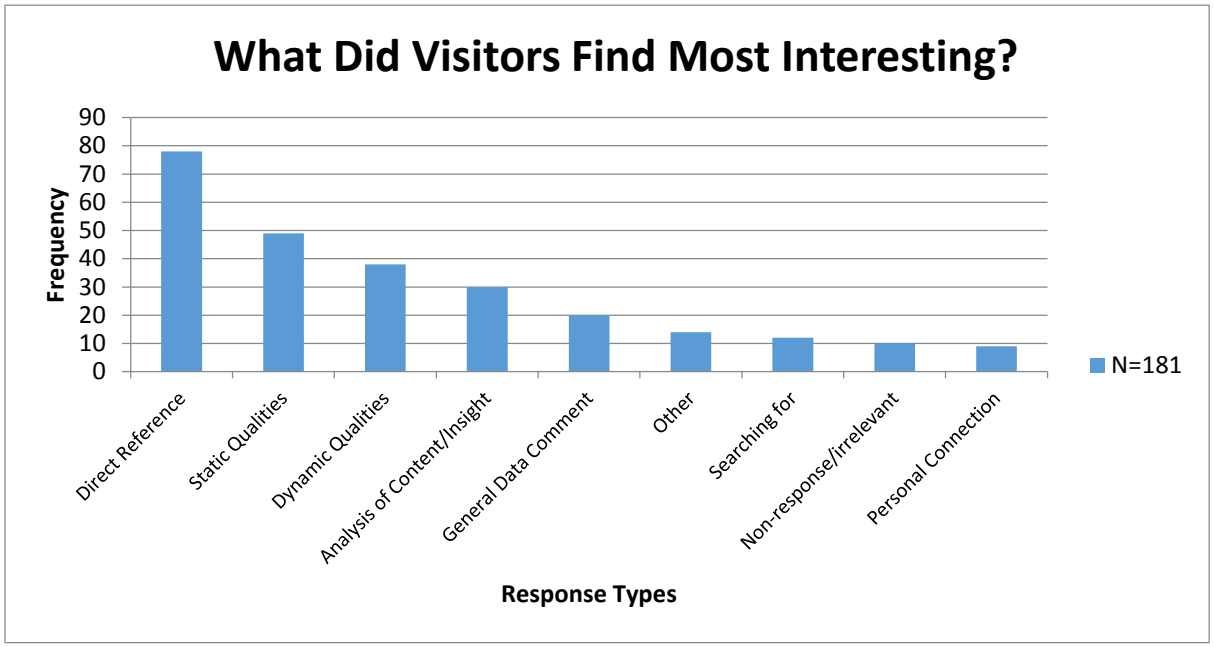
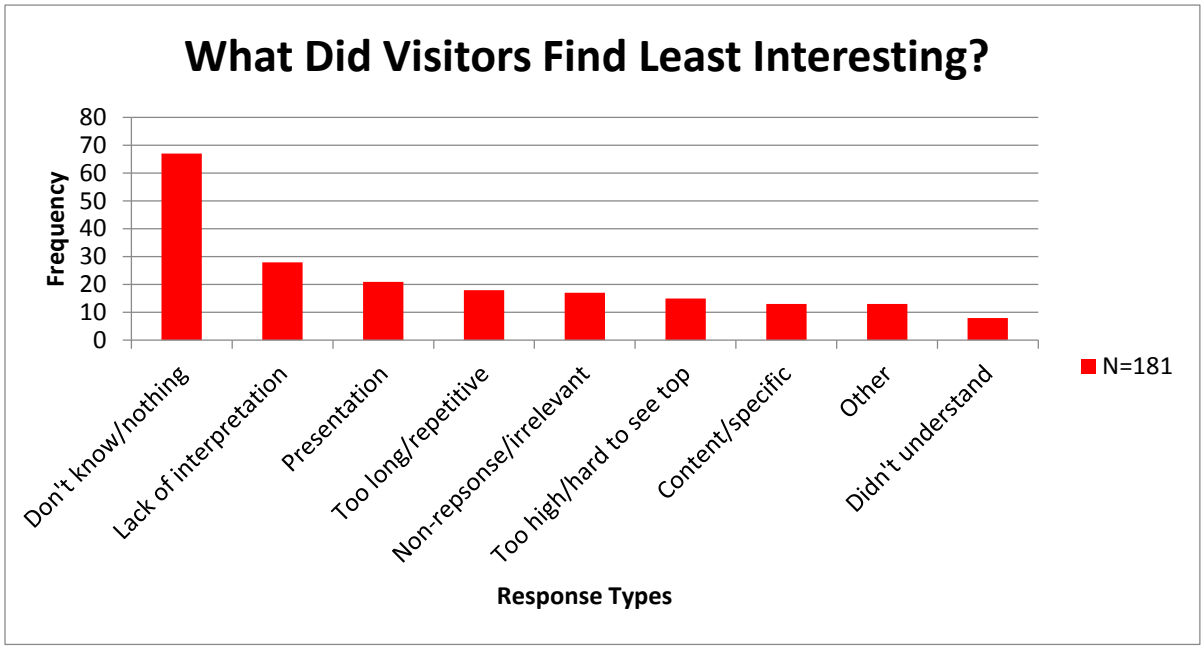
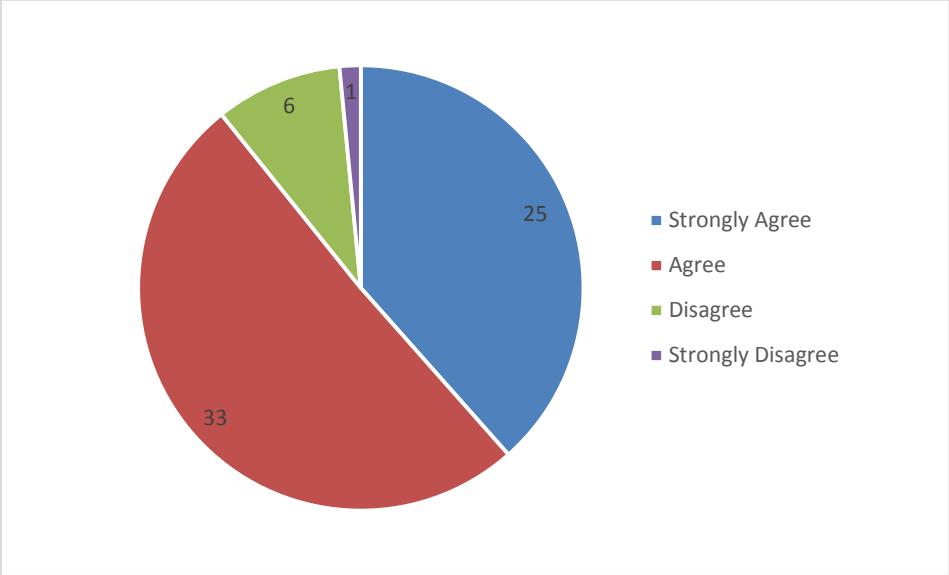


Figure 11: What Did Visitors Find Least Interesting?



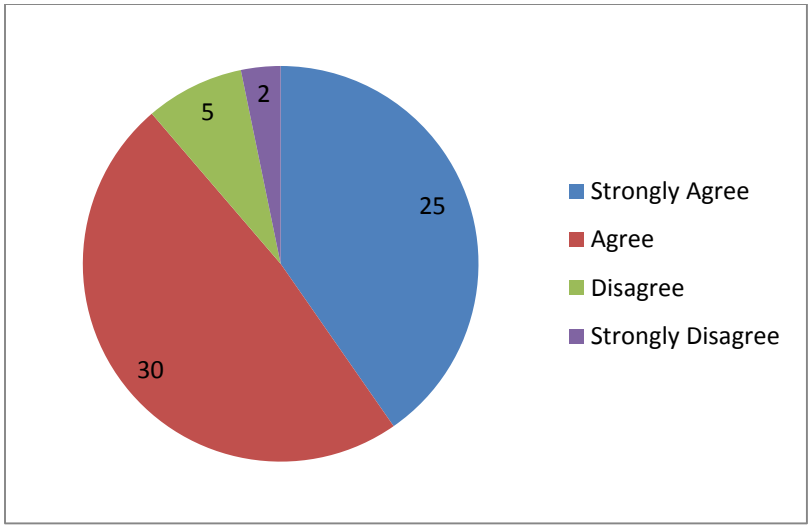
In the survey, visitors were asked to rate how strongly they agreed with the statement "I thought about the question while looking at the sphere." Of the visitors who saw the question displayed on the sphere, about 90% of the visitors either agreed or strongly agreed with this statement, showing that visitors generally utilized the question prompts (see *figure 12).*

Figure 12: Did You Think About the Question?



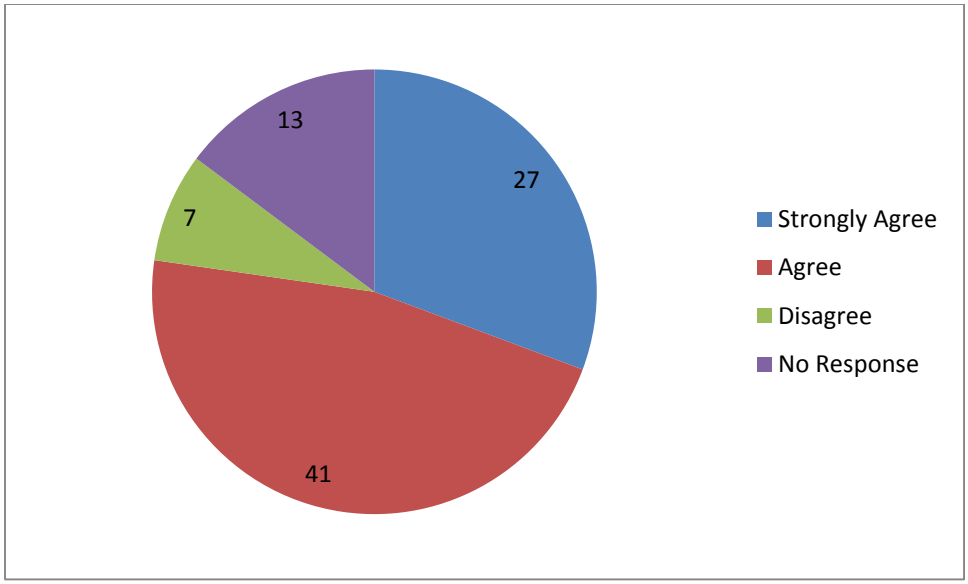
Visitors were then asked whether they noticed the legend on the sphere (if it was present), and for those that noticed, whether or not they found it to be helpful. The majority if visitors either agreed or strongly agreed with the statement "the legend was helpful to me in understanding the information on the sphere."

Figure 13: Was the Legend Helpful?



Then visitors were then asked whether they noticed the rotation on the sphere (if it was present), and for those that noticed, whether or not they found it to be helpful. While again the majority of visitors found the rotation helpful, a larger portion of the sample either disagreed or strongly disagreed with the statement "seeing the globe rotate was helpful" than the statement about the question.

Figure 14: Was the Rotation Helpful?



Finally, visitors were asked on the survey whether or not there were other exhibits in the Pacific Science Center that made them think more about the globe. Over three-quarters of the visitors reported that they did not made a connection between what they saw on the sphere and the surrounding exhibits (see *figure 15*). Of those that did report making a connection between the sphere and surrounding exhibits, the majority of those visitors reported making a connection between the SOS exhibit and the surrounding astronomy exhibits (see *figure 16*).

Figure 15: Did you see anything else that made you think more about SOS? (Follow-up survey)

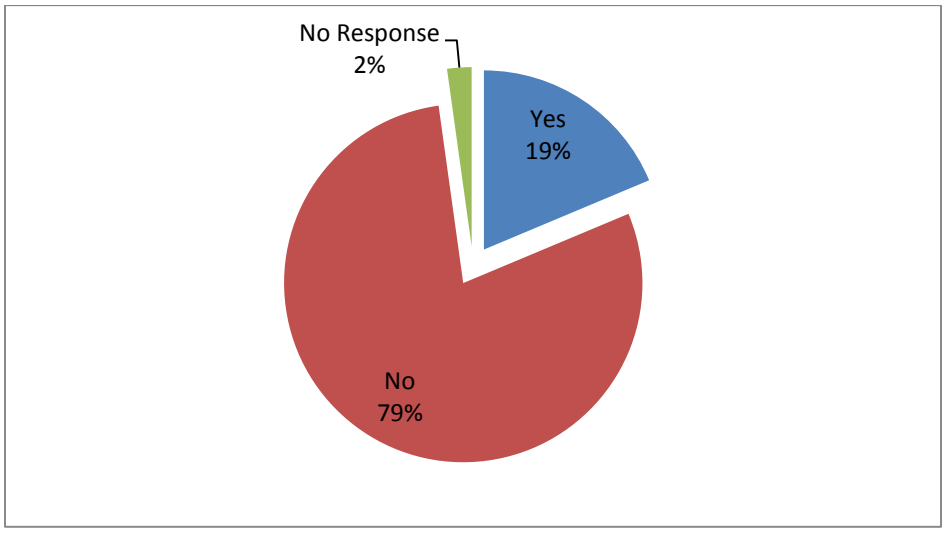
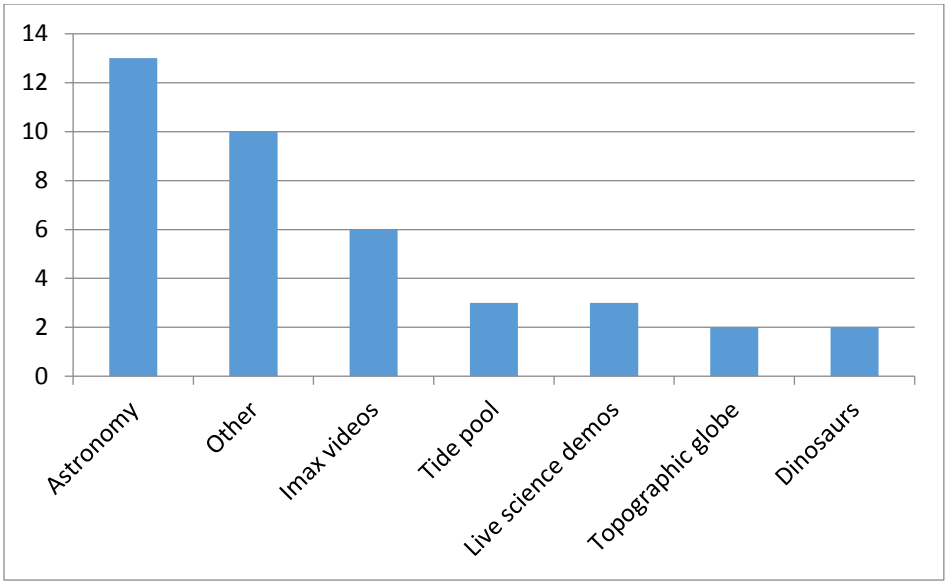


Figure 16: What did you see that made you think more about SOS?



Due to the nature of the space around the SOS exhibit, the content of visitors' discussions could not be obtained with the observational behavior mapping instrument. In order to get an idea of what visitors were discussing around the sphere, visitors were asked to self-report the topic of their conversations in the follow-up survey (see *figure 17*). 41 visitors who were observed having a discussion in the space around the exhibit said they were explaining or discussing the information that was displayed on the sphere, which was the most common response. 27 visitors said they were talking about a location or region displayed on the sphere, such as "the Gulf of Mexico" or "earthquakes in Washington."

Finally, the survey revealed that over half of the visitors that were observed to have engaged with the sphere had visited the Pacific Science Center previously (see *figure 18*).

Figure 17: What were visitors discussing around SOS?

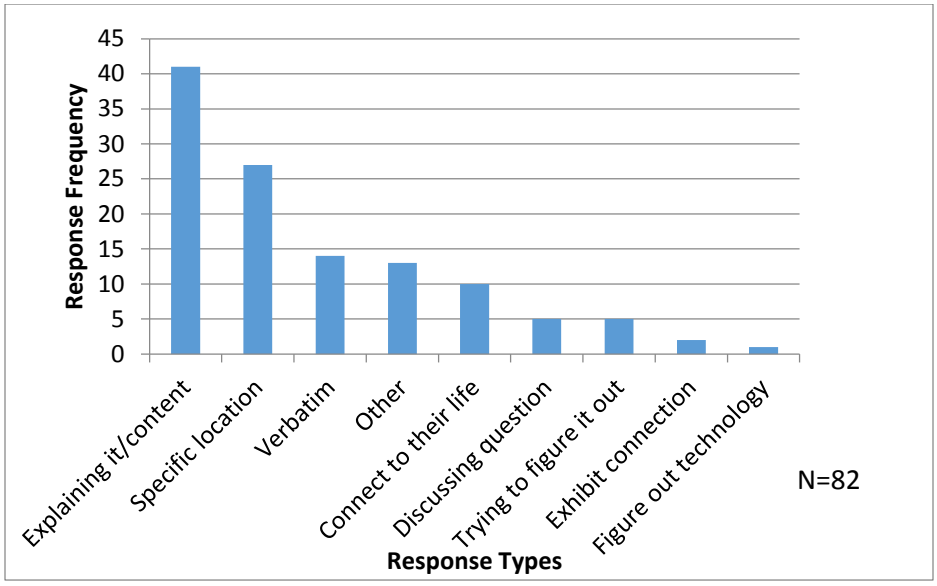
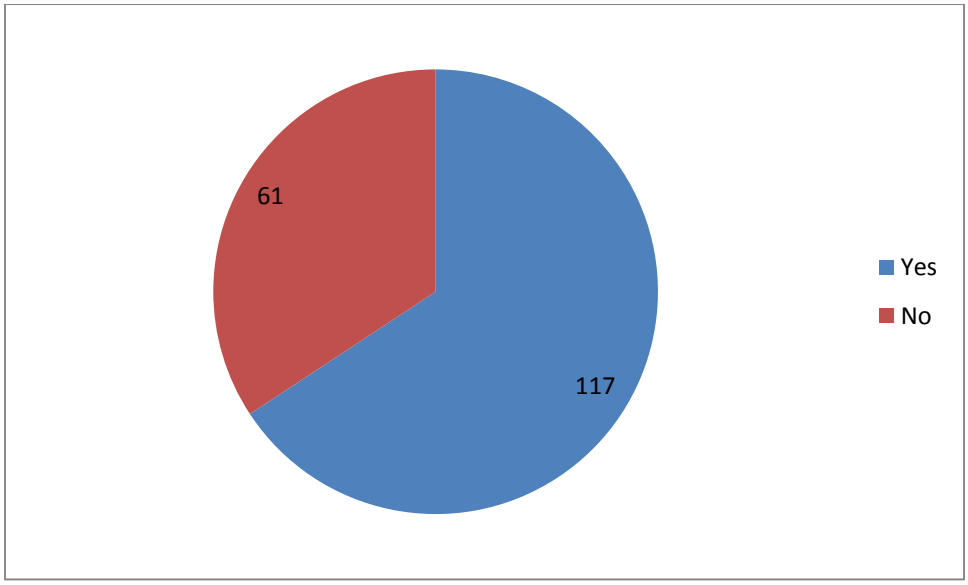


Figure 18: Have you been to PSC before?



Instrument 3: Reflective Mapping Follow-up Questions

Responses collected from the survey instrument indicate that people entering the space from different directions tend to engage with the sphere differently (see *figure 19*). People coming into the space from an undetermined location or from the Dinosaurs exhibit were most likely to stop at the SOS exhibit. Interestingly, the vast majority of visitors entering the space from the Tropical Butterfly House area saw the globe but did not stop to engage. Furthermore, 25 of the respondents who entered the space from the Dinosaur exhibit claimed they did not see the globe, although they would have had to pass the globe in order to reach the area where data collectors were stationed in the space.

Over half of the respondents who claimed that they saw the SOS exhibit reported that they did not stop to engage with it (see *figure 20*). However, Science on a Sphere was one of the most popular exhibits in the space. Of the 278 visitors who responded to the survey, 94 visitors stopped at the Science on a Sphere exhibit. The same number of visitors said they stopped at other astronomy exhibits near the entrance of the Dinosaur exhibit, and 96 stated that they visited the Saltwater Tide Pool exhibit.

Figure 19: Visitor entry point into the gallery and interaction with SOS

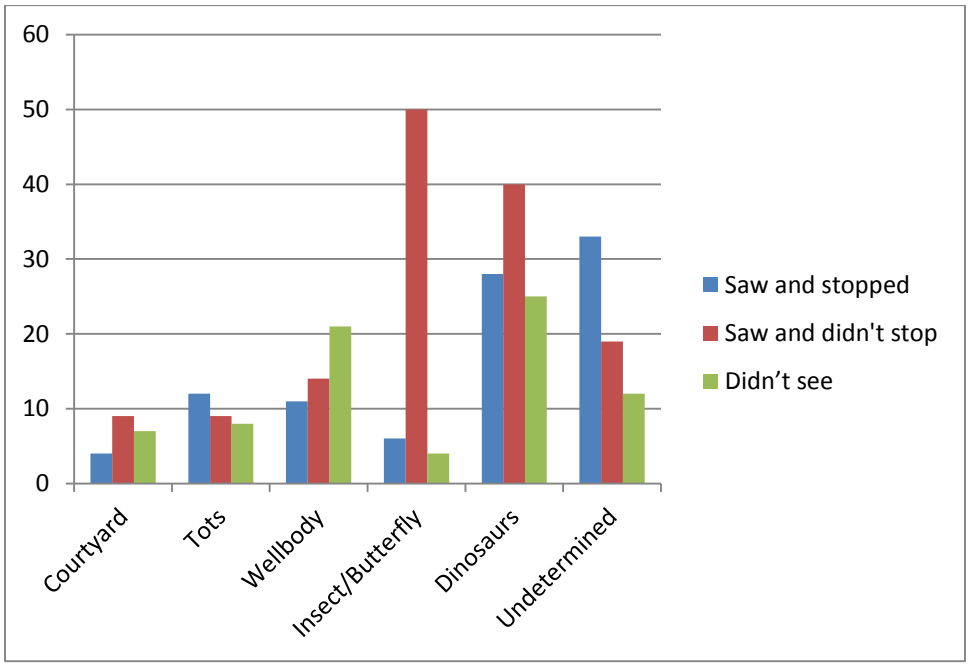


Figure 20: Did visitors stop at the sphere?

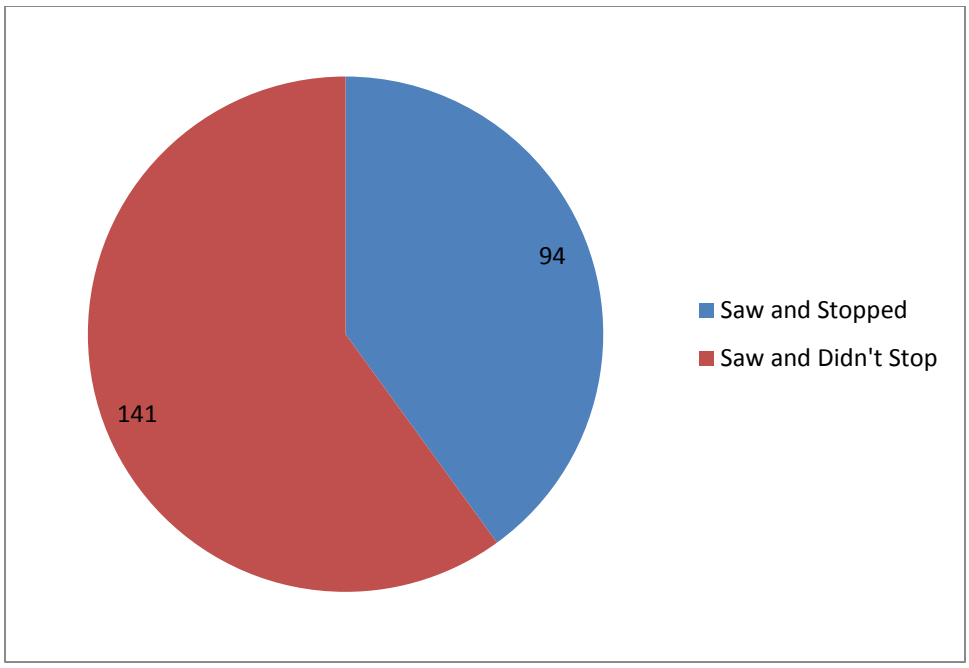
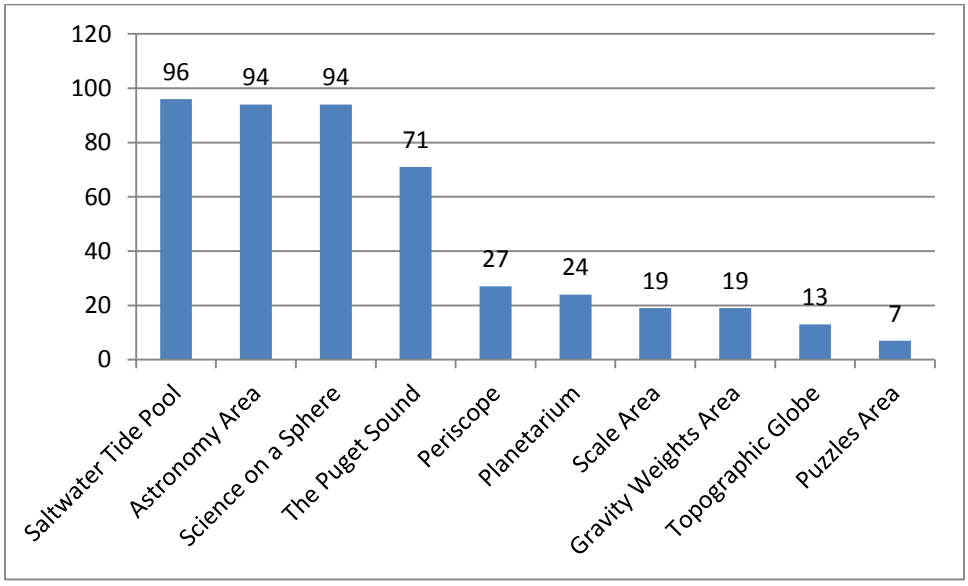


Figure 21: What other exhibits did visitors stop at?



The most commonly stated reason that respondents didn't stop to engage with the sphere was that they were attracted to another exhibit or that they were distracted (see *figure 22*). Many visitors stayed that they were interested in seeing the "Wellbody" exhibit or the Tropical Butterfly House, and so they walked past the Science on a Sphere to get to these areas. Many of the visitors who claimed they were distracted said they were trying to locate other family or group members and were not focusing on engaging with the sphere. Children were reported to be a major influence on whether or not visitors engaged with the sphere. 25 of the 141 visitors who saw the sphere and did not stop to engage said they were following their children, who ran right past the exhibit. While a small portion of the sample said that they guided their children away from the sphere because they thought the children were too young to be interested, children still seemed to be an important consideration in whether or not respondents engaged with the exhibit. Furthermore, about 10% of visitors stated that they had seen the exhibit before during previous visits to the Pacific Science Center, and decided not to engage with the sphere.

The most commonly cited reason for why visitors decided to stop to engage with the exhibit was that visitors were attracted to the technology and design of the exhibit and found it visually appealing (see *figure 23)*. 40 of the 94 respondents stated that they liked the 3-D projection and display on the globe, and were drawn in by the colorful, animated displays. 22 of these respondents said that they were interested in the content of a specific dataset that was playing. Children also played an important role in why visitors did stop to engage with the sphere. Nearly 20% of the visitors who stopped at the SOS exhibit stated that they stopped because their kids were attracted to the sphere.

Similar to the results from the follow-up survey, very few respondents claimed that they made a connection between the SOS exhibit and surrounding exhibits (see *figure 24*). Only 8% claimed that other exhibits at the Pacific Science Center made them think more about the information displayed on the sphere.

Figure 22: Why didn't visitors stop at SOS?

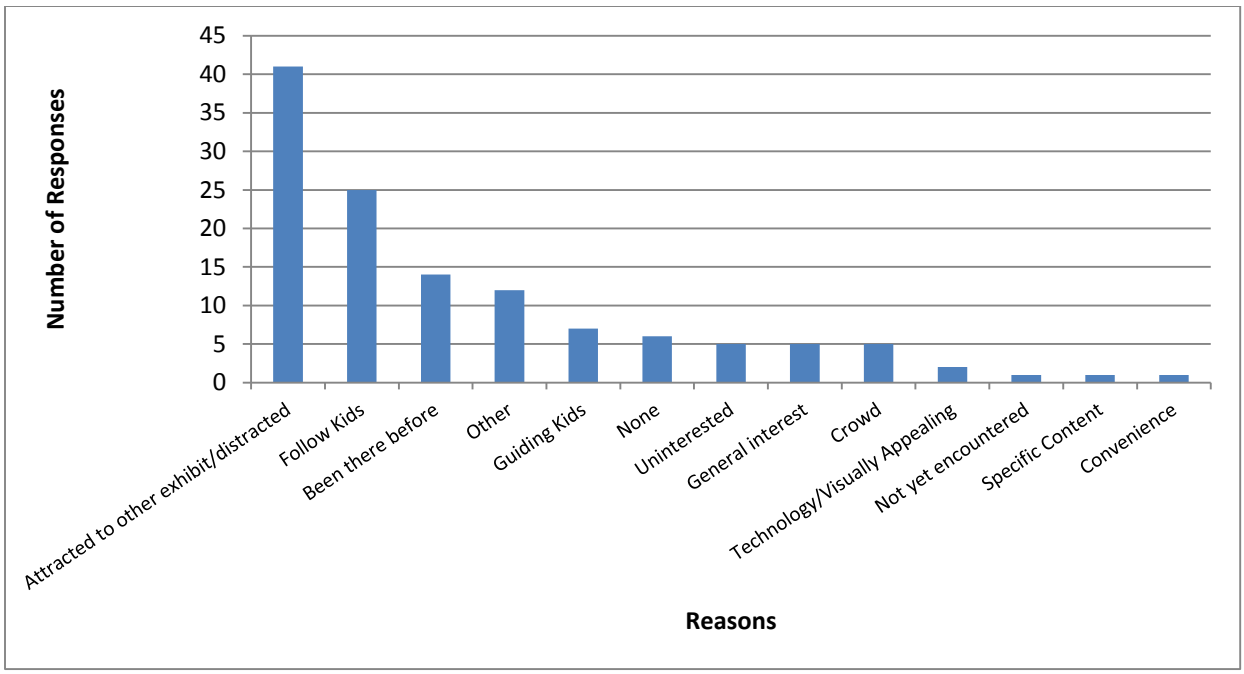


Figure 23: Why did visitors stop at SOS?

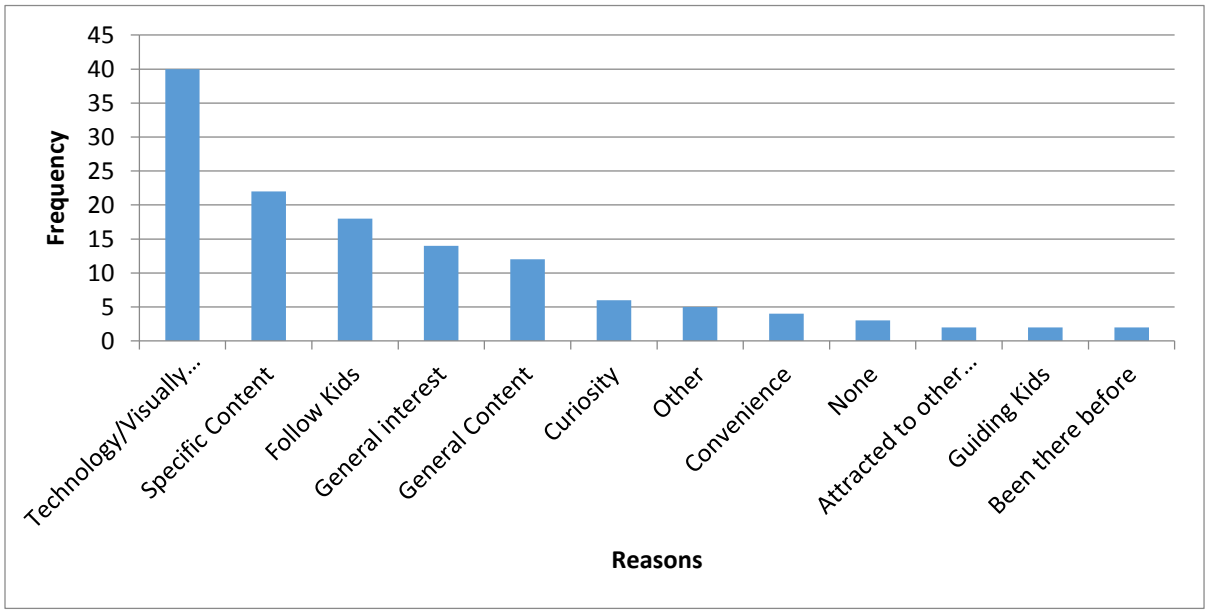
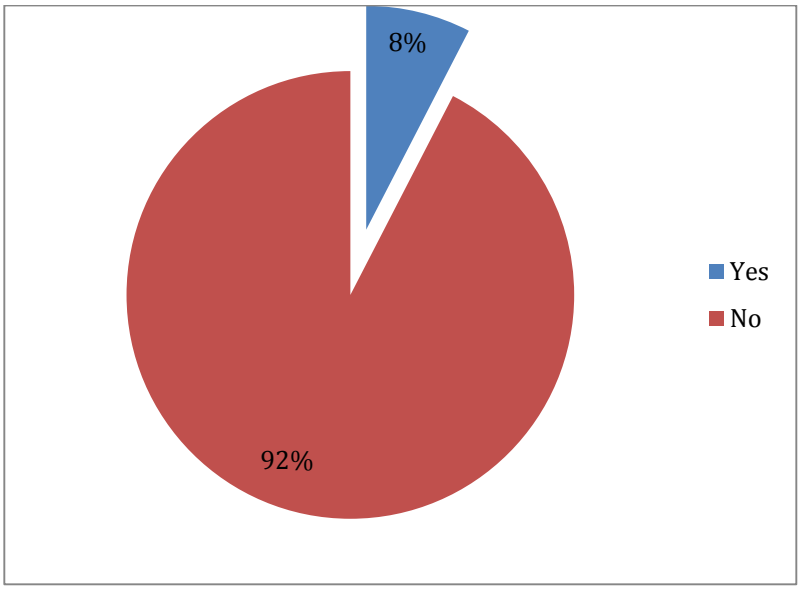


Figure 24: Did you see anything else that made you think more about SOS? (reflective map)



Discussion

Evaluation Question #1: Which presentation elements engage visitors most effectively?

Most of the variables that we tested did not affect visitor engagement positively or negatively. This is important because it narrows the variables that can affect the unfacilitated interaction of visitors with SOS. Future studies can target other variables, or adaptations of these (e.g., what happens then the sphere rotates and is tilted at an axis mirroring Earth's natural tilt?).

The Question Prompt

The most important finding from this evaluation is the effect of providing a question prompt and that it is the only variable tested that returned a statistically significant result. Visitors who viewed a dataset with a question prompt on average showed more signs of engagement and stayed longer at the exhibit (see *figure 6* and *figure 7*). PSC has been providing a question prompt on the sphere in many of their datasets, but this information will guide PSC to create more questions in the future. In the follow-up interview, a number of visitors mentioned that they talked about the question with their group, such as one visitor who stated: "I asked my

kids if they could answer the question." Visitors appeared to be more engaged with SOS when a question was included. At the moment, PSC intentionally does not provide the answer as a method to inspire conversation amongst visitors. However, during the follow-up interview, several visitors mentioned that they would like to have the answer to the question appear on the sphere. One visitor said one of the things that was least interesting about the exhibit was that the sphere "asked questions but had no answers." PSC may wish to test what happens when the answer is provided somewhere, or if it is better to let groups of people discuss the question. Further evaluation may be done into whether the question prompt (and answer) increases learning at the sphere, as well.

Prior to this evaluation, there had been no evaluations of Science on a Sphere at Pacific Science Center. PSC was very interested to know how their visitors were engaging with the sphere while no facilitator was present. By providing a baseline and variable comparison, we can show PSC what methods may engage visitors more fully than the current presentation methods. This evaluation will guide future studies of the sphere and will inform future dataset selections for SOS, and may guide PSC to select datasets to which meaningful or engaging questions can be asked.

Datasets

The datasets selected for our study fell into three content categories: astronomy, oceanography, and earth science (sans oceanography). Analysis of the data for visitor engagement with the datasets from these content areas revealed that visitors did not seem to be more engaged with any particular content area. However, visitors did show more signs of engagement and stayed longer while viewing specific datasets. Visitors engaged most with the Ocean Currents dataset and lingered around the sphere longest while it was playing (*see figure* 8 and *figure 9*). They engaged least with the Jupiter dataset, and spent the least amount of time at the sphere while it was playing.

Evaluation Question #2: What is the nature of visitor engagement with the SOS and its space during the auto-run program?

Engagement Behaviors and Stay-time

While visitors were around the SOS exhibit, several engagement behaviors were observed. The most common sign of engagement was when an individual paused to look at the sphere (see *figure* 5). A large number of visitors pointed at the sphere, and engaged in discussion. Very few of the visitors were observed reading the labels placed on the four pillars surrounding the sphere.

Visitors observed for this study stayed at the sphere an average of 50 seconds during the course of the evaluation. When a question prompt was displayed, visitors tended to stay slightly longer, around 60 seconds, and only stayed about 42 seconds when the question was absent. On average, visitors lingered around the sphere for about 3 minutes and 20 seconds, although this was affected by an outlier in the data. However, visitors did show more signs of engagement with this dataset (see *figure 8*).

Results from the reflect map instrument indicate that 64% of the visitors who stated that they saw the SOS exhibit decided not to stop and engage with it (see *figure 20*). The most frequently stated reason for passing by the exhibit was that they were attracted to another exhibit or distracted while walking through the space (see *figure 22*). The visitors who did stop to engage most often stated that they stopped because they thought the technological design of the exhibit was interesting, or that the figure was visually appealing (see *figure 23*).

Visitor Conversations

In the follow-up survey, visitors who were observed talking around the SOS exhibit were asked about what they were discussing. Most conversations seemed to revolve around explaining or discussing the content of the sphere to the other members of the group (see *figure 17*). Half of the visitors who mentioned that they were having a discussion around the sphere stated that this was the topic of conversation. Also, a third of the visitors reported that they were talking about a specific place on the sphere. This included both geographic locations, such as Seattle or the Gulf of Mexico, as well as event locations, such as the 2004 Indian Ocean tsunami and hurricane alley. While visitors appeared to be more engaged when a question prompt was displayed, only a small portion of the sample explicitly stated that they talked about the question within their group.

Group Composition

Groups with more adults tend to stay longer at the sphere. These groups on average also showed more signs of engagement. Responses from visitors on the reflective map indicate that children had a noticeable impact on visitor groups' engagement with the sphere. When asked why they did or did not stop to engage with the sphere, many adult visitors indicated that they were following the lead of children in the group (see *figure 22* and *figure 23).* If the children were drawn to the sphere, the adults would follow their children there. When children were attracted to other exhibits, the adults would pass by the exhibit to follow them to the exhibit that had caught the children's attention. Furthermore, a number of adults indicated that they were guiding their children either to engage with the sphere to pass by. Several adults stated that they thought the sphere was too complex for their children to understand, and did not encourage them to engage. Others believed that their children would be interested in viewing the SOS exhibit, and led their children there.

Evaluation Question #3: What are visitors most interested in seeing?

Visitor Interest

Visitors reported being most interested in the content from a particular dataset, which is coded as a "direct reference" in *figure 10*. Not only did the Ocean Currents dataset appear to engage visitors more, it also appealed to visitors' expressed interest. However, visitors did mention being interested in almost all of the datasets presented, even those they engaged with least. Furthermore, over 25% of visitor responses related to an interest in the static qualities of the exhibit. These are characteristics of the exhibit that do not change with each dataset, such as the technology and physical design of Science on a Sphere. For example, several visitors mentioned that they liked how the exhibit glowed, or the way that the images were projected onto the sphere. 20% of the survey respondents stated that they were interested in the dynamic qualities of the exhibit. Several visitors mentioned how they were interested in the colors of specific datasets, as well as the way the datasets moved. This level of interest may have led to the higher engagement and longer stay-times for the carbon tracker and ocean currents datasets, which are both colorful, moving datasets.

While most of the visitors could not identify those aspects of the SOS that they were least interested in, those that did mention something provide further insight into what may be keeping

visitors from engaging with the SOS exhibit. Of those that mentioned something they did not like about the SOS exhibit, the most common response was the lack of interpretation of the material presented on the sphere. Many of the visitors mentioned that they did not understand what was being presented on the sphere, and that more information and definition would have made them more interested. For example, one individual mentioned how the lack of information was a barrier for them while observing the carbon tracker dataset: "The carbon thing didn't have enough information. The question didn't go with visual, and there were no arrows pointing to where you were or no way for a child to learn where things were."

These types of responses echo those found in the evaluation done at the Science Museum of Minnesota[17], which found that visitors wanted more interpretative information to point out key information on the sphere. When interpretive signs were implemented at this site, the major of visitors read the interpretive signs. At Pacific Science Center, only 23 of the 553 visitors observed at the SOS exhibit were observed to read the interpretive signs on the projectors. However, the use of the question prompt did increase visitor engagement and stay-time, which may indicate that further interpretative information projected directly onto the sphere may lead to increased interest and engagement.

Visitors also mentioned specific presentation elements that made them less interested in the SOS exhibit. In particular, 10% of the visitors who were interviewed mentioned that they thought the datasets went on for too long. Many of the visitors did not wait around the sphere long enough to see the datasets change. Those that were around to see the information change mentioned that they were interested in how the datasets change, as was indicated in the "dynamic qualities" responses for what interested visitors most.

15 of the 181 visitors that were interviewed stated that they thought the sphere was too high up, making it difficult to see the top of the sphere. Evaluations from the Science Center of Minnesota confirm this finding, as many of the visitors in this evaluation suggested making the top of the sphere more visible[18]. This was particular problematic for children, whom parents stated had trouble seeing the top of the globe. Visitors had trouble seeing the Seattle area, which may have had an impact on how much visitors engaged with the sphere and were able to draw a

[17] Nelson and Ellenbogen, "Science On a Sphere: Front-End Evaluation Report."

[18] Nelson and Ellenbogen, "Science On a Sphere: Front-End Evaluation Report."

personal connection to the information on display. This aspect of the information displayed on the sphere impacted one visitor's ability to answer the question prompt on the sphere, which prompted visitors to consider the weather occurring over where they live. This may also explain the low number of visitors who stated a personal connection to the information on the sphere as being an interesting part of their experience around the sphere.

Evaluation Question #4: To what extent are visitors making a connection between the sphere and surrounding exhibits or programs?

Connection

Participants in the study did not appear to be making a connection between the SOS exhibit and surrounding exhibits. When asked if they saw anything else in the Pacific Science Center that made them think more about what they saw on the sphere, the majority of visitors said they did not (see *figure 15* and *figure 24*). Visitors do not appear to be using the information from surrounding exhibits to interpret what they see on the sphere. Of the visitors who did make a connection between the sphere and other exhibits, they most often said that the surrounding astronomy exhibits related to the SOS exhibit.

Limitations

There are several limitations to this study, including technical difficulties with the sphere, unscheduled facilitation or activity at the sphere that may have skewed our numbers during collection, the use of rookie data collectors, and inconsistent visitor group compositions or visitorship on different days of the study.

During this evaluation, a meteor landed in Russia. When natural disasters or rare natural events occur, people often come to PSC for better understanding of the event. In this case, a local news team came to the sphere to record a report on the event. This created a lot of attention, and our data collectors were instructed to stop to avoid skewing the data. Since this evaluation was on a strict timing schedule, this led to fewer instruments collected for this playlist.

Unanticipated technical issues also restricted the number of instruments collected. Just before our evaluation, the SOS system at PSC was upgraded, causing a few bugs and glitches

during data collection. At one point during the evaluation, SOS stopped looping/repeating the playlists. One evaluator stood at the SOS computer and manually refreshed the playlist. Troubleshooting this problem wasted time and collectors were unable record data while the system was down. The last technical limitations on this project were the datasets themselves. Some of our original dataset selections were non-adjustable (e.g., the rotation should not be turned off or there were captions that could not be removed). To keep our variables consistent, we selected new datasets.

Part of New Directions' two-year series of courses is learning to train data collectors, which were first-year students just beginning New Directions. Most of these data collectors had little/no experience with data collection. Although we held a training day before data collection began, it became apparent that our collectors needed additional training in the field. For this reason, the "A" playlists (A, A + rotation, A + question, and A + rotation + question), which were evaluated at the beginning of the study, had less experienced data collectors and less time for data collection. As the evaluation progressed and data collectors became more familiar with the process, the number of instruments collected increased dramatically. In addition, data collector errors decreased as the study progressed, as we corrected their collection mistakes. These initial mistakes primarily include inconsistent sampling, but also include missed responses and confusing short-hand or notes.

Another limitation of this study is the inconsistency in group composition that was discovered in our data analysis. This may be due to the different types of people that come to the science center on different days. Our data analysis discovered that for certain datasets, more groups including children were interviewed than for other datasets, which may skew the data. This may have been caused by holidays and school in-services that changed the normal demographic seen at PSC on weekdays/weekends. Our data intentionally excluded school groups—which are a primary audience on weekdays—therefore making school-age children unlikely to be part of an interviewed weekday group. Anecdotal evidence obtained from our personal observations during the evaluation show a pattern that groups with very young children are more likely to be at the science center on weekday mornings, small groups of primarily adults on weekday afternoons, and a mixture of both these categories and larger family groups on weekends.

Conclusion

The results from this study indicate that the use of a question prompt appeared to increase both visitor engagement as well as stay-time at the Science on a Sphere exhibit. Visitors are most engaged with specific datasets such as the Ocean Currents dataset, but this was unrelated to the larger content area of the information. This may be related to the dynamic qualities of these datasets, such as a colorful and animated display, which visitors reported being most interested in. They also expressed interest in the content of these specific datasets.

While most participants in the study could not express anything that was uninteresting about the exhibit, those that did most often mentioned the lack of interpretation. This is similar to the findings from previous evaluations of the Science on a Sphere exhibit in other locations. Several visitors also mentioned that the current dataset playtime was too long or that they wished it changed datasets more frequently.

Over half the visitors that saw the Science on a Sphere exhibit passed by without engaging with it. Those that did stay to engage, stayed for an average of 50 seconds. Visitors were observed pointing at the sphere and participating in discussions around the sphere. These discussions often revolved around explaining the content or talking about a specific location. However, few visitors stated that they discussed the question prompt on the sphere. Based on the results of this study, visitors do not appear to be making a connection between SOS and surrounding exhibits.

Recommendations

In order to increase visitor engagement with the Science on a Sphere auto-run program, the Pacific Science Center could explore a number of options. First, incorporating question prompts or other interpretive labels on the sphere may help to increase visitor engagement. Participants were more engaged with the datasets when a question was present, and indicated that they would be interested in further interpretive material. The Pacific Science Center may want to test various methods of displaying this information, such as testing different question prompts, including an answer with questions, explanatory text or labels on the sphere, or physical signage around the sphere.

Further evaluations of the auto-run program should determine which datasets are most engaging to visitors. While the selection is large, datasets which are colorful and animated appear to be the most engaging, which provides a means of narrowing the possible candidates. Furthermore, evaluations could focus on determining an optimal dataset playtime. Some visitors indicated that the datasets played for too long. Since the average stay-time was considerably less than the dataset playtime, many visitors did not experience multiple datasets. Finally, the Pacific Science Center may wish to test engagement when datasets are tilted on the sphere so visitors can more easily see the information at the top of the dataset.

Acknowledgements

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Appendix A

Instrument 1: Timing & Behavior Checklist

Instrument #: _____ **Interviewer: _____ Date:_____**
Time of Day: _____ **Adults #____ Children #_____**

Total Time Spent at Sphere: _____

Behavior Frequency Checklist:

Pause and Look _____ Use camera_____

Point_____ Discuss_____

Lean on railing_____ Sit on bench _____

[ ] Facing sphere [ ] Facing sphere

[ ] Facing away from sphere [ ] Facing away from sphere

Look at Pillar label_____

Datasets playing *(Check all that apply)*

[ ] Jupiter [ ] Ocean Currents

[ ] Earthquake [ ] All Satellites

[ ] Ocean Drain [ ] Real Time Weather

[ ] X-Ray Sun [ ] Ocean Temperature

[ ] Carbon Tracker

Appendix B

Instrument 2, SOS Follow-Up Survey Questions (semi-structured)

Instrument #: _____ **Interviewer: _____ Date:_____**
Time of Day: _____ **Adults #____ Children #_____**

1. I thought the videos on the globe were interesting.

Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*

2. What are 3 things that you were most interested in seeing on the globe?

3. What are 3 things you thought were the least interesting on the globe?

4. Did you notice the legend describing the information on the Sphere? ***Yes*** ***No***

(a) The legend was helpful to me in understanding the information on the sphere.

Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*

5. Did you notice the **question** displayed on the Sphere? ***Yes*** ***No***

(a) I thought about the question when looking at the sphere.

Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*

6. Seeing the globe **rotate** was helpful.

Strongly Agree	*Agree*	*Disagree*	*Strongly Disagree*

7. Did you see anything else at Pacific Science Center today that made you think more about what you saw on the globe? **Yes** **No**

a. *If yes*: What did you see?

8. *If yes*: Did the information on the sphere help you to understand what you saw in any of the other exhibits today (or vice versa)? ***Yes*** ***No***

a. *If yes:* How?

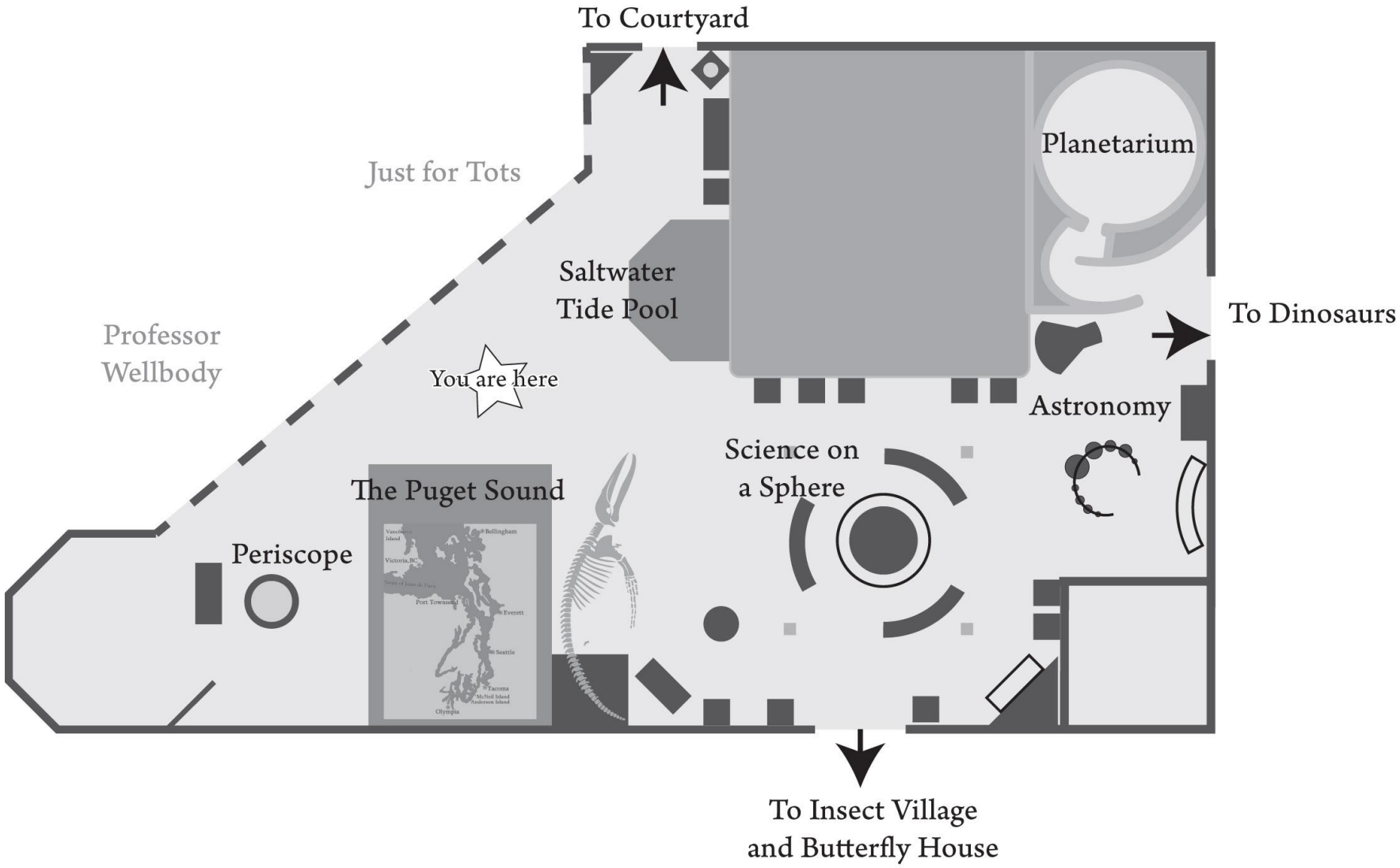
9. *IF RESPONDENT WAS HAVING A CONVERSATION WHILE LOOKING AT THE SPHERE:* I noticed that you were discussing something while you were looking at the sphere. Would you mind telling me what you were talking about?

10. Have you been to PSC before? ***Yes*** ***No***

Appendix C

Instrument 3: Reflective Mapping

Please draw your path through this exhibit. Circle any areas where you stopped. If you have any questions, please ask!



Instrument 3: Reflective Mapping Follow-up Questions

Instrument #: _____ **Interviewer: _____ Date:_____**
Time of Day: _____ **Adults #____ Children #_____**

1. Did you see the globe exhibit during your visit today?

I saw it and I stopped	*I saw it and didn't stop*	*I didn't see it*

2. Why did you or didn't you stop at the globe exhibit?

3. What did you see playing on the globe? (Don't give options, allow respondent to answer and check corresponding responses)

- [ ] Jupiter
- [ ] Earthquake
- [ ] Ocean Drain
- [ ] X-Ray Sun
- [ ] Carbon Tracker
- [ ] Ocean Currents
- [ ] All Satellites
- [ ] Real Time Weather
- [ ] Ocean Temperature

- Other _____

_____

4. Did you see anything else at Pacific Science Center today that made you think more about what you saw on the globe? **Yes** **No**

a. *If yes*: What did you see?

5. *If yes*: Did the information on the sphere help you to understand what you saw in any of the other exhibits today (or vice versa)? ***Yes*** ***No***

a. *If yes:* How?

Appendix D

Program Data Collection Matrix Goals

		With Question	Without Question
With Rotation	**Playlist 1**	10	10
	Playlist 2	10	10
	Playlist 3	10	10
Without Rotation	**Playlist 1**	10	10
	Playlist 2	10	10
	Playlist 3	10	10

Appendix E

Coding schema for open-ended survey and reflective map questions

Coding Schema: What Visitors Found Most Interesting

Coded as…	Included if visitor mentioned…	Examples:
Direct Reference	A verbatim description of dataset content	*Movement of the currents* *Solar flares*
Analysis of Content	Conclusions drawn from information from dataset	*I liked the temperature and how it shows different climates*
General data content	Information on sphere unrelated to dataset theme	*The bodies of water* *Geography*
Static qualities	Physical attributes of the exhibit that do not change with the dataset	*The size* *The way it glows* *Colors*
Dynamic qualities	Physical attributes that change with each dataset	*Movement* *Change in the data*
Searching for	Attempt to locate specific event/location	*I wanted to show the kids where we live on the globe*
Personal connection	Connection between SOS and individual's life	*I liked seeing the flow of currents near our house*

Coding Schema: What Visitors Found Least Interesting

Coded as…	Included if visitor mentioned…	Examples:
Lack of Interpretation	A lack of signage or explanation of material	*No labels explaining events*
Didn't Understand	Lack of understanding of information	*No details, couldn't understand everything*
Too long/ repetitive	Datasets play too long or repeat too much	*Pictures didn't change*
Too high/ hard to see top	Difficulty seeing all the information at the top of the globe	*It was kind of high up for the kids to see* *Jupiter*
Content specific	Information from specific datasets	*Sun is okay. Has flares. So what? Not interesting*
Presentation	The manner in which information was displayed	*It caught my eye but didn't hold me.* *No tilt on the globe*

Coding Schema: Discussions

Coded as…	Included if visitor mentioned…	Example:
"Shiny"	Something eye-catching about the exhibit	*The colors*
Discussing Question	The question prompt	*I asked my kids if they could answer the question*
Specific location	Geographic locations or environmental events	*Naming continents, looking for USA*
Verbatim	Repeating the content from the dataset	*Where the ocean currents are*
Explaining it/content	Attempting to analyze or explain the information presented on SOS	*She [daughter] wanted to know what the bright areas on the sun were, so we talked about it.*
Connect to their life	Relate information to their own life experiences	*We are moving to Italy, wanted to see carbon there*
Trying to figure it out	Trying to figure out the mechanics of the exhibit	*How the video projector worked*
Exhibit connection	Connection to the surrounding exhibits	*The other constellation exhibit*

Coding Schema: Why did you stop?

Coded as…	Included if visitor mentioned…	Example:
Follow kids	Following children, who were attracted to the exhibit	*The children were drawn to it, so I followed them over*
Guiding kids	Parents took children to go show them the exhibit	*My daughter is three and I wanted to show her the world*
Technology/ Visually Appealing	The technology of the sphere or visually appealing characteristics	*Because it is a big floating thing that changes color*
General interest	Non-specific interest in the exhibit	*It's cool and interesting*
Specific Content	Stopped to look at a specific dataset	*To look at the temperatures of the Earth*
General Content	Interest in content on SOS not specific to a dataset	*I wanted to read the information*
Curiosity	Mentioned being "curious" about something on the sphere	*Curious about what it was measuring*
Convenience	Stopped because of location of the sphere in the space	*We were wandering through the area.*

Coding Schema: Why didn't you stop?

Coded as…	Included if visitor mentioned…	Example:
Uninterested	Not interested in viewing the sphere	*It just didn't call to us*
Attracted to other exhibit/ distracted	Wanting to see another exhibit in the area or distracted by other events	*Wanted to go to Wellbody. Had to catch up with my wife and son*
Follow kids	had to follow children who passed by exhibit	*The kids ran past to go see the Tide Pool*
Guiding kids	Parents stated children wouldn't have understood SOS	*Kids are too little to get it*
Specific Content	Passed by because of a specific dataset	*Because it was on Earth. If it was on Jupiter we would have stopped*
Been there before	Had already seen SOS on a previous visit	*We stopped last time, so we didn't this time*
Crowd	Didn't stop because of a crowd around the sphere	*There was a bunch of little kids around it making noise*