2013

Evaluation of the Children's Museum of Manhattan's *EatSleepPlay*™ Exhibit

Hunter College

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ACKNOWLEDGEMENTS

We would like to thank Andy Ackerman, Leslie Bushara, Lizzy Martin, Yalda Nikoomanesh, Tom Quaranta and all of the very dedicated Children's Museum of Manhattan's (CMOM) staff for giving us the opportunity to perform this evaluation study and for facilitating its execution.

In addition, we are in awe of and thankful for our dedicated, creative, and talented Hunter College student interviewers, observers, and data analysts: Catherine Diamond, Margaret Dunn-Carver, Marian Glick-Bauer, Stephanie Herman, Shani Jordan-Goldman, Corey King, Jennifer Lattur, Beverly Lauchner, Lauren McNoble, Alix Palmer, Dawn Poirier, Emilie Rosano, Stephanie Seiler, Julia Sharkey, Samantha Teece, Samantha Tryon, Seren Wechsler, Ilona Williamson, and Amanda Woo.

Finally, we would like to thank the children and caregivers who gave us their time and valuable input about how they experienced the *EatSleepPlay*™ exhibit.

Evaluation of the Children's Museum of Manhattan's *EatSleepPlay*™ Exhibit

Final Report
June 14, 2013

Submitted to:
Children's Museum of Manhattan

Prepared by:
Charles Platkin, PhD, JD, MPH; Christina Zarcadoolas, PhD; May May Leung, PhD, RD; Ming-Chin Yeh, PhD, MEd, MS; Sue Nestler, MPH; Amy Kwan, MPH; Alen Agaronov, MS

Hunter College
CUNY School of Public Health

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EXECUTIVE SUMMARY

A multi-modal evaluation study was conducted to identify and assess how children (aged 4-8) and adult visitors experience the Children's Museum of Manhattan's *EatSleepPlay™* exhibit and what they are learning from their experience, and to recommend ways to enhance learning of healthy habits by children and families within the context of *EatSleepPlay™*.

Methods and Aims
Methods included:

- Direct ethnographic observation of physical activity and children-parent interactions
- Video recording of exhibit activity
- Exit interviews with children
- Written surveys with parents
- Physical activity monitors

The aims of the study were to identify:

- How visitors in the target audiences navigate, engage and interact with the exhibit
- What knowledge, attitudes, perceptions and questions the exhibit instigates
- What demographic differences exist in physical activity engagement of child visitors
- Recommendations for enhancements to *EatSleepPlay™* based on findings

***EatSleepPlay™* Pilot Study**
A seven-hour pilot of all protocols took place at CMOM on Saturday, January 26, 2013. Modifications included and addressed time of day of data collection, multiple days of data collection, recruitment strategies, on-site data cleaning, interviewing techniques, survey questions.

Data Collected
Over the span of two weekend days (February 23 and March 2, 2013), 26 researchers, including undergraduate, master's and doctoral students and faculty collected data via: 87 interviews with children, 65 surveys with parents, physical activity monitors from 35 child visitors, and over 100 children observed on-the-floor. Almost 4 hours of non-continuous video were also analyzed.

Given the available time and resources we did not attempt an analysis of all of the data we collected. We observed more children in our target age group at the Brain and the Bikes and therefore, we analyzed representative portions of data collected at these two sites (live ethnography and video). We will use the Brain and, more extensively, the Bikes, to discuss our findings.

Key Findings
The Children's Museum of Manhattan's innovative and popular *EatSleepPlay™* exhibit aims to be fun and engaging for children and adults while also introducing and teaching both about food, health and nutrition. We consistently found the exhibit to be a space where it is nearly impossible to find an idle child. They are clearly exploring, playing and having fun. We observed and analyzed evidence of different kinds of play and learning, as well as obstacles to learning.

- Children spent an average of 33 minutes in the exhibit. Boys spent slightly more time at the exhibit compared to girls (35.5 vs. 31 minutes), as did older children compared to younger ones (38.5 vs. 28 minutes).
- When asked "What was your favorite thing in the exhibit today?" 17% of children cited the Green Cart as their favorite, followed closely by the Laser Dance Room (16%), Intestines (14%) and Bikes (13%).

Four Central Themes emerged from the three primary types of child data analyzed– ethnographic observation, video, and exit interviews with children:

- Playing to play
- Play to learn
- The role of intermediaries
- Room for magical thinking

Playing

- At the Green Cart and Intestines we commonly observed collaborative play among children - upon entering the exhibit area, observing other children and "joining up." Common to many social play settings, a child observed and copied or mirrored the behavior of another child.
- We observed far more parallel play than collaborative play at the Energy In/Energy Out, Sleep, Table Top Cardio and Brain stations. At the Table Top Cardio station particularly, we observed much active competition with known playmates or a parent, rather than with unknown others.

Learning

- We observed children who figured out the "lesson" of a station, as well as children who did not.
    - [Toilet] *"I learned that when people pass gas, I thought it was on purpose, but after going through where how your food digests, they say it's natural. It's a way of getting out any bad gas that you don't want in your body. [Before] I felt like it was on purpose, I was embarrassed."* – 9 year old, talking about the "Flush" toilet
    - When asked how she figured the Bike station out, one child responded directly, "*You press a food and you have to burn all the calories off"…."How did you learn that?" "I read the instructions"* - 5 year old girl.
- *"I didn't know what to do anything with [sic] the wheel but I kept trying to push it"* – 8 year old girl.
- A key variable influencing whether or not a child got the point of a station or stayed and interacted with the station was the role the accompanying parent played. We observed that children are more likely to "figure out" a station when it is: 1) child-intuitive and easy to use, and/or 2) the child is instructed or encouraged by a parent/intermediary.

Intermediaries

- Analysis of the Bike station showed that intervention by a parent with timely instruction clarifies the activity and makes the goal of the play task apparent. However, we found that a majority of parents are not playing an instructional role at this station.
- Of the total 63 distinct children observed by floor ethnographers at the Bikes with a parent present, (only 4 children were unaccompanied by a parent), exclusive of reading out loud, 21 children did not receive assistance from a parent, and 13 did (remainder no data).

- Aside from reading signage or parts of signage out loud to the child, verbal interaction of parent to child included: 1) expressing encouragement, 2) giving straight instructions, or 3) posing instruction-motivated questions.

Magical Thinking
The children who we targeted (aged 4-8, with more children at the young end) demonstrated much fluidity in how they view the world. Their "candid camera" worthy remarks provided us with endlessly interesting explanations of stations in the exhibit and the exhibit as a whole:

- A 6 year old boy explains to us that the lights in the red tube are "…*electricity. I'm interested in electricity."*
- "*The tunnel that had those little lasers because it has lots of lasers, I was playing secret agents inside and trying to steal dinosaur bones inside."* – 6 year boy talking about the Laser Room
- Intestines are called "*the body tunnel*"
- A 4 year old boy at the Heart, and explaining the white (unhealthy part). "*It's broccoli. No. Cauliflower."*

There were also times, magical thinking or not, when honesty trumped reason:

- The last exit interview questions posed to children was, "If the museum was going to have snacks for children to have in the exhibit here (pointing generally to the exhibit) what would be good snacks to have? While many children did suggest fruits and vegetables, many also suggested pizza, french fries, candy and pasta.

  "*Fruits. Vegetables. And nothing else. Because it's Health. I learned it*."
  "*Well this is about being healthy, so I think I'd put a salad bar and like fruits*."
  "*Can't put crumby foods because the mice might come*." – 6 year old girl
  "*French Fries. Pizza*" [loud with squeals of enthusiasm] – five girls (cousins) in a group exit interview

Physical Activity

- Children spent more than 50% of their time engaged in moderate-to-vigorous physical activity (MVPA), greater than reported in previous studies for school recess and physical education.
- Younger children spent more time engaged in MVPA compared to older ones, and Hispanic/Latino children spent significantly more time engaged in MVPA compared to children of other ethnicities.
- NYC Green Cart exhibit was the most visited area accounting for nearly 30% of the visit time by all children, while the Decision Center was the least visited as children spent less than 10% of their visit in that location.
- Findings were presented in Ghent, Belgium at the 2013 Annual Meeting for the *International Society for Behavioral Nutrition and Physical Activity*.

Parent Survey
Parents completed a written survey while their child was interviewed.

- Almost 97% of parents surveyed rated their overall experience as good or excellent. At the same time, the majority (75%) thought that their child had "a lot of fun."
- Over three-quarters (78%) of parents rated the exhibit's ability to teach their children about healthy habits as good or excellent while 94% rated the exhibit's ability to teach the parents themselves as good or excellent.

- Almost 60% of the parents indicated that they learned something at the exhibit that would cause them to make changes at home in regards to nutrition, sleep, or activity level for their family.
- When parents were asked in the survey how to improve the exhibit and signage, recommendations included adding audio and headsets; incorporating more visuals like video and pictures; and enhancing signs with larger, simpler, and bullet pointed text in brighter colors.

Other Findings

- On both study days, at least one exhibit was found not to be working properly (Stomach and Table Top Cardio).
- We often observed that children in our target age did not "fit" well on the bike. Often their feet left the pedal and they had to reposition, or the overall movement of the mechanism was not smooth. Sometimes they persisted in spite of these ergonomics, and often they seemed frustrated.

Based on this evaluation, recommendations to enhance learning and physical activity at *EatSleepPlay™* include:

- Facilitate parents to be more active instructors at the exhibit. This might be achieved by providing signage prompts that give parents questions/short scripts to use with their children, or including web links or QR codes on signage that would allow parents to access further information on their mobile phones while they are at the exhibit.
- Train student volunteers/docents to walk the floor to explain, educate and engage children (and their parents) in particular station activities.
- Reconceive and redesign signage so that it poses clearer questions, tasks and problems in a user-friendly game-like environment since signage content may not be making its way to the children in some instances.
- Use technology as a mediator of engagement through live and virtual gaming and create after visit tools and resources, preferably mobile accessed for families to use together. Technology can also be used to extend contact both pre and post visit.
- Expand efforts to promote the *EatSleepPlay™* exhibit to socioeconomically disadvantaged and minority populations, as there is evidence the exhibit has the potential to have a greater impact on these groups.
- Design any future exhibit enhancements with the intention of increasing MPVA whenever possible, including the addition of stairs, slides and loose items in play settings which may aid in evenly promoting MVPA for both boys and girls.

BACKGROUND

Children's Museum of Manhattan (CMOM) & Hunter College

In May 2011, the Children's Museum of Manhattan's (CMOM) Executive Director Andy Ackerman invited Hunter President Jennifer Raab to visit the museum to view a model of its new health exhibit and learn more about CMOM's involvement in the area of childhood obesity. President Raab was shown a preview of *EatSleepPlay™*, the museum's new interactive exhibition where children and their families can explore how and why food, sleep and physical activity (PA) work together to power the body and fuel the mind. The 3,500 square foot exhibition is an immersive environment that reaches families with children as young as 2 years of age and up to 10 years old with creative messages focused on helping families develop positive behaviors in areas that most affect obesity: nutrition, physical activity, and, based on the latest medical research, sleep. CMOM's *EatSleepPlay™* exhibition is unique in that it targets parents and young children together, providing them with the building blocks to create a foundation for healthy lifestyles and uses an innovative interactive approach to deliver the latest medical and scientific information directly to families.

As discussions continued, their respective institutions' mutual interest in obesity and chronic disease prevention, nutrition and food choice, physical activity, and the development of healthy habits at a young age became more apparent. Both committed to exploring ways in which Hunter faculty and students and CMOM staff could partner and create meaningful linkages around these important health topics.

As a follow up to that initial meeting, a team of CUNY School of Public Health faculty, students, and staff met with CMOM staff to begin planning specific collaborations involving the museum's new *EatSleepPlay™* exhibit, CMOM's early childhood anti-obesity curriculum, and other health-related activities. Developing a field placement program for Hunter students at CMOM and reviewing the *EatSleepPlay™* exhibit content were identified as immediate next steps. Potential longer term priorities included evaluating the impact of *EatSleepPlay™*, creating professional development activities around the exhibit, creating policy-related components of CMOM's curriculum, assisting with the museum's health programming and exhibit in NYCHA housing, and incorporating use of social media and new technology in the museum's activities.

In Fall 2011, two Hunter faculty—Charles Platkin and Nick Freudenberg—served in a consultative role as expert reviewers on the content and signage of *EatSleepPlay™*. They worked closely with CMOM staff (along with other health experts) to enhance various elements of the exhibit prior to its opening to the public in November 2011. Around the same time, three Hunter student interns were placed with CMOM during that fall and winter to assist with nutrition research for CMOM's curriculum, website development related to *EatSleepPlay™,* and professional development training. CMOM also invited Hunter faculty and staff to attend a meeting at New York City Housing Authority's (NYCHA) Johnson Houses in East Harlem in January 2012 to learn more about its NYCHA engagement, tour the childcare and community facilities, and meet their Johnson Houses and NYCHA contacts.

In February 2012, CMOM indicated it was particularly interested in moving forward with one of its longer-term priorities—an evaluation of the *EatSleepPlay™* exhibit at the museum's West 83rd Street

location. In response, an internal Hunter College research working group was formed, consisting of four nutrition and community health education faculty members (Leung, Platkin, Yeh, Zarcadoolas), a dietetic intern (Agaronov) and a public health doctoral student (Kwan). This working group met over several months to design a multi-modal evaluation study to assess the impact of the exhibit on child and adult participants and recommend ways to enhance learning of healthy habits by children and families within the context of *EatSleepPlay™*. Hunter and CMOM signed a Memorandum of Agreement in summer 2012 which included scope of work, preliminary study design, timeline and budget and the study commenced at that time. The *EatSleepPlay™* evaluation's methodology, analysis, findings and recommendations are described in detail in this report.

Museums and Education

Examining the visitor's experience at museums has been a task that has grown in intensity over the course of the last 40 years.* There has been particular interest in the role that museums and zoos can play as sites of "free – choice" and informal science education. [1,2] Within the last fifteen years there has been a trend to move visitor studies away from assessments of literal factual learning, to more sociocultural approaches. [3]

Historically people visit museums for a wide range of social, recreational and educational experiences and their motivations can range from targeted information seeking to simply bringing children for a fun day. [4-9] The quality of the social experience that visitors have is often very important. [10]

Given the interest in informal science education, quality of social experience at museums, especially for families, and the epidemic of childhood obesity and other unhealthy lifestyle issues today, the Children's Museum of Manhattan's innovative and popular *EatSleepPlay™* exhibit aims to be fun and engaging for children and adults while also introducing and teaching both about food, health and nutrition.

Three frequently evaluated indicators of during-visit learning include: time spent, exhibit engagement, and interpretive talk.[11] It is generally understood that focusing on any one indicator is not highly revealing.

Food, Nutrition, & Physical Activity

Childhood obesity is a complex epidemic associated with poor dietary habits, such as inadequate intake of fruits and vegetables. [12] Only 30 to 45% of US children meet recommended fruit consumption levels, [13] while snacking on candy, salty snacks, fruit juice and fruit drinks has steadily increased in youth over the past three decades. [14] Furthermore, food preferences established in childhood tend to be maintained into adulthood, [15,16] thus highlighting the importance of promoting healthy dietary behaviors during childhood.

Physical activity (PA) compliments nutrition as one of the strongest predictors for childhood obesity. [17] Increased PA among youth is repeatedly shown to reduce the risk of child adiposity[18] as well as improve academic outcomes[19] and overall health status. [20] The Centers for Disease Control and Prevention (CDC) recommends that children receive at least 60 minutes of moderate-to-vigorous physical activity (MVPA) per day, [21] but less than 50% of children in the United States meet these guidelines. [22] In addition, disparities in PA are apparent across gender, age and ethnicity - girls engage in less PA than boys, PA

* See "Research Trends and Findings from a Decade (1997-2007) of Research on Informal Science Education and Free-Choice Learning, by Molly Phipps for an excellent review. *Visitor Studies*, 2010, 13(1), 3-22.

participation decreases with age and PA levels are disproportionately lower among certain ethnic groups.[22,23]

Schools are often identified as the ideal settings for the promotion of PA,[24] with recess providing the greatest opportunity to increase the number of children who meet PA recommendations.[25] However, the CDC reports that approximately 23% of children report no participation in MVPA during their free time.[26] Recent studies are encouraging cost-effective settings that are capable of promoting PA outside and after school.[27,28] Cultural institutions have especially been highlighted as potential settings for the promotion of healthy lifestyles for children.[29]

SPECIFIC AIMS

A stated goal of the Children's Museum of Manhattan's *EatSleepPlay™* exhibit is to provide interactive ways for families to create a healthier lifestyle together. Visitors are encouraged "to learn the essential facts and skills to make simple changes to build a strong and healthy future."

An evaluation study involving both qualitative and quantitative methods was conducted to identify and assess how child and adult visitors are experiencing the exhibit and what they are learning from their experience. The study was designed in two phases: Phase 1 includes Aims 1, 2 and 3 while Aim 4 is suggested for a potential Phase 2. This report describes findings from Aims 1, 2 and 3.

AIM 1: Identify and map how visitors in the target audiences navigate, engage and interact with the exhibit. The target audiences are children ages 4 to 8 years and adult primary caregivers accompanying their children to the exhibit. Methods include ethnographic observation, continuous videotaping and analysis.

AIM 2: Identify and characterize the knowledge, attitudes, perceptions, and questions the exhibit instigates. Data collection methods include short exit interviews, and surveys (age appropriate and caregiver).

AIM 3: Identify demographic differences in physical activity (PA) engagement of child visitors. Methods include direct observation and physical activity monitors.

AIM 4: Utilizing findings from Aims 1, 2 and 3, develop proposed exhibit aids and tools designed to enhance the target audience's learning experience from the exhibit (Phase 2, TBD).

METHODS

Exhibit Description

The *EatSleepPlay™* exhibit is composed of five areas: (1) *NYC Green Cart* encourages children to climb stairs, slide and play with loose items (toy fruit) in a jungle gym inspired by New York City Green Carts; (2) *Decision Center* utilizes electronic games to teach children about the brain's ability to make healthy choices; (3) In *Consequences*, children learn how nutrients are taken through the digestive system by crawling through intestines and pumping a giant heart; (4) *Sleep Center* includes manipulative games and screen-based activities to educate children on the importance of sleep; (5) *Play Center* encourages children to run, balance and pedal in an open space surrounded by five stations.

As stated above, the central goal in this study was to generate a rich description of the interaction of children, their parents and *EatSleepPlay™*, essentially focusing on how people interact with and experience the exhibit in order to gain insights about what they are learning from the CMOM exhibit.

We used a mixed methods approach in this study of the CMOM experience. Specific methods utilized were (see Appendix 1: Methodological flow chart):

1. Observation of children-parent (from here on, the term parent will refer to any adult accompanying the child) interactions with exhibit (on-the-floor observers using Formstack.com, an online form building tool and open-field notes)
2. Video recording of exhibit activity with multiple camera angles (no audio)
3. Exit interviews with children (partial audio)
4. Written survey of parent/adult accompanying the interviewed child
5. Direct observation of physical activity (on-the-floor observers using online and hard copy tracking forms)
6. Physical activity monitors

In this next section we briefly describe the methodological approaches for each form of data collection.

"I learned that when people pass gas, I thought it was on purpose, but after going through where how your food digests, they say it's natural. It's a way of getting out any bad gas that you don't want in your body. [Before] I felt like it was on purpose, I was embarrassed." – 9 year old, talking about the "Flush" toilet

Ethnographic Observation

Ethnographic observation is defined as the range of activities of watching and interacting with participants in naturalistic settings. The ethnographer's task is not only to collect information from the participant, but also to make sense of all data from the larger context perspective. Verbatim quotations are extremely useful in presenting a credible report of the research. These indicators allow the reader to judge the quality of the work and to assess whether the ethnographer used such data appropriately to support the conclusions.[30]

Ethnographers enter the field and focus on descriptive tasks that will enable them to answer questions about what type of interaction is taking place. With enough data gathered they then work toward explaining why patterns appear in their data. Ethnographic approaches are ideally suited for developing explanations of people in a wide range of social contexts. [31] Ethnography is a highly situated/contextualized form of research in which the environment, social context and actors are the central and dynamic components.

Qualitative research methods are especially useful for exploration and discovery. [32,33] The researcher interacts with people as "participants," rather than simply observing them as "subjects." Thus, the observers on the floor at CMOM were often seen as adult visitors, and it was not uncommon for other adults to make remarks or have brief conversations with them. With this model of research, participants who are potential beneficiaries of the research are directly involved in creating and revising the research through direct contact with the researcher.[34,35]

Video Recording of Exhibit Activity with Multiple Camera Angles (No Audio)

Five fixed video cameras were set up around the exhibit to record how children and their caregivers interact with the exhibit. No audio was recorded. A screenshot of the camera angles that were captured is below (see Image 1).

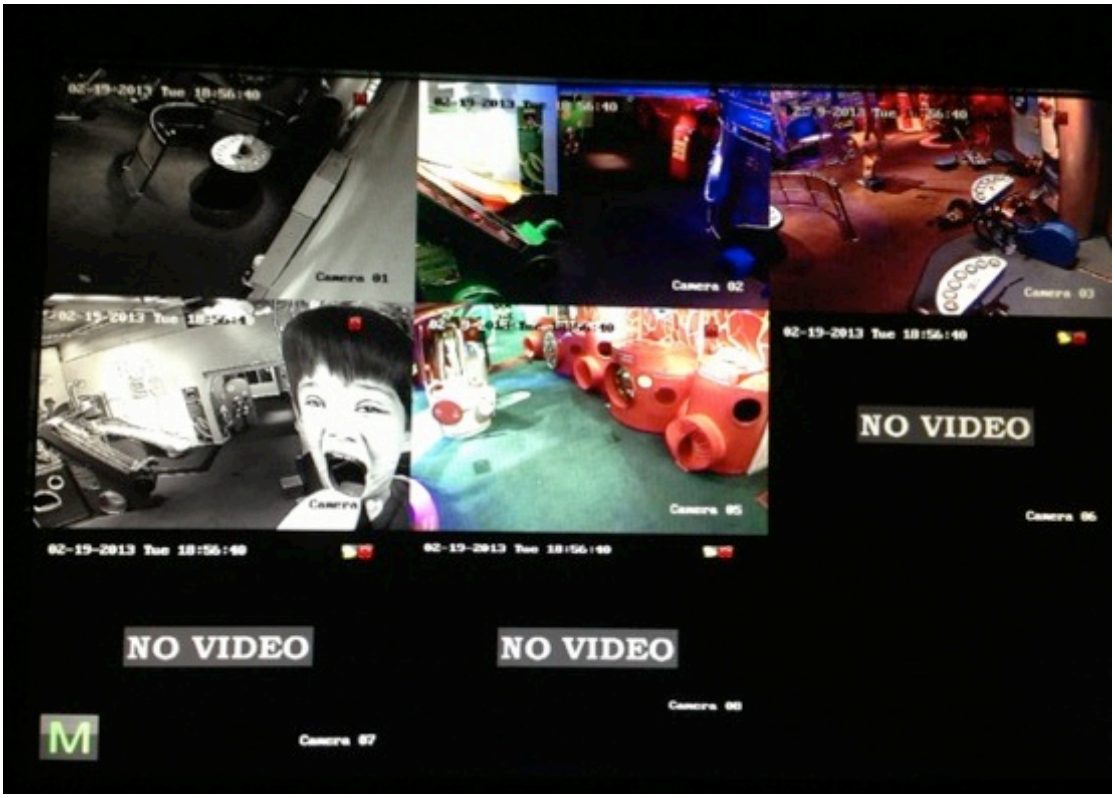


Image 1: Screenshot of Camera Angles

Exit Interviews and Surveys

Children between 4-8 years old who were accompanied by their primary caregivers and reside in the NY tri-state area were recruited to participate in brief exit interviews after they left the exhibit (see Image 2). Primary caregivers were also asked to complete a brief survey. Follow-up surveys with the primary caregiver (3-5 days post visit, and 6 weeks post visit) were emailed to those who participated in the exit interviews.



Image 2: Interviews

Direct Observation of Physical Activity

Physical activity (PA) was primarily measured by direct observation using a modified version of the System for Observing Play and Leisure Activity Among Youth (SOPLAY). [36] Observations were conducted across four different time periods between noontime and evening. Levels of PA (sedentary, moderate and vigorous) and predominant activity types (e.g. running, pushing buttons) were recorded across five exhibit areas (see Image 3) for both genders.

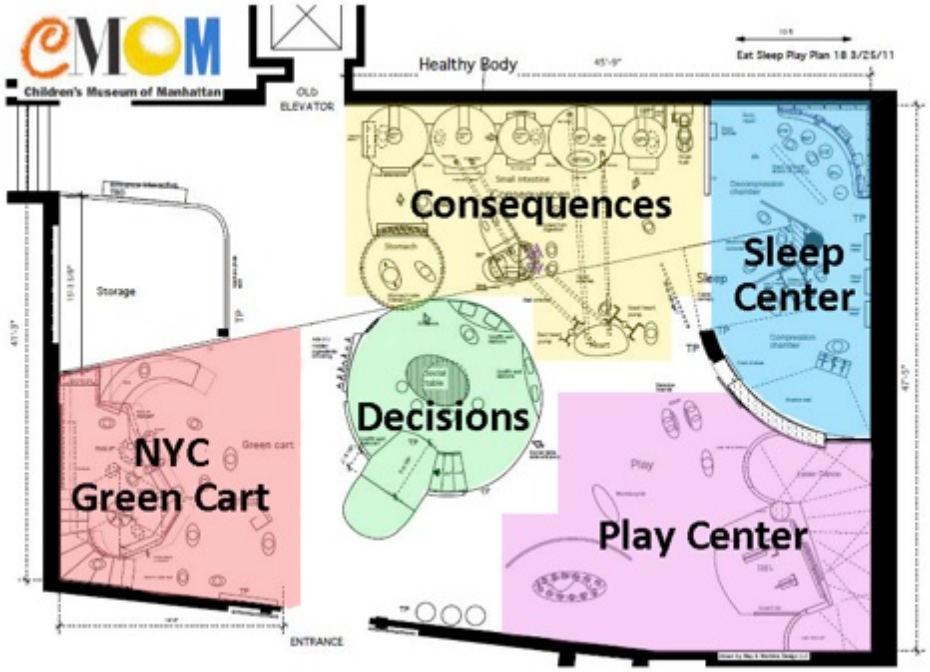


Image 3: SOPLAY Floor Map

Physical Activity Monitors

Physical activity was additionally measured with the use of physical activity monitors. [37] Children who agreed to be a part of the study were equipped with an Actical™ physical activity monitor (see Image 4) attached by an elastic belt on their right hip. Age, gender, weight (lbs), height (inches), and ethnicity were additionally collected from the participating child and/or parent. Activity monitors were set to collect activity data at one-second epoch lengths, as recommended for younger children.

Image 4: Actical™ Physical Activity Monitor

Time Spent Visiting Exhibit and Associated Areas

Child visitors who were recruited to wear physical activity monitors were additionally monitored for visit duration and exhibit location with the use of an observational tracking tool. Observers noted the location of child participants every 15 seconds using a mobile device linked to a form on Formstack (see Image 5). Observers monitored participants up to the first 20 minutes of their visit.

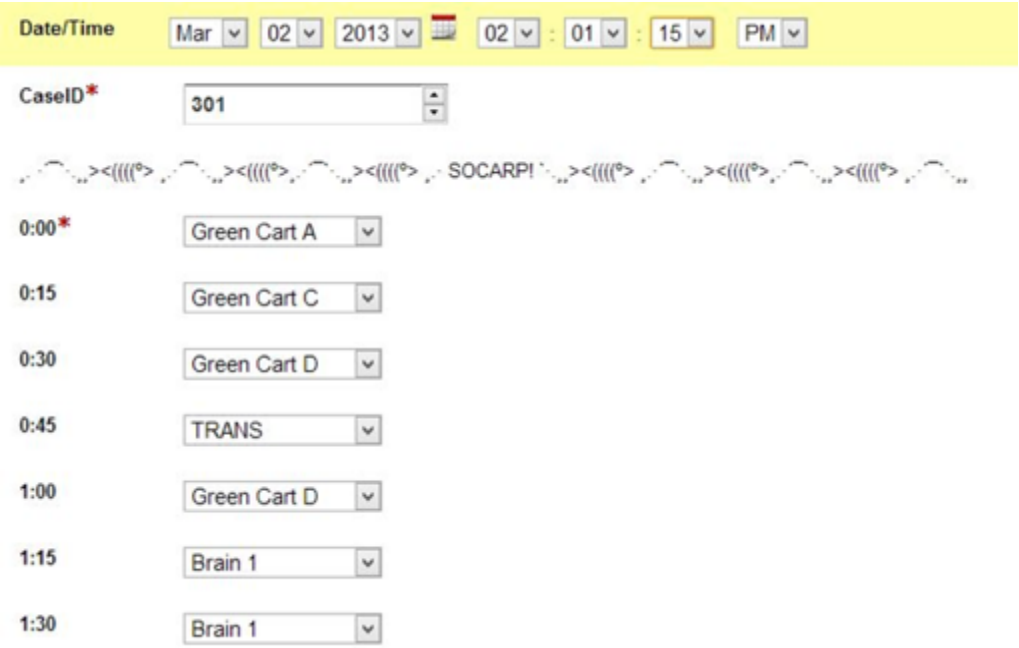


Image 5: Visit duration and exhibit location tracking form

PROCESS & PROCEDURES

Training of Student Researchers
Nineteen doctoral, master's and undergraduate students from Hunter College participated in four days of orientation to the CMOM evaluation project goals and objectives followed by training in the areas of ethnographic observation, participatory observation, and informed consent. Students gave feedback to draft observation and interview protocols and then were trained in the observation gathering tool (created in Formstack) and interviewing techniques.

A seven-hour pilot of all protocols took place at CMOM on Saturday, January 26, 2013

On January 11, 2013 from 10am - 3pm, students were trained in the ethnographic observation and the interviewing/consenting process. On January 15, from 1pm - 3pm, they were trained in the direct observation method and physical activity monitor portion of the study. On January 18, from 10am - 5pm, an on-site training at CMOM was held with all students, followed by a debriefing session on January 19, from 9am - 1pm (see Images 6 and 7).

Image 6: Training Session

Pilot Test

A seven-hour pilot of all protocols took place at CMOM on Saturday, January 26, 2013 (see Image 8). The pilot test allows researchers to determine how specific elements of data gathering are working and what needs to be adjusted for the formal field test. It also is a time to identify if there is something else that needs to be incorporated into protocols.


Image 7: Training Session

We revised the following specific items based on the pilot:

- Decision to begin data collection later in the day (~11am) as opposed to early in the morning, so as to better capture children in our target age range, as younger children (<4 years old) seemed to come during earlier hours
- Decision to collect data over the span of two days, to allow for reaching target sample size:

	4-6 year olds	**7-8 year olds**
Girls	30	30
Boys	30	30

- Increased focus and energy on recruitment for interviews
- Addition of pedometers for "extra" siblings to make them feel engaged even though the pedometers where not being tracked
- Inclusion of time to clean data – three laptop computers were set up in the Discovery Classroom to allow for ethnographers to revisit/update/clean data
- Location of the tables and more decorative (e.g., balloons, table cloths), inviting presence for children
- Addition of child-size table and chairs for interviews
- Inclusion of photographs of exhibit areas to help guide interviews. Pictures were enlarged and used as prompts for children to review and refer to during the exit interviews (see Image 8)
- Added question asking children to imagine what else they'd like to see in the *EatSleepPlay*™ exhibit
- Added question asking about what "snack" the museum might serve for children in this exhibit
- Modified data forms (e.g., Formstack.com) to accommodate both station observations and child observations
- Modified map of the exhibit and associated areas for direct observation

Image 8: Post pilot de-brief

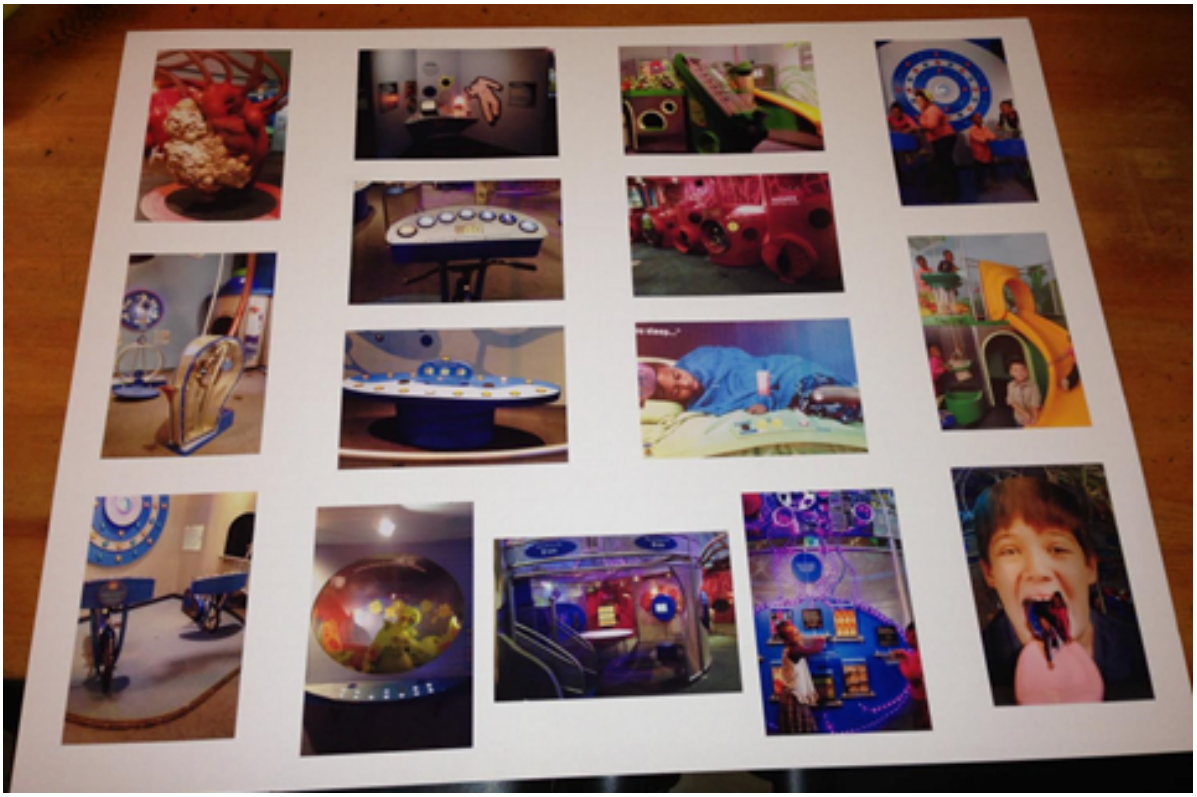
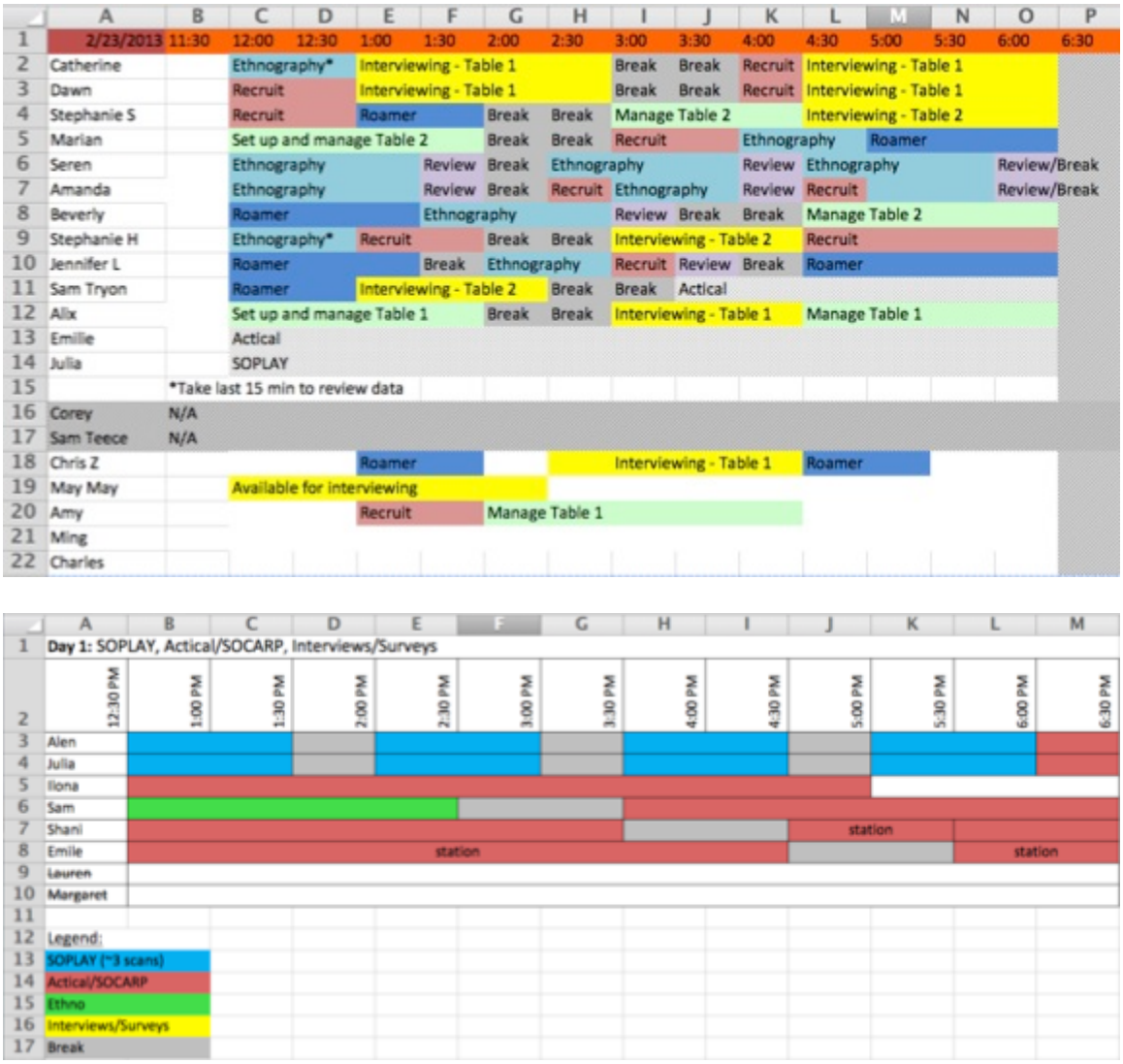


Image 9: Photographs of exhibit areas (used as prompts during interviews)

Image 10: Museum Director Andrew Ackerman and Deputy Director Leslie Bushara; Dr. Zarcadoolas interviewing a museum visitor.

Data Collection

Data collection occurred over the span of two consecutive Saturdays: February 23, 2013 (11:30am - 6:30pm) and March 2, 2013 (11:30am - 5:00pm). A detailed schedule was created to task individual researchers throughout the day and to ensure all modes of data collection were distributed throughout the day (see Image 11).



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	2/23/2013	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30
2	Catherine		Ethnography*		Interviewing - Table 1				Break	Break	Recruit	Interviewing - Table 1				
3	Dawn		Recruit		Interviewing - Table 1				Break	Break	Recruit	Interviewing - Table 1				
4	Stephanie S		Recruit		Roamer		Break	Break	Manage Table 2			Interviewing - Table 2				
5	Marian		Set up and manage Table 2				Break	Break	Recruit		Ethnography		Roamer			
6	Seren		Ethnography			Review	Break	Ethnography			Review	Ethnography			Review/Break	
7	Amanda		Ethnography			Review	Break	Recruit	Ethnography		Review	Recruit			Review/Break	
8	Beverly		Roamer			Ethnography			Review	Break	Break	Manage Table 2				
9	Stephanie H		Ethnography*		Recruit		Break	Break	Interviewing - Table 2			Recruit				
10	Jennifer L		Roamer			Break	Ethnography		Recruit	Review	Break	Roamer				
11	Sam Tryon		Roamer		Interviewing - Table 2			Break	Break	Actical						
12	Alix		Set up and manage Table 1				Break	Break	Interviewing - Table 1			Manage Table 1				
13	Emilie		Actical													
14	Julia		SOPLAY													
15		*Take last 15 min to review data														
16	Corey	N/A														
17	Sam Teece	N/A														
18	Chris Z				Roamer				Interviewing - Table 1			Roamer				
19	May May		Available for interviewing													
20	Amy				Recruit		Manage Table 1									
21	Ming															
22	Charles															

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Day 1: SOPLAY, Actical/SOCARP, Interviews/Surveys												
2		12:30 PM	1:00 PM	1:30 PM	2:00 PM	2:30 PM	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	6:30 PM
3	Alen													
4	Julia													
5	Ilona													
6	Sam													
7	Shani										station			
8	Emile					station							station	
9	Lauren													
10	Margaret													
11														
12	Legend:													
13	SOPLAY (~3 scans)													
14	Actical/SOCARP													
15	Ethno													
16	Interviews/Surveys													
17	Break													

Image 11: Schedule of Data Collection

Data Management and Hunter College Human Research Protection Program (HRPP) Office (IRB)
Upon approval by CMOM, the research plan was submitted to the Hunter College Human Research Protection Program (HRPP) Office (Institutional Review Board (IRB)); the research protocol (#377072-4) was approved on 11/14/2012. Subsequent amendments were approved on 1/17/2013 and 2/20/2013.

All necessary steps were taken to prevent identification of individuals who participated in the project. All research staff were required to successfully complete the protection of human subjects certification course provided by CITI (Collaborative Institutional Training Initiative, www.citiprogram.org). Any documents with personally identifying information (e.g., consent forms, contact information) were stored separately from questionnaire data so that they cannot be linked. Further, all interview and questionnaire responses were identified with codes, and not actual names.

Incentives
Each family was given a goody bag filled with CMOM and Hunter College items (e.g., magnets, pens, pencils) in addition to a CMOM pass.

ANALYTIC APPROACH

Video and audio were analyzed qualitatively (described below) and parent surveys were analyzed quantitatively. Finally, we triangulated data. Triangulation is the use of dissimilar methods or measures, which do not share the same methodological weaknesses – that is, errors and biases.[38,39] We triangulated the data from live observations (recorded in Formstack) with the data from the videos (not matching subjects), and interviews with children upon exit.

Live, On-the-Floor Observations

During the field study there were nine observers on the floor recording pre-determined phenomena at any given station. The observers used mobile devices (iPhones/iPads) to record observation in Formstack (see Image 12), using multiple choice categories and open-field notes (see Image 13).

Image 12: Ethnographer recording observations on Formstack

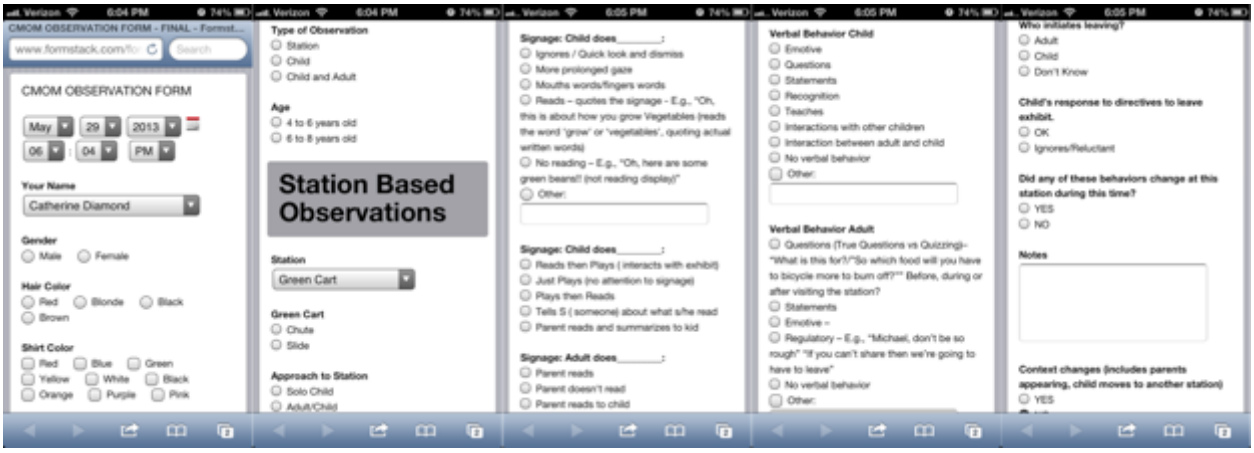


Image 13: Screenshot of Formstack for Ethnographic Observations

An example of elements that were coded during on-the-floor observations included noting what a child does at a station:

1. Attempts to use – with assistance
2. Attempts to use – without assistance
3. Joins in with others as models
4. Just Plays
5. Requests assistance

Data in Formstack were imported into Microsoft Excel for descriptive analysis. Numbers were tallied and presented in percentages. Findings presented were based on observations made on each of the two substations (Bikes substation within the Play station and Screen substation within the Brain station). A total of 63 and 21 observations of children were made at the Bikes and Screen substations, respectively. In order to facilitate interpretation of findings, response options from some questions with multiple choice options were combined in the tables presented.

Informal data analysis took its earliest form during informal discussions among the teams in the break room in between shifts on the museum floor. This time was used for researchers to "clean data" that they had just entered on the floor (Formstack) and to freely talk about what they had seen and heard on the floor. This included a wide range of observations and questions. For example, commenting on a phenomena such as, "lots of children spend only a few seconds at many exhibits," or, "Do children seem to understand how to play the Brain table game?" Researchers took quick notes on issues as well as questions that arose so that these could be reconsidered when formal analysis began.

Video/Audio Data Analysis

Qualitative/ethnographic methods were used to observe, record and analyze data from the video cameras, notes from floor ethnographers and interviews with children. As with all qualitative methods, the analytical process was highly collaborative and iterative. Data were analyzed interpretively, using the principles of grounded theory. [40-42] Grounded theory involves constantly comparing the data, coding and identifying interchangeable indicators to reveal patterns that ultimately lead to categories.

To reach inter-coder reliability two coders independently and repeatedly listened to segments of audio, referred to quick notes and then conferred to discuss and refine emerging topics and themes. This

process continued until agreement of more than 80% was reached and then the coding guide was finalized. The coding guide and accompanying narrative summary was developed to describe the key content of each interview. Two primary coders analyzed audio files. Because of the poor quality of the audios we determined that we would use this data to cull representative child statements once the major themes were derived from the observational data.

The same randomly chosen segments of video were independently viewed and coded. Coders came together to discuss their codes. They then coded additional data and returned to discuss evolving codes again. This process was continued until 100% agreement was achieved for all codes.

Parent Surveys

Formstack data were first imported into Excel and then analyzed using IBM SPSS Statistics 20. Frequencies and means were run on all variables. A total of 65 surveys were returned for analysis. However, due to missing values, the total numbers presented in tables may not always add up to 65.

Direct Observation of Physical Activity

Direct observation allows for a generalized measure of different PA levels (sedentary, moderate and vigorous) across a large group of people in an open environment. Moderate and vigorous PA were combined into moderate-to-vigorous physical activity (MVPA) and presented as percentage of time child visitors were engaged in MVPA. Predominant activity types were additionally presented as percentages. Data were analyzed using Chi-squared test.

Physical Activity Monitors

Data from PA monitors were collected on 35 child visitors. Levels of PA were selected based on cut-points provided by the manufacturer (Actical™). Moderate and vigorous PA were combined into MVPA and presented as the percentage of time child participants were engaged in MVPA. Average energy expenditure (EE) was calculated and presented in kilocalories (kcal). Total time of visit was additionally retrieved from monitors and summed across gender.

Time Spent Visiting Exhibit and Associated Areas

Child visitors who agreed to wear PA monitors were also observed for time spent visiting the exhibit. Observational count data from the tracking forms were converted into percentages to determine the percentage of time child participants spent at the five exhibit areas during their visit.

FINDINGS

The *EatSleepPlay*™ exhibit is a space where it is nearly impossible to find an idle child. From the time children and parents (we will use this term to refer to accompanying adult) enter, either queued for the coat check or entering this first floor exhibit, children are anxiously eyeing the fantastical and intriguing presence that is *EatSleepPlay*™. It is well known that children learn through play and interaction. [43,44] When children can make choices and have some control of their interactions, learning is enhanced. [45,46] Likewise, when children collaborate with other children learning is more likely to occur.[47,48]

Children can simply play for playing sake, or to more obviously learn. Experts agree the line between the two is almost impossible to identify and therefore these terms reflect more of intention that function. They can learn new concepts and facts similar to this knowledge in the adult world, and they can certainly "learn" new concepts and facts through the lens of the world as they see it at their stage of development.

- Green Cart: *"I liked the food conveyor belt. You pull food through the thing and they come up to the top then they put it back down the shoot. Grow foods, go foods, and slow foods. There are two shoots to put it down but there's only one thing to bring it up."* – 5 year old girl
- Intestines: *"I didn't really like this because it was hot and it was boring. I kept on going inside and I made the fun go out of it. I keep on going inside and then I keep on getting bored." "What's inside?" "Big brown balloon things."* – 6 year old boy
- [A little less accurate] Intestines: *"That's awesome. Because it has lots of stuff for me to go over and around. I am going over the red lumps. I went around the lungs."* – 6 year old boy

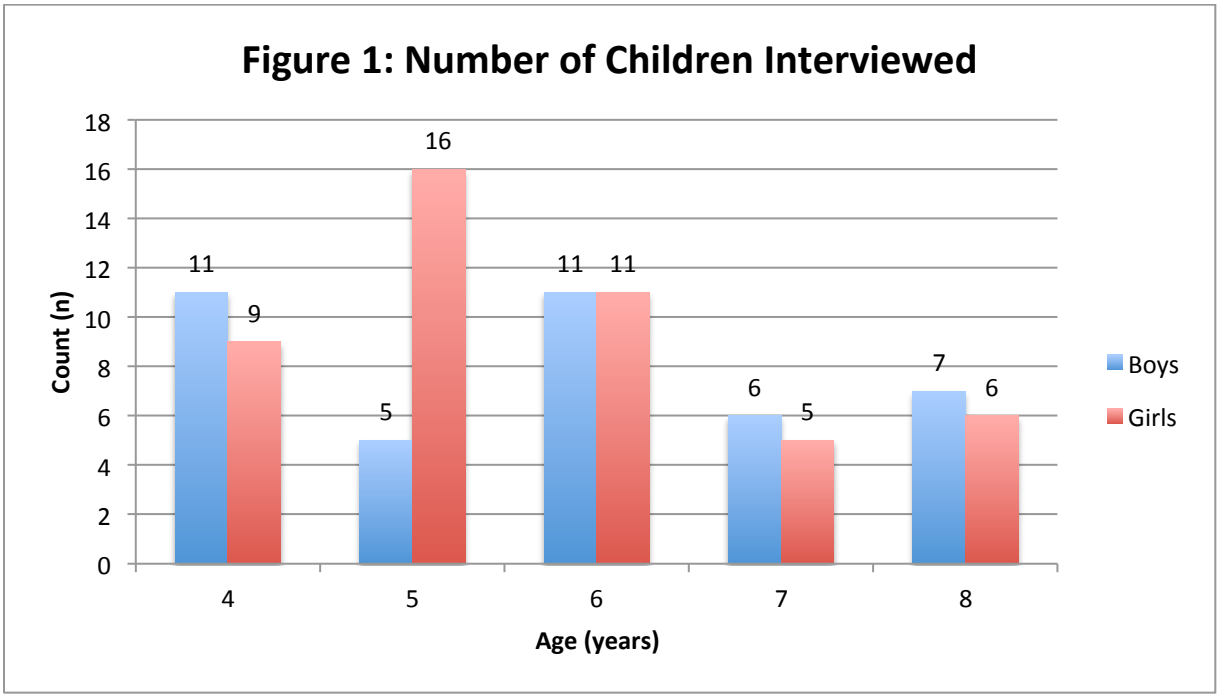
Children can be alternately exalted and befuddled in their attempts to play or learn. There are often not clear demarcation lines between the two. It is far easier to put your finger on learning when children proclaim it in loud statements. In our time at CMOM we saw evidence of all kinds of play and learning, and we also saw obstacles to learning. It is beyond the scope of our study and this report to take a deep dive into the layers at which learning may be occurring at *EatSleepPlay*™. What we can do is report how we observed play and learning manifesting themselves and identify some of the facilitators and barriers to play and learning.

"You press a food and you have to burn all the calories off"…."How did you learn that?" "I read the instructions" - 5 year old girl

Ethnographic Observation

Who We Observed, Where

We conducted 70 interviews with 87 children between 4-8 years old (see Figure 1). Three interviews were conducted with children outside of our target age range, and are not included in these analyses. Several interviews were conducted jointly with siblings. Of the 87 children, half were visiting *EatSleepPlay*™ for the first time, while the other half had visited before.



Four central themes emerged from the three primary types of data analyzed (live ethnography; video; exit interviews with children). The themes are:

1. Playing to Play
2. Play to Learn: I just figured it out by myself!
3. The Brain and The Bikes: The Role of Intermediaries - Hoverers, Helpers and Not-So-Muchers
4. Room for Magical Thinking

We discuss these themes below.

Playing to Play

EatSleepPlay™ is a place of play. Play is one of the earliest and most powerful things we do as humans, especially when we're young. It's something that we share with the larger animal world. Play is a primary way we learn and continue learning through life. [49,50] While some child development and language development experts argue convincingly that all play has a teaching/learning function, for our purposes we first will talk about observing children engaging in the most unambiguous forms of play. With the exception of the Green Cart and Intestines, the majority of play we observed was singular children at play. The collaborative play we observed was more likely to occur with siblings or with friends who had come to the museum together.

- *"I played tag there with my friend. It has a lot of tunnels."* - 8 year old girl, at the Intestines

At the Green Cart and Intestines we commonly observed children, upon entering the exhibit area, observing other children and "joining up." Common to many social play settings, a child observed and copied or mirrored the behavior of another child. It was not uncommon for children to shout instructions to other children. We certainly observed much competition at the Green Cart.

- *"Because I got to grab, grab, grab and put the food in and it goes up, up.*" – 5 year old boy, describing why he liked the Green Cart so much

We observed far more parallel play than collaborative play at the Energy In/Energy Out, Sleep, Table Top Cardio and Brain stations. At the Table Top Cardio station particularly, we observed much active competition with known playmates or a parent, rather than with unknown others. In the focused observation on the bike we did not observe much collaborative play. For example, you might expect that one child would see what number another had reached in pedaling and then commented. We did not observe this at all. Rather we did observe one child waiting, sometimes impatiently for the other child to abandon the bike so that they could get their turn.

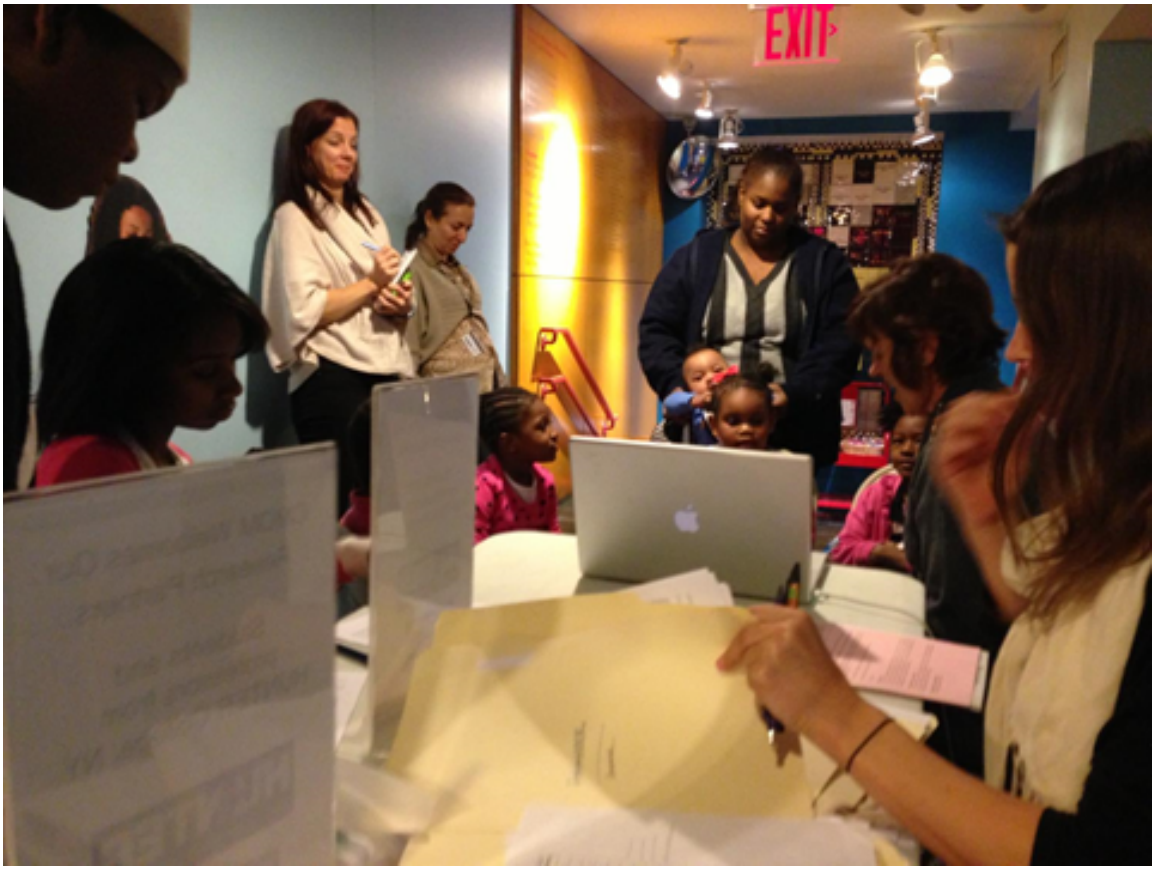


Image 13: Dr. Zarcadoolas conducting an exit interview with a group of 5 girls with Hunter College research team observing close by

Play to Learn: I just figured it out by myself!

While learning is only one function of visiting a museum, the *EatSleepPlay*™ exhibit foregrounds learning through playing as a way to introduce concepts and information about health and wellness. We observed children figuring things out and we spoke with children who told us how they "figured things out" on their own or with little assistance. The following are comments of children explaining various stations:

"*[On the bike] You press a food and you have to burn all the calories off"…."How did you learn that?" "I read the instructions"* - 5 year old girl

[Toilet] *"I learned that when people pass gas, I thought it was on purpose, but after going through where how your food digests, they say it's natural. It's a way of getting out any bad gas that you don't want in your body. [Before] I felt like it was on purpose, I was embarrassed."* – 9 year old, talking about the "Flush" toilet

[Sleep] *"If you press the things that take the sleep away, then they're grumpy in the morning."* – 4 year old boy

[Heart] *"This is the good part and this is the bad part…it's hard to turn and it can't pump blood."* – 6 year old boy explains that he and his mother did it together

[General about exhibit] *"It's cool because I'm learning we have lots of different things in our bodies and you think what you don't know."* – 8 year old girl

[Heart] *"It's broccoli. No. Cauliflower."* – 4 year old boy at heart, explaining the white, unhealthy part

There were also clear examples of children not learning even when they were trying:

"I didn't know what to do anything with [sic] the wheel but I kept trying to push it" – 8 year old girl

7 year old girl #1: *"I put my hands on the table."*
Interviewer: *"Do you know what the point was? Was it a game?"*
7 year old girl #1: "Body part…Like moving snakes."
7 year old girl #2: *"It was like going into a kid's brain.*"

"The food you pick tells you how many minutes you ride." – 5 year old girl, discussing the bike

"*Fingers."* – 5 year old girl, when asked [while pointing to a picture of the Intestines] naming what she thought the station was

"I saw things that looked like feet." – 6 year old boy, describing the Intestines. This was a frequently heard comment. Children said there were feet / legs in the intestines.

"It's cool because I'm learning we have lots of different things in our bodies and you think what you don't know." – 8 year old girl

The Brain and the Bikes: The Role of Intermediaries - Hoverers, Helpers and Not-So-Muchers

Given the available time and resources we did not attempt an analysis of all of the data we collected. We observed more children in our target age group at the Brain and the Bikes and therefore, we analyzed representative portions of data collected at these two sites (live ethnography and video). We will use the Brain and, more extensively, the Bikes, to discuss our findings.

We found that a key variable influencing whether or not a child got the point of a station or stayed at the station was the role the accompanying parent played. We observed that children are more likely to "figure out" a station when it is: 1) child-intuitive and easy to use, and/or 2) the child is instructed by a parent/intermediary.

We will use the two computer screens in the Brain Station and the Bikes as examples of the important roles intuitive design and the use of intermediaries as instructors play. We will use the terms parent/s to mean any adult accompanying the child.

Computer Screens at the Brain Station

A total of 21 live observations (no video) were made at the "Computer Screen" substation in the "Brain" station (see Table 1). We found that 19% of the parents did not read any signage at all, 19% of the parents read the signage to themselves and 29% read the signage to their children. Generally speaking, we observed that children most often approached the screens interested in doing something with them and expecting to figure it out. There is much evidence showing that intuitively designed screens are very quickly figured out by very young children. However most children we observed could not figure out what these screens were for. They attempted to use it as an interactive touch screen but within 30 – 60 seconds abandoned the area. Furthermore, although as stated above that close to 50% of parents either read the signage themselves or to their children, we observed that parents didn't seem successful at figuring them out either. As a result, they seemed lost and often left for other stations quickly. No child mentioned this station on interview.

Table 1: Signage Reading at Computer Screen/Brain Station	**n**	**%**
Signage: Adult does _____:		
No parent	0	0%
Parent doesn't read	4	19%
Parent reads to self	4	19%
Parent reads to child	6	29%
Other	3	14%
Blank	4	19%
Total	**21**	**100%**

A total of 87 children between 4-8 years old were interviewed

The Bikes (An example of child / parent interactions and behavior at one exhibit station)
We analyzed 3 hours and 40 minutes of non-continuous video from the Bikes and analyzed ethnographer observational data from 110 children at the Bikes (we did not attempt to match children across the two observational methods). Footage was chosen because it represented a time of day at CMOM where a greater number of older children, rather than very young children, were in attendance. Video of the Bikes allowed us to closely observe whether a child "figured out" the main point of the bike – that peddling gives you a number that stands for the calories you are burning off and this number needs to be compared to the number in the snack food you selected – or did not figure this out. We did this by closely observing in two scenarios: when an adult was present and when an adult was not present. We observed for the following behaviors: 1) adult/child interaction and the child's responses; 2) willingness to stay on task and expressions of trying to reach a goal; and, 3) ultimately an expression from the child or parent of accomplishment.

Of the total number of 110 children in the target age group observed on selected video 62 were observed with an adult, and 48 without an adult. Table 2 represents the behaviors we coded in the two scenarios.

Table 2: Coded Parent Behaviors (Video)	**Counts**
Context 1: Child Accompanied by Adult	
Engagement	
Adult points	29
Adult reads (out loud or to self)	11
Instruction	
None	27
Initially instructs	12
Corrects or re-instructs as some point in episode	20
Context 2: Unaccompanied Child (No Adult)	
Goal or Play	
Attempts, doesn't figure out goal and leaves	8
Attempts, doesn't figure out but stays and plays	23
Attempts and figures out goal – stays on task	17

From the video we observed that there were three common parent behaviors at the Bikes station. The first scenario is: parent(s) would accompany a child to the bikes. These parents would either be disengaged, looking at their cell phone or staring into space, or they would loosely monitor the child's location and behavior, or they would provide instruction to the child to indicate the purpose and goal of the Bikes. The second scenario is: children who approached the Bikes alone, without parent accompaniment. A number of these children rode the bike with a defined purpose, shown by scrutinizing the calorie counter, interacting with the buttons, and adjusting their biking according to the goal. The majority of children we observed however, biked for varying periods of time without purpose, became disinterested with playing, and left the station. The third approach is telling – a child begins biking and seemingly does not have a goal. After a period of time, a parent enters the scene and begins instructing. There is a clear transition from biking for play to biking with a purpose. With instruction, there is indication of understanding and the focus of the play is redirected towards goal. The intervention of the parent with timely instruction clarifies the causal relationships and makes the goal of the play task apparent.

When we compared video data to live observation data (Formstack, not of the same children), findings revealed that a majority of parents are not playing an instructional role at this station.

The two tables below are live observation data (Formstack) from the Bikes. The tables report parents' reading behaviors at the Bikes (Table 3a), and importantly, the frequency of instruction they provided to their child (Table 3b). Of the total 63 distinct children observed by floor ethnographers in the scenario of parent present, (only 4 children were unaccompanied by a parent), exclusive of reading out loud, 21 did not receive assistance from a parent, and 13 did. Among the children who used the bikes without assistance, none figured it out (calorie lesson). It was difficult. We conclude that the parent as instructor/intermediary is an important factor, especially when the station items do not behave as the children are expecting them to, or when other design elements present barriers. We will discuss these two factors in the Recommendations section.

Table 3a: Parent Reading Behaviors at Bikes (Live Observation)	**n**	**%**
Signage: Adult does _____:		
No parent	4	6%
Parent doesn't read	14	22%
Parent reads to self	9	14%
Parent reads to child	18	29%
Blank	18	29%
Total	**63**	**100%**

Table 3b: Parents Aid/Instruction at Bikes (Live Observation)	**n**	**%**
Child at a station does: _____		
Attempts to use – with assistance	13	21%
Attempts to use – without assistance	21	33%
Joins in with others as models	4	6%
Just plays	12	19%
Other	2	3%
Blank	11	17%
Total	**63**	**100%**

Aside from reading signage or parts of signage out loud to the child, some parents verbally interacted in other ways with their child. They did so by 1) expressing encouragement, 2) giving straight instructions, or 3) posing instruction-motivated questions (see Table 4). The following are examples:

Expressing Emotion/Encouragement:

- *"Yay! Good job."*
- *"Almost done buddy!"* The child actually bikes the entire length of time burn.

Instruction:

- *"This is how many calories you can burn."* [Encourages faster peddling].
- *"You gotta burn that pizza off*, [name of child]! *Go faster!"*

Instructional Questions:

- (Child peddling.)"*Calories are energy, which has the most?"*
- *"It's easier to balance with your feet apart. It's harder if your feet are closer together."*
- *"Oh, 23 that was good."*
- *"Soda is very bad for you. What about fried chicken? Is it good for you? What other kinds of potatoes can you have - others that aren't fries?"* (when referring to the snack selection on the handlebars).

Table 4: What Parents Say to Their Child	**n**	**%**
Verbal Behavior (Adult)		
Emotive	1	5%
No verbal behavior	5	24%
Questions	3	14%
Regulatory	3	14%
Statements	8	38%
Blank	6	29%
Number of observations	**21**	

Room for Magical Thinking

Metaphor and magical thinking are closely associated and hallmarks of children's thought and language.[51-53] Both metaphorical thinking and magical thinking are critical parts of language and cognitive development. Some describe the 5-6 year old as "predictably unpredictable" in their thinking and reasoning. Certainly the early years of school give a child the place to experiment and grow into better understandings of important concepts such as agency and cause and effect. The children who we targeted (aged 4-8), with more children at the young end, still were at a stage of moving easily in and out of reality and there was a fluidity in how they view the world that provided us with endlessly interesting explanations of stations in the exhibit and the exhibit as a whole.

- A 6 year old boy explains to us that the lights in the red tube are *"…electricity. I'm interested in electricity."*
- *"The tunnel that had those little lasers because it has lots of lasers, I was playing secret agents inside and trying to steal dinosaur bones inside."* 6 year boy talking about the laser room
- Intestines are called *"the body tunnel"*
- A 4 year old boy at heart, and explaining the white (unhealthy part). *"It's broccoli. No. Cauliflower."*
- *"It's pumping and pumping….and it tells you when you have to breathe."*

The entire exhibit says, "Touch me, climb up onto me, crawl through me and push and pull as many levers as you see here."

What did you like the most?

We asked children, "What was your favorite thing in the exhibit today?" Of the 87 children we spoke to, 71 responded to this question. The majority (17%) cited the Green Cart (e.g., *"broccoli, I sent it up the conveyer and down the shoot"* – 7 year old boy) as their favorite. This was closely followed by the laser room (16%), intestines (14%) and bikes (13%).

What else would you like to see in the EatSleepPlay™ exhibit?

One of the last questions we posed to the older children (6-8 year olds) in the exit interviews was: "We need your help – how would you make this exhibit even better?" Children were creative in their ideas about what to add to the exhibit. Their answers more often reflected the themes of healthy behaviors, activity and nutrition (e.g., many children recommended the addition of a trampoline), but sometimes the association was harder to make.

- *"I would put in an indoor trampoline. It's exercise." "Anything else?" "Running course"* – 9 year old boy
- *"A sandbox"* – 8 year old girl
- "*Add a castle, (take intestines away and add it), Put shoes inside and little carrot people and ghosts flying up?"* – 6 year old boy.
- *".…….if there was an exhibit that was a water park [sic] I'd love it."* – 5 year old girl

As one of the very last questions we asked children, "If the museum was going to have snacks for children to have in the exhibit here (pointing generally to the exhibit) what would be good snacks to have? While many children did suggest fruits and vegetables, many also suggested pizza, French fries, candy and pasta.

- *"Can't put crumby foods because the mice might come."* – 6 year old girl
- *"Vegetables and fruits. Things that help us to grow and make us strong."* – 7 year old girl
- *"Fruits. Vegetables. And nothing else. Because it's Health. I learned it."*
- *"Well this is about being healthy, so I think I'd put a salad bar and like fruits."*
- *"French Fries. Pizza"* [loud with squeals of enthusiasm] - five girls (cousins) in a group exit interview

Broken or Perceived Broken Exhibits

During the pilot and formal data gathering there was at least one exhibit that was not functioning correctly. For the pilot it was the Stomach and in March it was the Table Top Cardio. Kollmann's study at

Boston Science Museum found that when visitors perceived that exhibits were broken or not working correctly, this more negatively impacted their satisfaction with the visit more than the actual number of broken exhibits. "The number of broken exhibits a visitor perceives impacts their disappointment in the gallery more than Museum counts of broken exhibits."[54]

Additionally we often observed that children in our target age did not "fit" well on the bike. Often their feet left the pedal and they had to reposition, or the overall movement of the mechanism was not smooth. Sometimes they persisted in spite of these ergonomics, and often they seemed frustrated.

Parent Survey

Table 5 below shows the demographic information of parents who completed the survey (n=65). Seventy percent of the respondents were female and 73% had a bachelor's degree or higher. The majority of those surveyed were white (59%), followed by Caribbean/West Indian (9.8%) and African American (8.2%). A separate question regarding Hispanic ethnicity indicated that 27% identified themselves as Hispanic/Latino. The majority of respondents (52%) had a household income of $110,000 or greater. The average age was 37.7 ± 8.5 years.

Table 5: Parent Demographics (n=65)*		
	n	%
Gender		
Male	17	29.8%
Female	40	70.2%
Education		
Less than high school	0	0.0%
High School/GED	6	9.5%
Some College/ 2 year diploma	10	15.9%
Technical/vocational training	1	1.6%
College diploma (Bachelors)	23	36.5%
Some graduate school	0	0.0%
Graduate school diploma (Masters or higher)	23	36.5%
Race/Ethnicity		
African-American	5	8.2%
African	0	0.0%
Asian/ Pacific Islander	4	6.6%
Caribbean/ West Indian	6	9.8%
American Indian/ Alaska Native	0	0.0%
White	36	59.0%
Multiracial/ Mixed Race	2	3.3%
Other	8	13.1%
Latino/Hispanic Ethnicity		
Yes	16	27.1%
No	43	72.9%
Household income		
under 9,999	1	1.6%

10,000- 29,999	6	9.7%
30,000- 49,999	6	9.7%
50,000-69,999	8	12.9%
70,000-89,999	6	9.7%
90,000- 109,999	3	4.8%
> 110,000	32	51.6%
	Mean	SD
Age	37.7	8.5

*Due to missing values, total n may not always add up to 65.

Table 6 summarizes the overall experience at the *EatSleepPlay*™ exhibit. Sixty-four percent of the respondents indicated that this was their first time visiting and almost 97% rated their overall experience as good or excellent. At the same time, the majority (75%) thought that their child had "a lot of fun." Of the stations within the exhibit, parents felt that their children most enjoyed the Green Cart (52%), the Laser Dance Room (42%), and the Bikes and Big Wheel Paddle (41%). Parents also enjoyed the Laser Dance Room and the Bikes and Big Wheel Paddle (both 30%), followed by the Intestines (25%). When asked for the reason why they chose a station as their favorite, most indicated that they found the station interesting or informative (57%) followed by interactive and just fun (32% respectively).

Table 6: *EatSleepPlay*™ Experience		
	n	%
First time visiting exhibit		
Yes	42	64.6%
No	23	35.4%
Overall Experience		
Poor	0	0.0%
Fair	2	3.1%
Good	27	41.5%
Excellent	36	55.4%
Exhibit level of Fun for Child		
Not much fun	0	0.0%
Some fun	16	24.6%
A lot of fun	49	75.4%
Child's favorite station *		
Green Cart (chute, slide)	33	51.6%
Ads (portion sizes, advertising messages)	0	0.0%
Intestines (nutrients, fiber, tunnel, flush)	21	32.8%
Sleep (hockey table, food choices, monsters, mood mirrors)	6	9.4%
Heart and Respiratory	11	17.2%
Brain (telephone, screens, choice table)	7	10.9%
Bikes, Big Wheel Paddle	26	40.6%
Laser Dance Room	27	42.2%
Table Top Cardio, Balance	18	28.1%

Other: Entrance Tongue Slide	1	1.6%
Don't Know/ Can't really say	1	1.6%
Parent's favorite station *		
Green Cart (chute, slide)	12	19.0%
Ads (portion sizes, advertising messages)	8	12.7%
Intestines (nutrients, fiber, tunnel, flush)	16	25.4%
Sleep (hockey table, food choices, monsters, mood mirrors)	8	12.7%
Heart and Respiratory	11	17.5%
Brain (telephone, screens, choice table)	11	17.5%
Bikes, Big Wheel Paddle	19	30.2%
Laser Dance Room	19	30.2%
Table Top Cardio, Balance	5	7.9%
Other	0	0.0%
Don't Know/ Can't really say	2	3.2%
Reason for choosing favorite station *		
Just Fun	20	32.3%
Interesting/ Informative	35	56.5%
Interactive	20	32.3%
Increased activity level of my child(ren)	10	16.1%
Doing it together with my child(ren)	6	9.7%
Other: to learn	1	1.6%

* Multiple select question, % does not total 100

Figure 2 offers a visual comparison of the parent's versus children's favorite stations, as perceived by the parents and not as reported by the children. While children most enjoyed stations where they could play and have fun (Green Cart and Laser Dance Room), parents were more evenly distributed and enjoyed the informative stations like Heart and Respiratory, Brain, Sleep, and Ads more so than their children did.

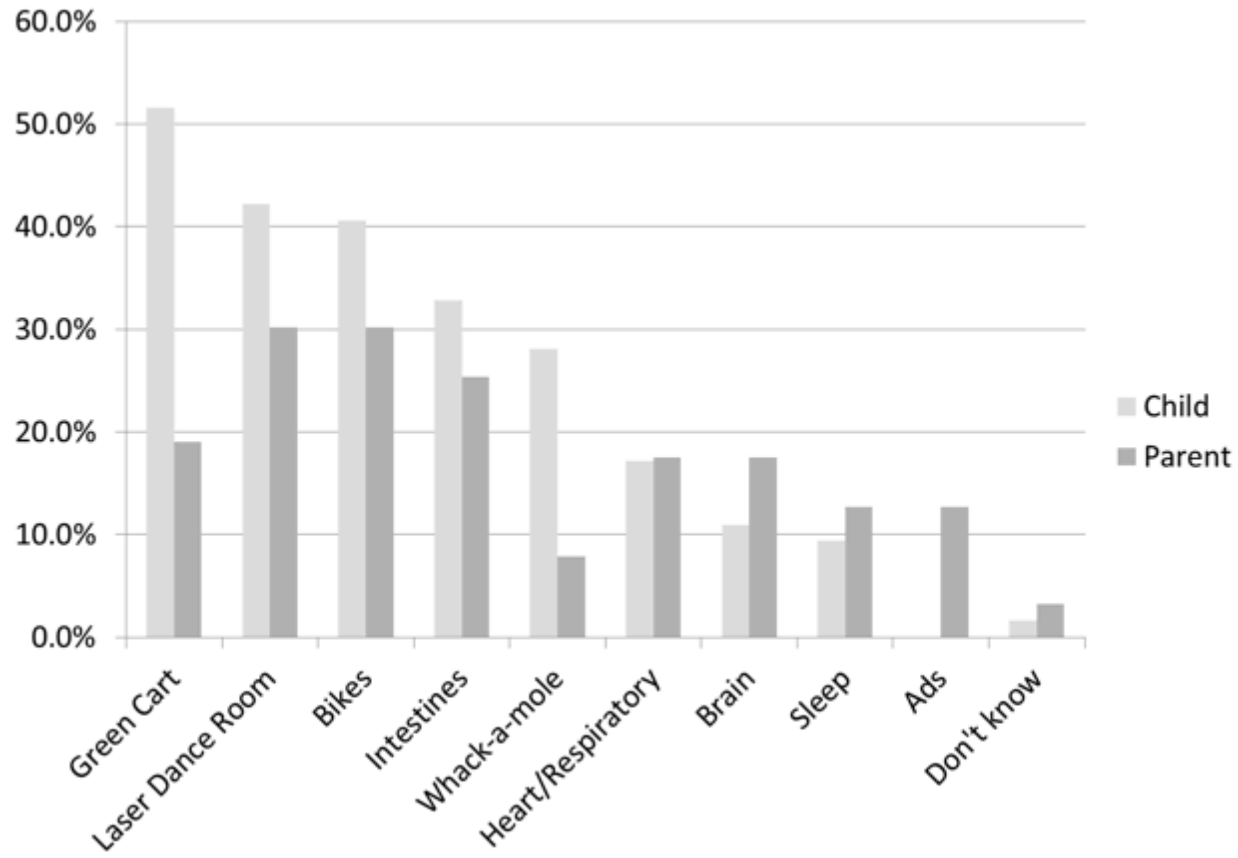


Figure 2: Favorite Station Comparison between Parent and Child

Table 7 summarizes the extent of learning and signage effectiveness. Over three-quarters (78%) of parents rated the exhibit's ability to teach their children about healthy habits as good or excellent while 94% rated the exhibit's ability to teach the parents themselves as good or excellent. Almost half (44%) felt that their children sometimes read signs and 38% reported that their children did not read the signs. In contrast, 100% of parents said that they read the signs. Further, all of the respondents reported that the information was easy to read and use and 98% reported that the information was interesting. Almost 60% of the parents indicated that they learned something at the exhibit that would cause them to make changes at home in regards to nutrition, sleep, or activity level for their family. While almost 41% reported that they would not make changes, some stated in the open-ended response that they already focused on healthy habits for their family.

Table 7: Learning and signage effectiveness*		
	n	%
Exhibit ability to teach children about healthy habits		
Poor	0	0.0%
Fair	13	20.0%
Good	23	35.4%
Excellent	28	43.1%
Don't Know/ Can't really say	1	1.5%
Exhibit ability to teach parents about healthy habits		

Poor	0	0.0%
Fair	3	4.7%
Good	30	46.9%
Excellent	30	46.9%
Don't Know/ Can't really say	1	1.6%
Children read signage		
Yes	10	15.9%
No	24	38.1%
Sometimes	28	44.4%
Don't Know/ Can't really say	1	1.6%
Parents read signage		
Yes	59	100.0%
No	0	0.0%
If Yes: information is easy to read and use		
Yes	58	100.0%
No	0	0.0%
If Yes: information is interesting		
Yes	50	98.0%
No	1	2.0%
Make changes at home because of something learned at exhibit		
Yes	32	59.3%
No	22	40.7%

*Due to missing values, total n may not always add up to 65.

Moderate-to-Vigorous Physical Activity (MVPA)

Gender

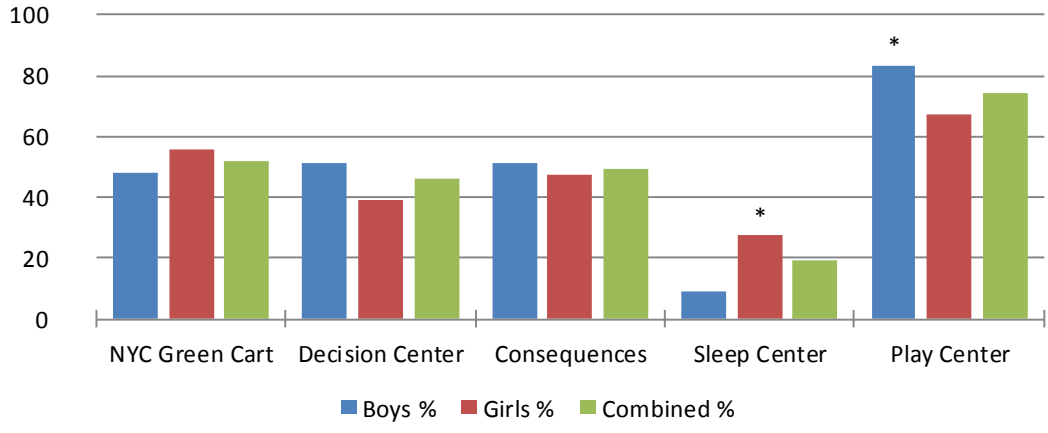
Table 8 presents the percentage of time child visitors were engaged in sedentary, moderate and vigorous activity by exhibit area and gender. In regards to the entire exhibit, child visitors spent more than half (51.5%) their time engaged in MVPA and no significant differences were observed between boys and girls (51.3% and 51.6%). However, significant gender differences in PA were observed across certain exhibit areas (Figure 3).

Table 8. Percentage of time child visitors were engaged in sedentary, moderate and vigorous activity by exhibit area and gender.

		Level of Physical Activity			
Area	**Gender**	Sedentary %	Moderate %	Vigorous %	MVPA %
NYC Green Cart	Boys	51.7	17.5	30.8	48.3
	Girls	44.5	28.2	27.3	55.5
	Combined	48.3	22.6	29.1	51.7
Decision Center	Boys	48.5	12.1	39.4	51.5
	Girls	60.7	3.6	35.7	39.3
	Combined	54.1	8.2	37.7	45.9
Consequences	Boys	48.6	8.6	42.9	51.4
	Girls	52.5	25.0	22.5	47.5
	Combined	50.7	17.3	32.0	49.3
Sleep Center	Boys	90.6	0	9.4	9.4
	Girls	72.2	11.1	16.7	27.7*
	Combined	80.9	5.9	13.2	19.1
Play Center	Boys	17.0	15.1	67.9	83.0*
	Girls	32.8	8.2	59.0	67.2
	Combined	25.4	11.4	63.2	74.6
Entire Exhibit	Boys	48.7	13.2	38.1	51.3
	Girls	48.4	18.5	33.1	51.6
	Combined	48.5	15.9	35.6	51.5

MVPA: sum of moderate and vigorous physical activity; Combined: average value for boys and girls combined.
* denotes statistically significant difference between boys and girls.

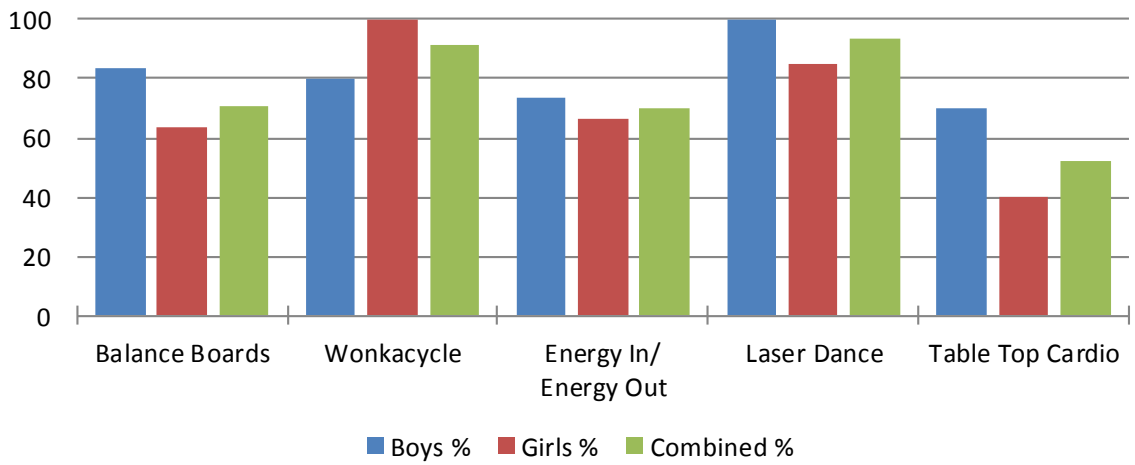
Figure 3. Percentage of time child visitors were engaged in MVPA by exhibit area and gender



MVPA: sum of moderate and vigorous physical activity; Combined: average value for boys and girls combined.
* denotes statistically significant difference between boys and girls.

- *NYC Green Cart* displayed no significant differences between boys and girls engaged in MVPA (48.3% vs. 55.5%). Predominant activities for boys and girls were "climbing stairs" (11.5% and 13.5%) and "playing with loose items" (13.5% and 12.6%).
- *Decision Center* also displayed no significant differences between boys and girls engaged in MVPA (49.5% vs. 51.1%). Predominant activities for boys were "sliding" and "pushing buttons/pulling levers" (18.8% and 18.8%). Predominant activities for girls were "standing" and "climbing stairs" (31.6% and 21.1%).
- *Consequences* displayed no significant differences between boys and girls engaged in MVPA (51.4% vs. 47.5%). Predominant activities for boys were "turning wheels," "screen-based activities" and "standing" (24.1%, 17.2% and 17.2%). Predominant activities for girls were "screen-based activities," "walking" and "crawling" (25.9%, 22.2% and 14.8%).
- *Sleep Center* produced the greatest percentage of sedentary behavior across both genders, especially for boys compared to girls (90.6% vs. 72.2%). Accordingly, girls were significantly more engaged in MVPA compared to boys (27.7% vs. 9.4%; p=0.05). Predominant activities for boys and girls were "screen-based activities" (25.0% and 24.0%) and "manipulative games" (60.0% and 64.0%).
- *Play Center* produced the greatest percentage of MVPA across boys and girls (83.0% vs. 67.2%; p=0.05). However, gender differences were observed as boys were more engaged in MVPA than girls, especially in the *Laser Dance* (100.0% vs. 84.6%; p=0.094) and *Table Top Cardio* (70.0% vs. 40.0%) stations (Figure 4), while girls were more engaged in the *Wonkacycle* station compared to boys (100.0% vs. 80.0%). Predominant activities for boys were "running," "bicycling" and "manipulative games" (15.4%, 15.4% and 17.9%). Predominant activities for girls were "hand peddling," "balancing" and "bicycling" (13.0%, 17.4% and 19.6%).

Figure 4. Percentage of time child visitors were engaged in MVPA in *Play Center* by station



MVPA: sum of moderate and vigorous physical activity; Combined: average value for boys and girls combined.

Children spent more than 50% of their time engaged in MVPA, greater than reported in previous studies for school recess and physical education.

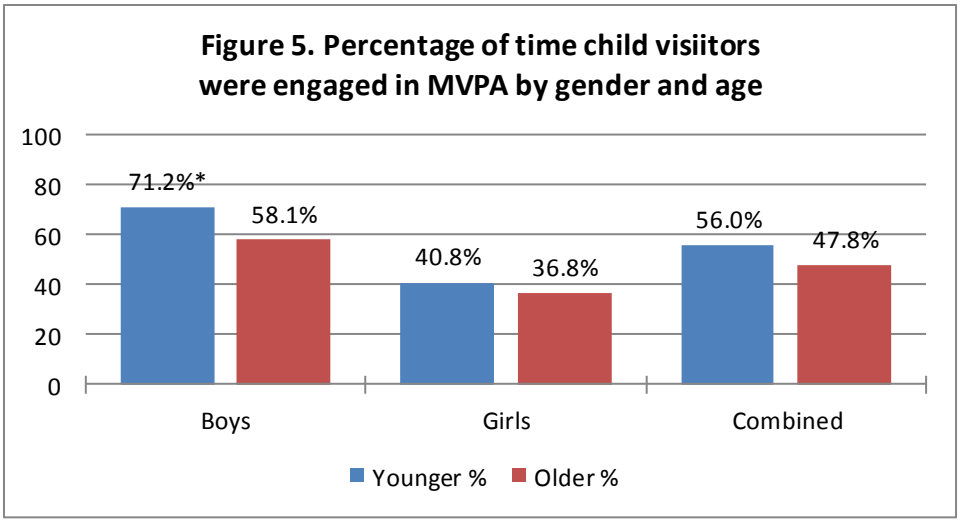
Age and Ethnicity

Table 9 presents the percentage of time child visitors (n=35) were engaged in MVPA by ethnicity, gender and age according to the PA monitor data. Younger boys and girls were more engaged in MVPA (71% and 41%) compared to older boys and girls (58% and 37%) (Figure 5). Hispanic/Latino children were significantly more engaged in MVPA (79%) compared to the other ethnicities (p=0.00), which ranged between 36% and 46% (Figure 6). The greatest levels of MVPA were among younger boys of Hispanic or Latino origin (96.0%) and the lowest levels of MVPA were among white non-Hispanic (20.8%) older girls.

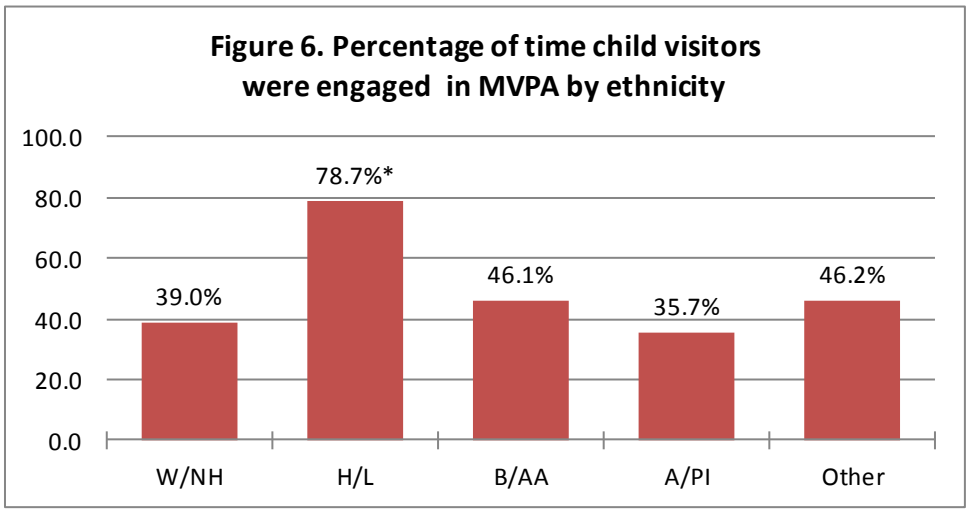
Table 9. Percentage of time child visitors were engaged in MVPA by ethnicity, gender and age.

		Gender (MVPA %)		
Ethnicity	**Age Group**	Boys (20)	Girls (15)	Combined (35)
White/Non-Hispanic (11)	Younger	46.9	40.0	44.7
	Older	50.7	20.8	37.9
Hispanic/Latino Origin (9)	Younger	96.0	57.5	77.7
	Older	88.2	81.5	84.1
Black/African American (8)	Younger	90.9	28.7	38.7
	Older	85.0	57.1	70.7
Asian/Pacific Islander (4)	Younger	34.5	0	34.5
	Older	0	41.7	41.7
Other (3)	Younger	60.0	31.4	46.2
	Older	0	0	0

MVPA: sum of moderate and vigorous physical activity; Younger: ages 4-5; Older: ages 6-8; Combined: average value for boys and girls combined.
Number in parentheses denotes number of children within each group.



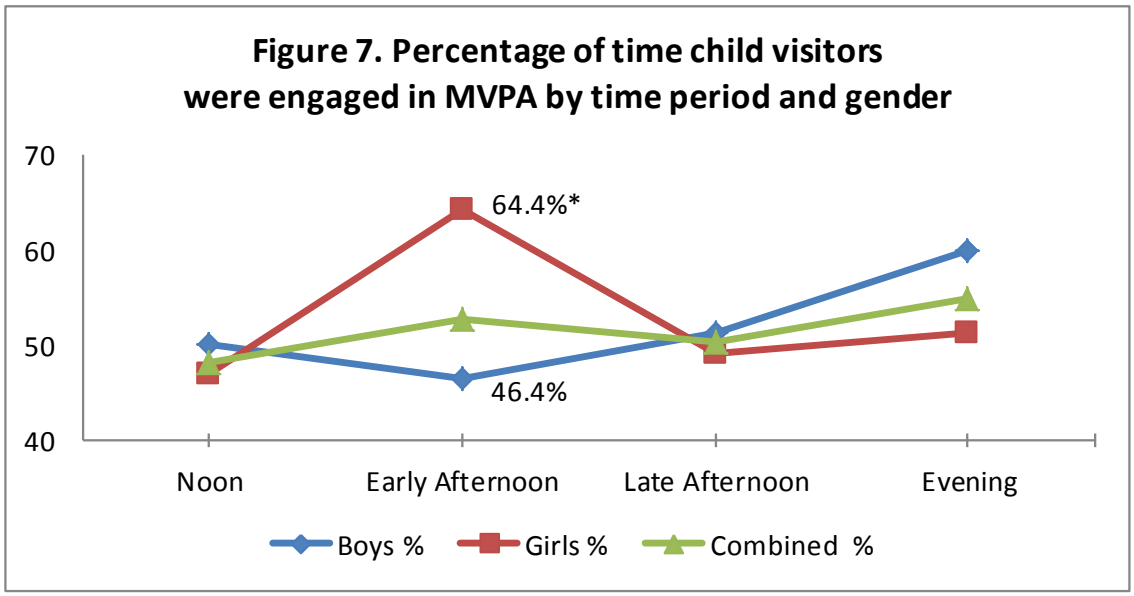
MVPA: sum of moderate and vigorous physical activity; Combined: average value for boys and girls combined; Younger: ages 4-5; Older: ages 6-8.
* denotes statistically significant difference between younger and older boys.



W/NH: White/Non-Hispanic; H/L: Hispanic/Latino Origin; B/AA: Black/African American; A/PI: Asian/Pacific Islander; Oher: All other ethnicities.
* denotes statistically significant difference between H/L and other ethnicities listed.

Time of Day

Figure 7 presents the percentage of time child visitors were engaged in MVPA by time period and gender. Both genders were engaged in similar levels of MVPA during the first time period (at noontime). In the afternoon, levels of MVPA were significantly different between boys and girls (46% vs. 64%; p=0.05). Levels of MVPA were similar for both genders in the late afternoon and increased for both genders in the evening, however, MVPA levels were higher for boys.

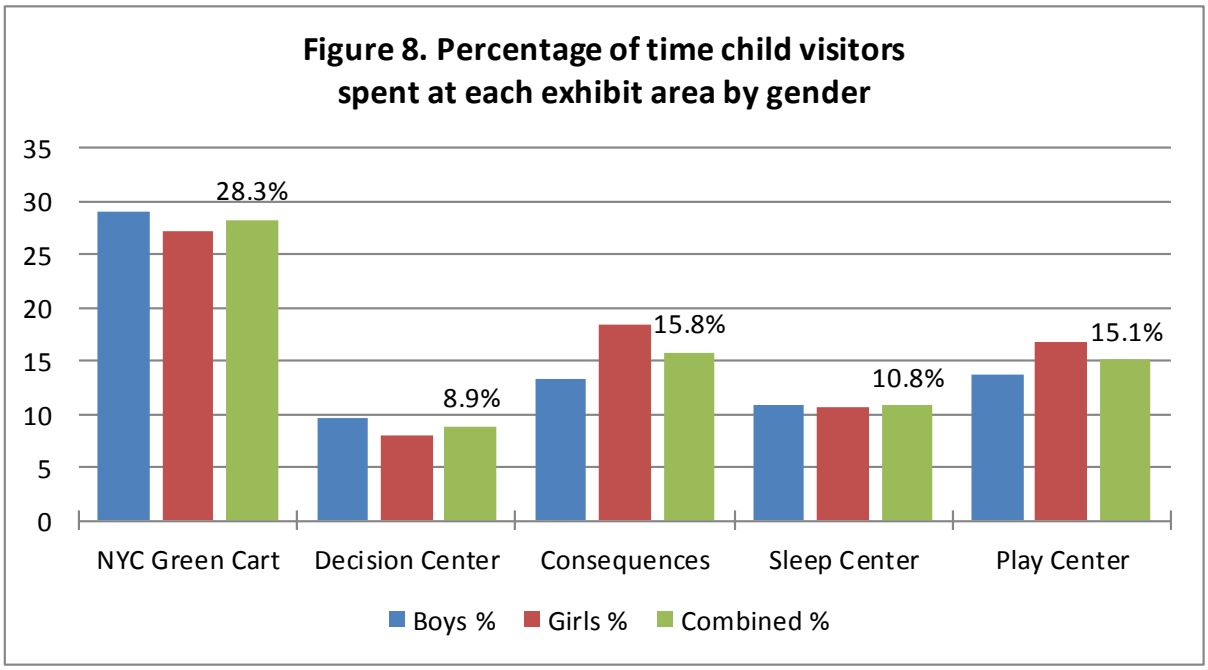


MVPA: sum of moderate and vigorous physical activity; Combined: average value for boys and girls combined; Noon: 12:30 - 1:30 PM; Afternoon: 2:00 - 3:00 PM; Late Afternoon: 3:30 - 4:30 PM; Evening: 5:00 - 6:00 PM.
* denotes statistically significant difference between boys and girls.

Energy Expenditure. Children (n=35) expended an average of 23 kcals during their visit to the exhibit. No significant differences in EE between boys and girls were observed (24 kcals vs. 22 kcals). However, older children expended more energy on average compared to younger children (27 kcals vs. 19 kcals).

Time Spent Visiting Exhibit and Associated Areas

Figure 8 presents the percentage of time child visitors (n=35) spent at each exhibit area by gender. Children spent an average of 33 minutes in the exhibit. Boys spent slightly more time at the exhibit compared to girls (35.5 vs. 31 minutes), as did older children compared to younger ones (38.5 vs. 28 minutes).



Combined: average value for boys and girls combined.

- *NYC Green Cart* was the most visited area of the exhibit, accounting for 28.3% of the time spent by all children. No significant differences in visit time were observed between boys and girls (29.1% and 27.3%), but younger children spent slightly more time (34.3%) in *NYC Green Cart* compared to older children (28.3%).
- *Decision Center* was the least visited area of the exhibit. No significant differences in visit time were evident between boys and girls (9.6% vs. 8.1%) or younger and older children (7.8% vs. 8.9%).
- Girls spent more time at *Consequences* compared to boys (18.5% vs. 13.4%) and it was the girls' second highest visited area after the *NYC Green Cart*. Additionally, older children spent more time in *Consequences* compared to younger children (15.8% vs. 10.8%).
- Neither boys nor girls spent a large proportion of their time in the *Sleep Center* and it was the second least visited area after the *Decision Center*. Similar to *Consequences*, older children spent more of their time (10.8%) in *Sleep Center* compared to younger children (7.2%).
- *Play Center* was the second highest visited area among boys, but boys spent less of their time in *Play Center* compared to girls (13.8% vs. 16.7%). There were no significant differences observed between younger and older children (13.4% and 15.1%).

DISCUSSION & RECOMMENDATIONS

Our primary goal in this multi-method descriptive study was to formalize some information that CMOM had as either working assumptions or informal knowledge, and to add some new information that can assist CMOM in the evolution of their conception and design of exhibits. Our approach and methods were intended to move beyond traditional museum studies to begin to characterize the lived experience of visiting children and identify components of the installation that facilitate engagement and learning, as well as form some working theories about what would augment these.

Intuitively and empirically we know that children, regardless of the wide and differing reasons and expectations they bring to a museum, remember exhibits, especially large ones, that create hands-on participation with interesting artifacts and manipulables. [55,56] CMOM's *EatSleepPlay*™ exhibit fits these criteria superbly. The entire exhibit says, "Touch me, climb up onto me, crawl through me and push and pull as many levers as you see here." In the following we return to the central findings of the analysis of our data thus far, and suggest activities and opportunities.

Activating Parents/Intermediaries and Other Ways to Extend Learning

In our analysis thus far we have focused on children's abilities to engage with the exhibit, exert physical and mental energy, and through this process learn the central proposition at any given station. As discussed throughout this report, we find visiting children are engaged, active, inquisitive and experimental in *EatSleepPlay*™. We have focused on the Bikes as our exemplar because it drew more children in our target age range, particularly among 6 and 7 year olds, and because a child's approach, engagement and time at station provided the most concentrated display of analyzable phenomena.

The central proposition (we can also think of this as a "narrative" or take away message) of the Bikes station is something like – some snack food has more calories than others and you will have to be more physically active (biking) if you want to burn off those calories to be healthy. A similar proposition is present at the heart, the stomach, and part of the sleep exhibit. By closely examining behavior of children with and without intermediaries, and by speaking to them and listening to how they framed their narrative of the bike, we concluded that there is not enough facilitating infrastructure to this station for children to easily put the pieces together to form a coherent causal proposition/narrative. It is very possible that part of the proposition or take-away message gets learned, but it is more likely that these messages, or facts, are acquired as discrete, unconnected facts, linked by child reasoning. Examples of this are things children told us about stations: *those numbers on the Bikes console are telling me how fast I'm peddling; your heart could be red and healthy on one side, but have cauliflower on the other or; or food travels in your intestines, and passes some trees;* and one of our favorites*, the numbers on the bike tell me what time the pizza's coming.*

There are a number of ideas we propose as a starting point for dialogue with CMOM. They follow:

1. Parents as Teachers

There is evidence that families look for social environments where learning is a shared activity[57] and where parents assist their children to explore and experience new environments and information.[58] In cases such as the Bikes when the full propositional intent of the lesson is not likely to be obtained without some mediating, educating presence, it's not clear that parents we observed see their inattentiveness as a missed opportunity for learning. We saw more direct instruction by parents to very young children and more hands-off with older children. Only one-third of parents observed with our target aged children read the signage in some fashion to their child. Therefore we suggest looking at possible signage prompts that give parents questions/short scripts to use with their children. These prompts are intended to assist the child to learn from interaction with the station. For example signage could say:

Help your child learn right here ↓
– Try these 2 questions

1. What snack do you want to pick?
2. How many calories do you have to burn off?

And when goal is reached, GREAT. You reached your goal!

Another idea is to include web links or QR codes on the signage that would allow the parent to access further information on their mobile phones while they are at the exhibit.

Overall, our findings show that while parents enjoy the more informative stations and learn from reading the signs, children's favorite stations are the "fun" exhibits where they can play. Parent responses to open-ended questions (not shown in above tables) indicate that the children either cannot read or do not spend time reading all of the signs.

When parents were asked in the survey how to improve the exhibit and signage, recommendations included adding audio and headsets; incorporating more visuals like video and pictures; and enhancing signs with larger, simpler, and bullet pointed text in brighter colors.

Another possible approach is for CMOM to train volunteers/docents to walk the floor and serve as intermediaries to explain, educate and engage children (and their parents) in particular station activities. College, or even high school students might be particularly suited to this role.

Nearly **97%** rated their overall experience as good or excellent. **75%** thought that their child had "a lot of fun."

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2. Consulting Children

Children will engage you in discussions and voice opinions and serve as good commentators and critiques about things they're interested in.[56,59-61] We found this and wish we had more time to speak to many more children. They all had opinions and many could have talked with us longer. For this reason, and broad support in the literature, there is much room for CMOM to actively learn from children on an ongoing basis when it comes to the exhibits at CMOM. Informal focus groups with children could be used to learn how they experienced an exhibit or station, what expectations they have for a visit, and what insights they have about use of space. The point in the children's exit interview where our respondents seemed to give the most thought was when we asked them, "What else would you like to see them put in the exhibit?"

3. CMOM Creating Opportunities for More Collaborative Play and Problem Solving

The artifacts that children are seeing and learning about at *EatSleepPlay*™ are not dinosaur bones or a live, food chewing, captivating species of charismatic mega fauna (the panda, for instance, or even a deer). The artifacts are our own bodies, their parts and functions. These are both literal but, for the child, very abstract. Just where is my gut and where is that gas? Is it like gas from the car? Gas in a balloon?

We recommend adding components to stations that make these body parts and systems more personalized, thus strengthening the engagement and buy in a child has. For example, before starting an activity station have a touch sensor that would report a child's pulse on an easy to read screen, and then the child could see that pulse changing with physical exertion. There is strong evidence from both health communication and marketing research that self-monitoring tools significantly increase user involvement, learning and behavior change.[62,63]

We also recommend design and signage that poses clearer questions, tasks and problems in a user-friendly game like environment. We observed children readily taking on tasks, such as the balancing board or Table Top Cardio, or stomach lever, but without any payoff. If one is to compete with oneself, it should be clearer what the goal or end result means. We suspect that CMOM intended the signage to do this heavy lifting, and we have discussed that the content of the signage is not making its way to the children in many instances. We believe there are effective ways to pose clearer tasks and problems without communicating a normative approach ("You should be able to do this") or a stigmatizing one ("Gee, I couldn't balance for 3 minutes").

If done with signage it could be messages as simple as: What would happen if people couldn't balance? (followed by funny/dramatic visuals of falls, and near falls). If done as inherent in the station design, one example is to have more of a guessing or hypothesizing component. For example, in the stomach, the child could be given choices of what to put in the stomach and make it more of a game – can s/he make the meal without overfilling the stomach.

4. Extending Contact Pre and Post Visit

Repetition and reinforcement of key messaging and contact after visiting a zoo, museum or other informal science education environment has been shown to be a key facilitator for learning.[45,64] Mobile technology is making it exciting and functional to design ways to expand the reach and connection to visitors both before and after they visit CMOM. As the gaming community is large, creating a physical "gaming" experience might engage them. Use of high score logging, like old arcades, might encourage repeat visits to beat old score or if their score is beat to come back for redemption. Our two recommendations are:

1. Use Technology as a mediator of engagement through live and virtual gaming. For example, Scavenger Hunt With Friends, http://scavengerhuntwithfriends.com/ or Wolf quest, http://www.wolfquest.org/

2. Create after visit tools and resources, preferably mobile accessed for families to use post visit.[65] These tools could be self-selected SMS including reminders, prompts and new tools for nutrition and wellness for parents and children.
    a. Help CMOM look at how we might expand health-related activities using cell phone, social media and technology to extend and track family learning and communication around *EatSleepPlay*™ exhibit and curriculum.
    b. Social media/technology could be used to track what is taking place in terms of family learning, parent/child interaction as a result of interaction with CMOM content, and potential to expand *EatSleepPlay*™ pre-school curriculum.

5. Cultural Broadening

We formally observed on weekends when school groups were not visiting CMOM. It is clear that the visiting population on the days when we observed was predominantly white, affluent, highly educated and non-diverse (see Table 5 – parent survey), likely due to its location in an affluent neighborhood of Manhattan with less than optimal weather conditions (January 26 – 21 degrees, cold; February 23 – 39 degrees, heavy rain; March 3 – 35 degrees). (Further study would be needed, but we also believe that minority children we observed came in groups of children.)

The percentage of whites who said that they would make changes at home as a result of something learned from the exhibit was 39% (n=14) as compared to the 72% of minorities who said they would make changes (n=18). Because the exhibit has the potential to have a greater impact on minorities, CMOM should consider continuing and expanding their efforts in promoting the *EatSleepPlay™* exhibit to socioeconomically disadvantaged and minority populations.

Engaging in Physical Activity

Findings from this pilot study suggest that the *EatSleepPlay™* exhibit may be helpful in promoting child PA, as child visitors spent over 50% of their time engaged in MVPA, greater than reported in previous studies for school recess[66] and physical education.[67]

The *EatSleepPlay™* exhibit may be capable of encouraging PA for both boys and girls, as no significant gender differences in PA engagement were observed in the exhibit as a whole. These findings are in contrast to the current literature that shows boys participate in greater levels of MVPA compared to girls.[23,68,69] Unstructured play, which is found during school recess and provided by the exhibit, may explain these findings as this environment allows boys and girls the same opportunity to be physically active.[70]

The exhibit was particularly capable of promoting MVPA for both boys and girls in *NYC Green Cart*, *Consequences* and *Decisions*, possibly due to the inclusion of loose items (e.g., toy fruit) and fixed play equipment (stairs, slides), both of which have been found to encourage MVPA among boys and girls in play settings.[71-75]

Not necessarily surprising, levels of MVPA were lowest in the *Sleep Center.* However, boys' participation in MVPA was significantly lower compared to girls, possibly because boys were slightly more engaged in

sedentary activities, such as sitting and standing, whereas girls appeared to be more engaged with the manipulative games that induced moderate levels of physical activity, such as walking.

Play Center produced the greatest levels of MVPA for both genders, but boys were more engaged in MVPA compared to girls, especially in the *Laser Dance* and *Table Top Cardio* stations. Previous studies[74] have found that the availability of open space, such as provided by the *Laser Dance* and *Table Top Cardio* stations, positively influences MVPA among boys, which may explain the increased boys' engagement in MVPA in *Play Center.* On the contrary, girls may be more engaged by fixed equipment, which may explain the higher levels of MVPA among girls in *NYC Green Cart*, *Consequences* and *Decisions,* as well as the *Wonkacycle* and *Energy In/Energy Out* stations in *Play Center.*

Younger children were more engaged in MVPA compared to older children. Evidence suggests that unstructured play environments, such as offered by the exhibit, are capable of promoting MVPA among younger children. [76] *NYC Green Cart* was especially the most popular area among younger children, possibly due to the mixed-use design.

Interestingly, ethnic differences were observed in PA levels as Latino youth were significantly more engaged in MVPA compared to other ethnicities. These findings (albeit with a limited sample size) may be explained by how the families perceive and utilize the museum exhibit. Latino families may view the exhibit as an opportunity for their children to expend energy in a safe, large indoor playground[77] whereas families from other ethnicities may utilize the exhibit more for combined learning and play. Across time periods, girls were more engaged in MVPA than boys in the early afternoon, whereas the opposite was the case in the evening. Similar findings can be found in the literature regarding boys and girls on weekdays, which report higher levels of MVPA for girls at noontime and for boys in the late afternoon after school. [78]

To further promote physical activity within the context of *EatSleepPlay™* we offer the following observations and suggestions:

1. The availability of stairs, slides and loose items in play settings may aid in evenly promoting MVPA for boys and girls. Similar additions to other areas may continue to promote activity across both genders.

2. Museum design for children is a balance between playing and learning. Educational activities should be designed with the intention of increasing MVPA whenever possible, such as by encouraging MVPA and discouraging sedentary activity.

3. Open space (we realize that space is a constraint in Manhattan) may aid in the promotion of PA among boys, whereas girls may be more inclined to engage with fixed equipment. Mixed-design that includes both features may promote PA across both genders.

LIMITATIONS

Because of time and resources only a portion of the overall data collected has been formally analyzed. We intend to continue analysis in the Fall 2013 through a graduate class at Hunter College, and other informal activities. Additionally, there were a number of analysis activities that did not enter into this study. They are as follows:

- We did not collect data on weekdays. There could be a weekend vs. weekday variation.
- We did the study in winter. This could influence attendance.
- We did not include data from school and other group visits and so the findings can only be generalizable to individual parent-child dyad observations.
- We did not segment the data by age of child. We did not match child interviewed with that child observed on the floor.
- The small number of parent surveys allowed for only descriptive analysis and not other in-depth analyses, such as sub-group analysis.
- Parents received repeated email reminders to fill out a follow up survey; however, very few completed the survey (only 14 completed the first follow-up survey, and 8 completed the 6-week follow-up survey). Due to an extremely small number of returned follow-up surveys, we could not assess the mid- to long-term impact of the exhibit on dietary, physical activity and sleeping behaviors.
- Physical activity data were only based on two days of observation, which may not be representative of usual PA levels among child visitors.
- Broken equipment (Table Top Cardio) may have resulted in a conservative estimate of PA behavior in youth.
- The observed findings can only apply to mostly white, upper middle class populations and not other ethnic and socio-economic groups.
- Given time and existing resources we did not analyze all of the data we collected. We will work with CMOM to pursue possible opportunities to do so going forward. We welcome the opportunity to collaborate more extensively with CMOM in the future.

CONCLUSION

Our central goal in this study was to generate a rich description of the interaction of children, their parents and *EatSleepPlay™*, essentially focusing on how people interact with and experience the exhibit in order to gain insights about what they are learning from the CMOM exhibit. The mixed methods approach yielded data and understandings which CMOM can translate into conceptualizing and designing the enhancement of the *EatSleepPlay™* exhibit as well as future exhibits. We believe such studies are a necessary component of museum evaluation.

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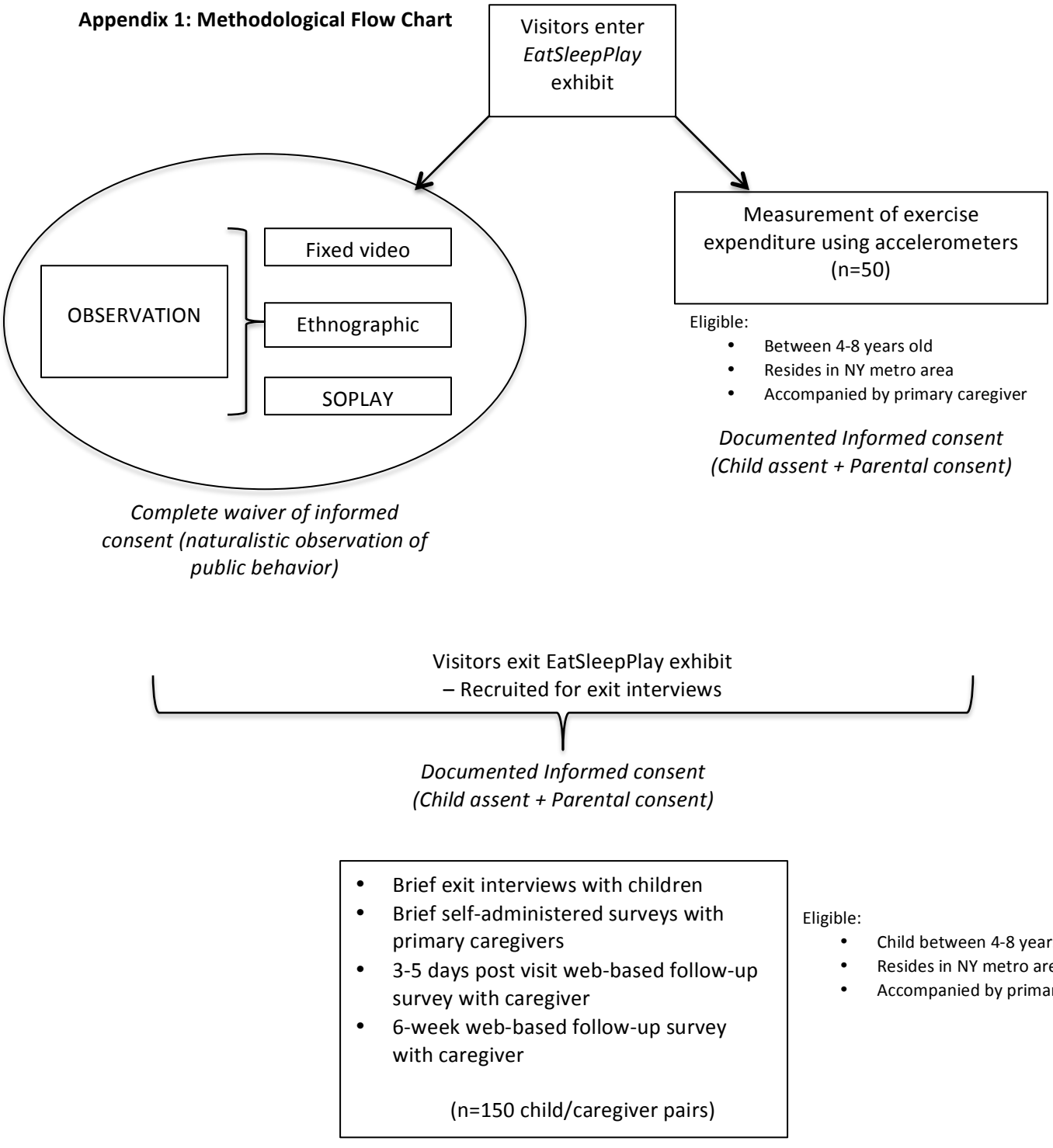
Appendix 1: Methodological Flow Chart



Appendix 2: Formstack guides

CMOM OBSERVATION FORM

Jun 13 2013 02 : 51 PM

Your Name
Catherine Diamond

Gender
○ Male ○ Female

Hair Color
○ Red ○ Blonde ○ Black ○ Brown

Shirt Color
☐ Red ☐ Blue ☐ Green ☐ Yellow ☐ White ☐ Black ☐ Orange ☐ Purple ☐ Pink

Style Shirt
○ Checkered ○ Striped ○ Solid ○ Polka dot

Type of Observation
○ Station
○ Child
○ Child and Adult

Age
○ 4 to 6 years old
○ 6 to 8 years old

Station Based Observations

Station
Green Cart

Green Cart
○ Chute
○ Slide

Approach to Station

- ○ Solo Child
- ○ Adult/Child
- ○ Child/Child
- ○ Solo Adult
- ○ Group

Signage: Child does_____:

- ○ Ignores / Quick look and dismiss
- ○ More prolonged gaze
- ○ Mouths words/fingers words
- ○ Reads – quotes the signage - E.g., “Oh, this is about how you grow Vegetables (reads the word ‘grow' or ‘vegetables', quoting actual written words)
- ○ No reading – E.g., “Oh, here are some green beans!! (not reading display)”
- ○ Other:

Signage: Child does_____:

- ☐ Reads then Plays (interacts with exhibit)
- ☐ Just Plays (no attention to signage)
- ☐ Plays then Reads
- ☐ Tells S (someone) about what s/he read
- ☐ Parent reads and summarizes to kid

Signage: Adult does_____:

- ☐ Parent reads
- ☐ Parent doesn't read
- ☐ Parent reads to child
- ☐ No parent

Child at a station does:

- ☐ Attempts to use – with assistance
- ☐ Attempts to use- without assistance
- ☐ Joins in with others as models
- ☐ Requests assistance
- ☐ Just plays

Verbal Behavior Child

- [ ] Emotive
- [ ] Questions
- [ ] Statements
- [ ] Recognition
- [ ] Teaches
- [ ] Interactions with other children
- [ ] Interaction between adult and child
- [ ] No verbal behavior
- [ ] Other:

Verbal Behavior Adult

- [ ] Questions (True Questions vs Quizzing)– “What is this for?/”So which food will you have to bicycle more to burn off?”” Before, during or after visiting the station?
- [ ] Statements
- [ ] Emotive –
- [ ] Regulatory – E.g., “Michael, don’t be so rough” “If you can’t share then we’re going to have to leave”
- [ ] No verbal behavior
- [ ] Other:

Who initiates leaving?

- ( ) Adult
- ( ) Child
- ( ) Don't Know

Child’s response to directives to leave exhibit.

- ( ) OK
- ( ) Ignores/Reluctant

Did any of these behaviors change at this station during this time?

- ( ) YES
- ( ) NO

Notes

Context changes (includes parents appearing, child moves to another station)

- ( ) YES
- (•) NO

Submit Form

CMOM – Eat Sleep Play Evaluation – Exit Interview **Case ID: _____**

Younger Kids (4-5 year olds)

[Interviewer: state into audio recorder – your name, and Case ID]

Gender: ☐ M ☐ F

Hi, my name is _____.
(If child's name was given earlier in the consent, use name, if not ask: What's your name? (If hesitant, skip over)

How old are you? _____

We are talking to a lot of children here at the Museum today.

1. **Is this your first time here at this part of the museum** (pointing inside to ESP)?

   ☐ Yes ☐ No

2. **So, what did you think of that exhibit?** (pointing inside**)**

_____

_____

_____

Probe: Did you have a good time? ☐ Yes ☐ No

If Yes/Positive → Go to Q3.

If No/Neutral → Skip to 4.

3. **What was your favorite thing in the exhibit today** (pointing into the exhibit)**?**

_____

_____

_____

(use photo of appropriate station)

Probes: What did you like?
I didn't get to try that one yet.

What happens when you (insert appropriate activity at the station mentioned by child)?

Probe: How do you play that? (inquisitive tone).
How does that work?
How did you figure that out?
What happens at the end?

_____

_____

_____

Was there anything else that was a favorite thing today?

_____

_____

_____

Probe (as often as appropriate): Anything else that you liked?

(If you feel the child has more to say about another exhibit say "OK Anything else you want to tell me about?

_____

_____

_____

4. Why? What didn't you like?

_____

_____

_____

Probe (as often as appropriate): Anything else that you didn't like?

_____

_____

_____

So … I have another question for you. There are many kids coming here every day. We want to know what children might be learning when they come to the museum exhibit (pointing again).

5. What did you learn today?

If child says "nothing" "I didn't learn anything" Respond: "OK so today you would say you really didn't learn anything."

Probes: Let's look at the [insert favorite station]. You really liked the [station]. Can you tell me if you learned anything about the [station]?

_____

_____

_____

6. Would you like to come back to the EatSleepPlay exhibit (pointing to the exhibit) again?

☐ Yes ☐ No

If Yes/Positive → Which part would you like to go back to and play with again?

_____

_____

ADDITIONAL NOTES:

_____

_____

_____

[Interviewer: state into audio recorder – your name, and Case ID]

Gender: ☐ M ☐ F

Hi, my name is _____.
(If child's name was given earlier in the consent, use name, if not ask: What's your name? (If hesitant, skip over)

How old are you? _____

We are talking to a lot of children here at the Museum today.

1. **Is this your first time here at this part of the museum** (pointing inside to ESP)?

   ☐ Yes ☐ No

2. **So, what did you think of that exhibit?** (pointing inside**)**

_____

_____

_____

Probe: Did you have a good time? ☐ Yes ☐ No

If Yes/Positive → Go to Q3.

If No/Neutral → Skip to 4.

3. **What was your favorite thing in the exhibit today** (pointing into the exhibit)**?**

_____

_____

_____

(use photo of appropriate station)

Probes: What did you like?
I didn't get to try that one yet.

What happens when you (insert appropriate activity at the station mentioned by child)?

Probe: How do you play that? (inquisitive tone).
How does that work?
How did you figure that out?
What happens at the end?

_____

_____

_____

Was there anything else that was a favorite thing today?

_____

_____

_____

Probe (as often as appropriate): Anything else that you liked?

(If you feel the child has more to say about another exhibit say "OK Anything else you want to tell me about?

_____

_____

_____

4. Why? What didn't you like?

_____

_____

_____

Probe (as often as appropriate): Anything else that you didn't like?

_____

_____

_____

So … I have another question for you. There are many kids coming here every day. We want to know what children might be learning when they come to the museum exhibit (pointing again).

5. What did you learn today?

If child says "nothing" "I didn't learn anything" Respond: "OK so today you would say you really didn't learn anything."

Probes: Let's look at the [insert favorite station]. You really liked the [station]. Can you tell me if you learned anything about the [station]?

_____

_____

_____

OK, we're almost done.

6. Do you know what this exhibit is called? Does it have a name? ☐ Yes ☐ No

(Name):

_____

_____

7. If you were to tell your best friend about this exhibit (*pointing*) **what would you tell them?**

_____

_____

_____

8. We need your help – how would you make this exhibit even better?

Probe: Is there something that you think would be interesting or fun for children like you?

Where would you put this new station? And why would you put it there?

_____

_____

_____

9. Would you like to come back to the EatSleepPlay exhibit (pointing to the exhibit) again?

☐ Yes ☐ No

If Yes/Positive → Which part would you like to go back to and play with again?

_____

_____

ADDITIONAL NOTES:

_____

_____

_____

CUNY SCHOOL OF PUBLIC HEALTH
AT HUNTER COLLEGE

eMOM

Case ID: _____
Date: ____/____/____

Evaluation of the Children's Museum of Manhattan's EatSleepPlay Exhibit

We're interested in learning about how exhibits like this can be improved – how they can be better tools for teaching children and adults new information in fun and engaging ways.

Thank you for agreeing to participate in answering a few questions.

1. Is this your first time visiting the EatSleepPlay exhibit?
   - ☐ Yes
   - ☐ No

2. Overall, how would you rate your child's experience with the EatSleepPlay exhibit? (not the museum as a whole).
   - ☐ Excellent
   - ☐ Good
   - ☐ Fair
   - ☐ Poor

3. Overall, how would you rate the EatSleepPlay exhibits' level of fun for kids?
   - ☐ A lot of fun
   - ☐ Some fun
   - ☐ Not much fun

4. How would you rate the exhibit's ability to teach kids things about healthy eating, sleeping and activity?
   - ☐ Excellent
   - ☐ Good
   - ☐ Fair
   - ☐ Poor
   - ☐ Don't know/ can't really say

   If fair or poor, how can we improve the exhibit: _____

5. How would you rate the exhibit's ability to teach parents/caregivers things about healthy eating, sleeping and activity?
   - ☐ Excellent
   - ☐ Good
   - ☐ Fair
   - ☐ Poor
   - ☐ Don't know/ can't really say

   If fair or poor, how can we improve the exhibit: _____

6. What do you think was <u>your child's favorite</u> parts/stations of the EatSleepPlay exhibit?
(Check all that apply)

- ☐ Green Cart (chute, slide)
- ☐ Ads (portion sizes, advertising messages)
- ☐ Intestines (nutrients, fiber, tunnel, flush)
- ☐ Sleep (hockey table, food choices, green monsters, mood mirrors, sleeping child, sleep struggle)
- ☐ Heart and respiratory system
- ☐ Brain (telephone, screens, choice table)
- ☐ Bikes (bikes, big wheel paddle)
- ☐ Laser dance room
- ☐ Whack-a-mole, balance
- ☐ Other_____
- ☐ No favorite part

7. What was <u>your favorite</u> part/parts of the EatSleepPlay exhibit?
(Check all that apply)

- ☐ Green Cart (chute, slide)
- ☐ Ads (portion sizes, advertising messages)
- ☐ Intestines (nutrients, fiber, tunnel, flush)
- ☐ Sleep (hockey table, food choices, green monsters, mood mirrors, sleeping child, sleep struggle)
- ☐ Heart and respiratory system
- ☐ Brain (telephone, screens, choice table)
- ☐ Bikes (bikes, big wheel paddle)
- ☐ Laser dance room
- ☐ Whack-a-mole, balance
- ☐ Other_____
- ☐ No favorite part

8. If you had a favorite part/parts, what is the main reason?

- ☐ Just fun
- ☐ Interesting/informative
- ☐ Interactive
- ☐ Increased activity level of my child(ren)
- ☐ Doing it together with my child(ren)
- ☐ Other: _____

9. There are signs with information throughout the exhibit. Do you think children stop to read these signs?

- ☐ Yes
- ☐ No
- ☐ Sometimes
- ☐ Don't know

10. Did you find yourself reading the signs and information placed near or at stations?
    - ☐ Yes
    - ☐ No

    If YES → Did you find the information easy to read and use?
    - ☐ Yes
    - ☐ No

    Did you find the information interesting?
    - ☐ Yes
    - ☐ No

    If you'd like, please give an example: _____

11. What could the museum do to make the signs and information more useful to parents?

12. Did you see or read anything in the exhibit that will cause you to try to make some changes at home with nutrition, sleep or activity for your family?

    ☐ Yes: Can you explain what type of change?
    _____

    ☐ No: Why not?
    _____

13. Is there anything else about the exhibit you would like to share?

_____

Almost done…Please tell us a little about yourself:

14. What is your age? _____

15. What is your gender?
    - ☐ Male
    - ☐ Female

16. What is/are the ages/gender of your child(ren) being interviewed? _____
    - ____Age ☐ Male ☐ Female
    - ____Age ☐ Male ☐ Female
    - ____Age ☐ Male ☐ Female
    - ____Age ☐ Male ☐ Female

17. What is your home zip code? _____

→ ***Turn Page Over Please***

18. What is the highest level of education you've completed?
    - ☐ Less than high school
    - ☐ High school diploma/GED
    - ☐ Some college/2 year diploma
    - ☐ Technical/vocational training
    - ☐ College diploma (Bachelors)
    - ☐ Some graduate school
    - ☐ Graduate school diploma (Masters or higher)

19. With what racial/ethnic background would you identify with?
    - ☐ African-American
    - ☐ African
    - ☐ Asian/Pacific Islander
    - ☐ Caribbean/West Indian
    - ☐ American Indian/Alaska Native
    - ☐ White
    - ☐ Other: _____

20. Are you Latino/Hispanic?
    - ☐ Yes
    - ☐ No

21. What is your household income?
    - ☐ Under $9,999
    - ☐ $10,000 – $29,999
    - ☐ $30,000 – $49,999
    - ☐ $50,000 – $69,999
    - ☐ $70,000 – $89,999
    - ☐ $90,000 – $109,999
    - ☐ > $110,000

22. How many people are in your household, including yourself? _____

*Please provide the following information so that we can contact you for the two brief follow-up surveys, which will take place **3-5 days after today**, and **6 weeks after today**. Please indicate whether you would prefer to be contacted for the brief surveys via email or phone. Thanks!*

a. Email _____ ☐ Preferred

b. Phone_____ ☐ Preferred

c. Address: _____

_____

Thank you so much!

Appendix 5: Systematic Observation of Play and Leisure Activity (SOPLAY) form

System for Observing Play and Leisure Activity Among Youth: Sample page from data collection form

SOPLAY

Study: P1 P2 S1 S2
Obs. Initials: _____

Cycle: **1 2 3 4** Scan: **1 2**

START TIME	SPACE	GIRLS				BOYS			
		S	W	V	Act.	S	W	V	Act.
__ __ : __ __	Green Cart A	_____	_____	_____	_____	_____	_____	_____	_____
		Notes:_____							
	Green Cart B	_____	_____	_____	_____	_____	_____	_____	_____
	Green Cart C	_____	_____	_____	_____	_____	_____	_____	_____
	Green Cart D	_____	_____	_____	_____	_____	_____	_____	_____

ACTIVITY: **0**. none **1.** laying **2.** crouching **3.** sitting **4.** standing **5.** reading **6.** screen time
8. crawling **9.** walking **10.** running **11.** stairs **12.** jumping **13.** skipping **14.** balancing **15.** sliding **16.** bicycling
17. playing w/loose items **18.** buttons/levers **19.** turning wheels **20.** manipulative games **21.** other **22.** mixed

Appendix 6: Physical activity monitors (Actical) description

Parameter	Value	
Specification		
Size	1.14 in x 1.45 in x 0.43 without standard band	
	29 mm x 37 mm x 11 mm	
Weight	0.56 ounces, 16 grams, without standard band	
	0.77 ounces, 22 grams, with standard band	
Case materials	Polyurethane/polyester alloy	
Frame and battery cover	Titanium	
Attachment options	Wrist: Nylon wrist band (standard); elastic band (optional)	
	Waist: Belt clip or waist band (optional)	
	Ankle: Elastic band (optional)	
Battery	CR2025 lithium coin cell (user replaceable)	
Memory capacity	32 MB	
Maximum continuous recording time	Raw mode	Epoch mode 1 second + steps
	12 days	194 days
Accelerometer details		
Range	0.05 G to 2 G	
Bandwidth	.035 Hz to 3.5 Hz	
Resolution	100 counts or 0.02 G (at 1 G peak)	
Sampling rate	32 Hz	
Sampling modes	Raw + steps	
	Epoch: 1, 2, 5, 15, 30, 60 sec	
	Epoch + steps: 1, 2, 5, 15, 30, 60 sec	
Environmental attributes		
Moisture protection	Waterproof IEC60529 IPX7 1 meter for 30 min	
Storage/transportation temperature range	-4 to 140°F (-20 to 60°C) to 95% humidity	
Operating temperature range	41 to 104°F (5 to 40°C) 15% to 95% humidity	
Computer attributes		
Communication interface	9-pin RS-232 serial port (standard with ActiReader)	
	9-pin serial to USB adapter (optional)	
Operating system compatibility	Windows XP, Windows Vista (32 and 64 bit),	
	Windows 7 (32 and 64 bit)	
Hardware platform	Personal computer	

Please visit www.philips.com/actical

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Respironics Asia Pacific
+65 6298 1088
Respironics Australia
+61 (2) 9666 4444
Respironics Europe, Middle East, Africa
+33 1 47 52 30 00
Respironics United Kingdom
+44 800 1300 845

Philips Respironics
920 SW Emkay Ave, Ste 100
Shevlin Corp Park, Bldg C
Bend OR 97702
+1 541 598 3800
+1 800 685 2999
www.actigraphy.com
Email: respironics.minimitter@philips.com

Appendix 7: Visit duration and exhibit location tracking form

Visit Duration and Exhibit Location: Sample Tracking Form