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Evaluating Learning Team-led on-gallery Experiences at London Transport Museum

An Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science

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Abstract

London Transport Museum offers Learning Team-led on-gallery experiences which include a self-guided pack for families, two exhibits for children, and holiday activities for families. This report evaluates the visitation and visitor engagement at these activities using the methods of spatial tracking, visitor observations, and surveys. From these evaluations recommendations were made for possible improvements in order to increase learning. The results show that the Family Pack is currently not successful, while the two children's exhibits and the holiday activities are generally successful.

Acknowledgments

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Executive Summary

The main goal of this research was to assist London Transport Museum in evaluating the Learning Team-led on-gallery experiences, which include the Family Pack, All Aboard and Interchange, and the holiday activities. LTM had four main questions which were addressed by this research: (1) Is the Family Pack effective in encouraging movement throughout the museum? (2) How can visitor learning be improved at the Learning Team-led on-gallery experiences? (3) How can learning be improved at the Learning Team-led on-gallery experiences for overseas visitors? and (4) How can All Aboard and Interchange be improved? This study used interviews, surveys, visitor tracking, dwell times, observations of visitor engagement, and interviews with learning officers at other museums to answer these questions.

Conclusions

Family Pack

The research team discretely tracked families through the museum and upon their exit gave them a survey. By analyzing the spatial tracking of families, both with and without the Family Pack, the research team found that in general the Family Pack:

- Does not encourage families to move throughout the museum
- Does not increase visitation at exhibits mentioned in the Family Pack
- Does not discourage purchases at the gift shop
- Overall the Family Pack is not being used by a significant proportion of visitors[1]

Children's Exhibits

From observations of visitors at All Aboard and Interchange, along with surveys, the research team was able to determine which exhibit was more visited by selected age groups and which activities held the attention of the children for the longest amount of time. The research team also looked at learning at the exhibits.

All Aboard

- More entertaining than educational[2]
- Most visited by children under five
- Overall successful

Interchange

- More entertaining than educational, however some children do learn from activities
- Most visited by children between 6-11
- Overall successful

Holiday Activities

From observations of visitors at storytelling, make and take, and the illustration workshop, along with surveys, the research team was able to determine which activities were more visited by selected age groups and which activities held the attention of the children for the longest amount of time.

Storytelling

- Mostly entertaining, although moderately educational

[1] Of the families tracked 2 used the pack, 4 looked at it and put away, while 14 did not use it at all.
[2] Based on the learning levels established by PISEC – see page 50 of full report for details.

- Successful for target age group (3-10), although most visited by children under five
- On average, 70% of children remained for whole story
- 11:00 time slot most visited

Make and Take

- Most visited by children under five
- Mostly entertaining and with decent educational value
- High holding power (50% of children remained for 27 minutes)

Illustration Workshop

- Low visitation (three families) but received a high rating
- Mostly educational

Recommendations

Family Pack

- Give visitors Family Pack and pencil without bag
- Place signs about where to use in museum
- Given that this pack is written towards children, write future Family Packs to entire family

All Aboard

- Maintain screens in the vehicles
- Expand area
- Add more educational activities such as questions children and parents could answer together
- Add a padded floor

Interchange

- Make results from How did you get here? and Where do you live? more accessible
- Maintain activities and replace missing parts
- Make directions more visible for Touch Objects and Guess Who?
- Provide seating for parents

Storytelling

- Hold earlier in the day
- Staff should considering asking children more questions to increase learning

Make and Take

- Have one staff at entrance, one staff helping visitors
- Provide questions for parents to ask children

Illustration Workshop

- Increase advertisement in the form of signs in the museum and emails to mailing list

Overseas Visitors

- Use more visual components in exhibits and make and take
- Audio and paper trails should be created in multiple languages

Overall it was found the Family pack is currently unsuccessful, while the children's exhibits and the holiday activities are successful.

1.0 Introduction

Museums are always striving to find new ways to engage their key audiences. Since the 1960s and 1970s, many museums have moved away from the traditional didactic exhibits (Hein, H., 1990, p.23), which limit visitor interactions, to more hands-on, interactive approaches that encourage engagement and increase learning. Many studies, such as the 1998 study by the Philadelphia/Camden Informal Science Education Collaborative [PISEC], have shown that people learn more from interactive exhibits and those interactive exhibits are particularly effective among family groups. Many museums focus on the family experience because families make up a large segment of the visitors. For example, in FY2010, London Transport Museum had over 287,000 visitors, with nearly half of them being family groups (Charity Commission, 2011b).

London Transport Museum [LTM] hopes that new activities, programs and exhibits will encourage interactivity and appeal to all visitors, especially families, while encouraging education and entertainment. An example of how London Transport Museum reaches out to families is their *Learning Team-led on-gallery experiences*. Learning Team-led on-gallery experiences refers to the Family Pack, the two exhibits aimed toward children, and the holiday activities. The *Family Pack* is given to each family upon entering the museum, and includes a booklet highlighting major attractions on each floor to encourage families to visit these attractions. The Family Pack also includes perforated figures, a coloring section and a building section for children to enjoy while exploring the museum. The interactive exhibits oriented towards young children are called *All Aboard* and *Interchange*. The *holiday activities* are activities run by the museum's Learning Team during holidays, such as the half term holiday, that are specifically aimed towards children. These activities include storytelling, a make and take workshop, and an illustration workshop.

BDRC Continental, a group of independent research consultants, conducted an audience evaluation at London Transport Museum from July 2010 to January 2011 to develop a baseline for visitor information, behavior, and experience ratings. In order to collect visitor feedback, surveys were conducted regarding the following topics: overall enjoyment, likelihood to recommend to others, friendliness of staff, Website rating, and quality of displays (BDRC Continental, 2011). BDRC noted that visitors of the museum highly rated the Learning Team-led on-gallery experiences that London Transport Museum offers, but wondered if these activities

could be improved. BDRC suggested that it may be possible to use these Learning Team-led on-gallery experiences to encourage families to visit other activities throughout the museum. BDRC also questioned how the Learning Team-led on-gallery experiences could improve visitor learning and family experiences, and how to make these activities easier to understand for overseas visitors who may have possible language barriers. From the BDRC's evaluation, London Transport Museum came up with four questions which the research team assisted in answering: (1) Is the Family Pack effective in encouraging movement throughout the museum? (2) How can visitor learning be improved at the Learning Team-led on-gallery experiences? (3) How can learning be improved at Learning Team-led on-gallery experiences for overseas visitors? and (4) How can All Aboard and Interchange be improved?

The goal of this project was to assist London Transport Museum in evaluating the use of the Family Pack, the two interactive exhibits and the holiday activities, while answering the four questions posed by LTM. In order to achieve this goal, the research had three main objectives: (1) To study the flow of visitors through the museum with and without using the Family Pack, (2) To observe visitors' engagement at the children's exhibits and holiday activities, and (3) To interview staff members from other museums to see the techniques they use in their activities designed for families. In order to achieve these objectives the methods of spatial tracking, surveys, visitor entrance tally, dwell times and observation of visitor engagement were used, as well as interviews from other museums.

Through these methods and objectives the research team was able to evaluate the Learning Team-led on-gallery experiences. The research team found that overall the Family Pack is not being used in the museum and when it is being used, it is not successful in encouraging movement through the museum. The two children's exhibits, All Aboard and Interchange, as well as the holiday activities are successful in engaging visitors; however, the educational value of these activities can be improved. The research team makes recommendations to increase learning at the Learning Team-led on-gallery experiences. Since this was the first evaluation done on the Learning Team-led on-gallery experiences, the findings from this research establish a baseline for future evaluations. The research also assisted the museum in deciding if changes should be made to the Learning Team-led on-gallery experiences.

2.0 Literature Review

Museums have played an important role in culture and education since they were first incorporated into society. Some of the first museums in the United Kingdom were introduced over four hundred years ago. Their role in education and culture has continually grown, reflected by the fact that museums in the United Kingdom received over sixteen and a half million adult visits in 2006-2007, about 41.5% of the adult population (Museums, Libraries, Archives Council [MLA], 2006, p.2). These visits were to the over 1,800 museums that are accredited by the Museums, Libraries and Archives Council (Museums Association, *Frequently asked questions*, 2011). The fact that museums are so highly visited in the United Kingdom highlights their importance in society. Within the United Kingdom, three of the top five museums in Europe can be found in London (European Group Museum on Museum Statistics, 2010). This chapter reviews the background of museums to better understand their purpose and history. Educational theory was examined in order to find what types of learning are most successful in museums and at London Transport Museum [LTM] specifically. Theory behind evaluations and exhibit design is included in order to gain a better understanding of how to evaluate London Transport Museum, and in particular their Learning Team-led on-gallery experiences. Education and exhibit design for families was the focus of this chapter, given they are the main focus of the Learning Team-led on-gallery experiences. The Learning Team-led on-gallery experiences are explained in detail, to provide a background on what types of activities and exhibits were evaluated.

2.1 Purpose of Museums

A museum is defined by the International Council of Museums [ICOM] as "permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment" (International Council of Museums, 2009). There is a wide range of museums, but they all share a similarity in mission. That mission involves three types of functions: preserving and conserving of artifacts, relating those artifacts to different periods of time and societies, and acting as centers of research and education (Wittlin, 1970). The educational aspects of museums are pivotal. As Professor George Hein notes, "the museum by its nature is an educational institution" (2005, p. 11). Museums through time have fulfilled their educational role in various ways. Similarly to other

museums, London Transport Museum started out with an emphasis on preserving and collecting artifacts, but today emphasizes their role of educating visitors.

2.2 History and Development of Museums

Before the 1800s, private collections were the possessions of individuals gathered for their own personal enjoyment. Professor Hein explains that "the creation of the Public Museum was an expression of the eighteenth-century spirit of enlightenment, which generated enthusiasm for equality of opportunity in learning" (2005, p.11). During the 19th century, there was a major expansion in the creation of new museums. The approaches to the museum's educational role were developed in the 19th century by pioneering staff members. The aesthetic and educational criteria of the day highlighted more didactic methods of museum learning (Hein, 1998, p.25-28). These expository education methods were reflected in exhibits with rigid pathways that the visitors followed, incorporating labels and other didactic forms of learning. These exhibits offered information that supported the 'received views' of the day, but no way for visitors to pose their own questions or arrive at their own answers. The museums achieved their educational role in various ways including exhibits, public and school programs and events, and other outreach activities.

Today museum's outreach activities increasingly use the Internet which can both expand them while also limiting the social gathering role of the museum. Over time, museums have changed how they approached their missions. The nature of museums changed from displays of cabinets of curiosity to places of constructivist learning. This change resulted from museums varying the methods used to promote learning, and alter the emphasis to different learning theories.

2.3 Educational Theory in Museums

Educational theory that was more focused on the student's experience was developed in the 1920s and 1930s by John Dewey (Neill, 2005). Before Dewey, the educational theory mainly focused on how information was given to people, instead of the student's actual experience. The three components of educational theory are: knowledge, learning, and teaching (Hein, 1998, p. 16). The theories of learning (See Figure 1) include the passive mode, in which information

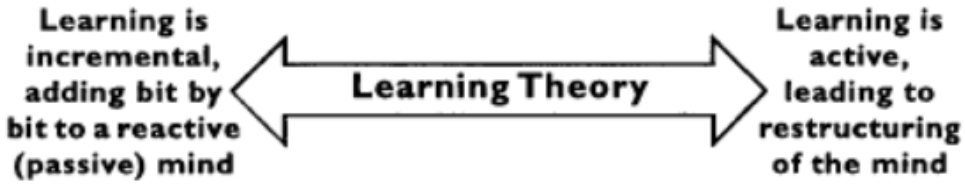

Figure 1. The Theories of Learning
Source Photo: Hein, 1998, p. 23

is presented and then absorbed, and the active mode, in which people learn by doing and responding to a situation (Hein, 2006, p. 345). Most people tend to be active learners, benefiting from a more hands-on experience. The theories of knowledge (See Figure 2) state that people

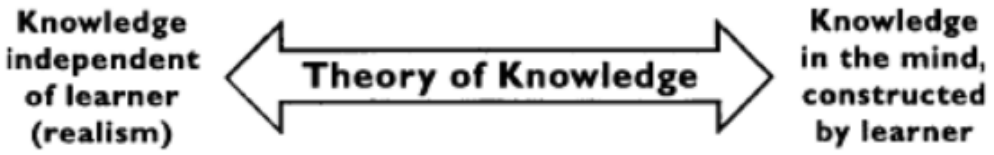

Figure 2. The Theories of Knowledge
Source Photo: Hein, 1998, p. 18

gain truths about the world by interacting with nature. The two extremes of the theories of knowledge include realist and idealist (Hein, 1998, p. 17). Realists accept what they are given, and work from their choices. Realists are often focused on gains, necessities, success, and what needs to be done to achieve an outcome. Realists see the world as full of facts leading to what is true and false, while seeking evidence for knowledge. Idealism, on the other hand, views an objective or goal as a vision. Idealists are less strict on measurement, but instead are focused on the reason behind reality, believing there is always a deeper meaning behind an outcome (Graebner, n.d., p. 311). An additional set of the theories of knowledge include objectivism and constructivism (Runes, 1962). Under the category of objectivist theory of knowledge there are two sub-categories: behaviorism and cognitivism. Behaviorism views learning as a science. A stimulus causes a learner to perceive, followed by a response, in that a fact or concept is learned. The other sub-category, cognitivism, asserts that the creation of knowledge occurs when a learner interacts with the environment causing connections in their mind. On the other hand, constructivism is the position that knowledge and truth are constructed by learners, and hence they do not exist outside of the individual's mind (Duffy & Jonassen, 1991, p. 7-12). When these theories of learning and knowledge are combined, four types of educational approaches are

formed (See Figure 3) three of which, didactic, expository learning, discovery learning and constructivism, are commonly used in museums (Hein, 1998, p. 25).

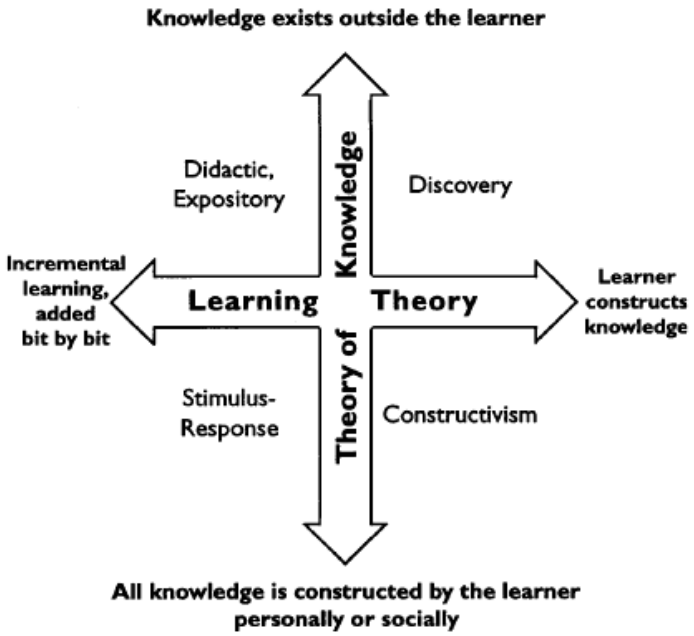

Figure 3. Educational Theories
Source Photo: Hein, 1998, p. 25

2.3.1 Formal versus Informal Learning

Generally, classroom learning is considered formal, while museum learning, and all unstructured learning, is considered to be informal (Borun, 2008, p.6). Informal learning depends more on observation and imitation, while formal learning consists of planned learning where the learner is considered the individual student. Dierking and Falk argue that defining formal and informal learning gives people the impression that one type of learning is better than another, therefore making formal learning seem superior (1992, p. 99). They believe there is no difference between the two, "Learning is learning. It is strongly influenced by physical settings, social interactions, and personal beliefs, knowledge, and attitudes….The terms 'formal' and 'informal' have little predictive value in relation to learning" (Dierking & Falk, 1992, p. 99).

2.3.2 Didactic, Expository Education

Didactic, expository education is the form of education most school children receive (Hein, 1998, p. 25-28). This is when information is given to the students in small bits to be absorbed. It is a very organized approach, in which there is little room for active hands-on learning; instead memorization is commonly used. The teacher decides what is true, and presents

it to the students bit by bit, starting from simple lessons and proceeding to the more complex ones. This form of education results from the combination of realism and passive learning. When this form of education is incorporated into exhibits, there is a very rigid pathway that the visitors must follow, with labels and other didactic forms of education stating what is to be learned from each exhibit. The exhibits present the information as truth, and generally do not suggest other interpretations. The exhibits offer answers, but not a way for visitors to arrive at those answers by themselves. The first museums commonly used these forms of exhibits, and although there has been a shift to more hands-on exhibits, they are still found in modern museums.

2.3.3 Discovery Learning

Discovery learning explains the concept that learning is accomplished by the learner constructing ideas for themself; however, the learner should draw the same conclusions as others (Hein, 1998, p. 30-33). The educational theory of discovery states: that learning is an active process, learners must undergo some form of change as they learn, their interaction with the material to be learned is fundamentally better than just absorbing it, and they change the way their minds work to learn the material. One major issue with discovery learning is that the goal of the experiment may not be obvious to the learner, and thus the purpose of the experiment may be overlooked or missed completely. Also, in order for discovery learning to be successful, the students must actively participate. Regardless of the pitfalls of discovery learning, it is still used in many museum exhibits. Museum exhibits that are organized with discovery learning will generally support exploration, prompt the visitors to find answers for themselves, and help visitors arrive at the accepted conclusions. Discovery learning in museums allows visitors to actively produce conclusions based on the knowledge, which is presented in each exhibit.

2.3.4 Constructivism

The final common form of museum education is constructivism, which uses active learning, both mentally and physically (Hein, 1998, p. 34). In the early twentieth century, the modern movement in museum education was object based with active learners, who learned through inquiry and problem-solving (Hein, 2005, p.32). This modern movement built upon philosopher John Dewey's Progressive educational theory (See Figure 4), which explains learning as a cycle (Hein, 2005, p.4). The contemporary term for this type of museum

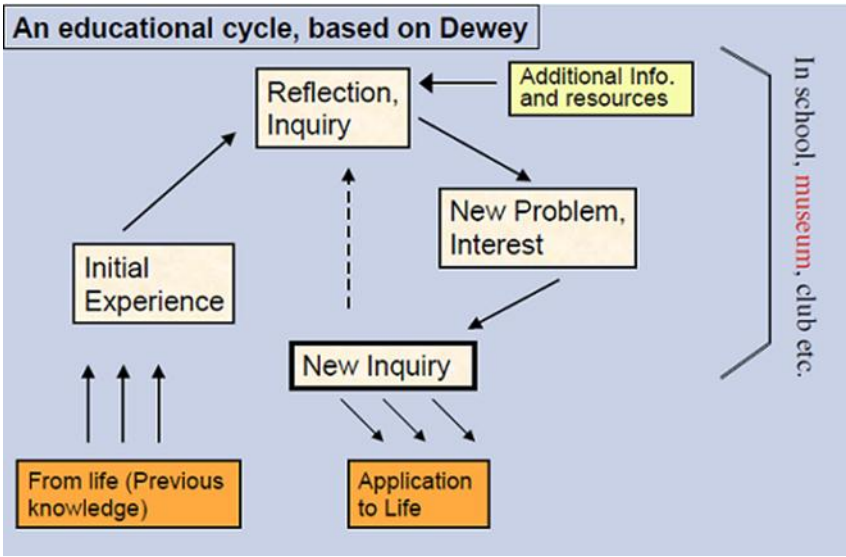

Figure 4. Dewey's Educational Cycle
Source Photo: Hein, 2005, slide 41

learning is "Constructivism, a combination of active learning (Learning Theory) and personal meaning making (Epistemology)" (Hein 2005, p.32). Experimentation is encouraged and there is no correct answer, as long as the answer a person reaches makes sense to them it is considered correct (Hein, 1998, p. 34-35). Constructivist exhibits are free flowing compared linear exhibits because there is no specific pathway to follow. Active learning is encouraged and many different viewpoints are presented to the visitors, so they can form their own answers through hands-on experimentation. The many viewpoints are presented with a wide variety of learning modes to engage a wide range of visitors. The exhibits allow for visitors to connect with the objects through experiment and other activities and ultimately draw their own conclusions from these experiences. The exhibits do not offer one truth, but instead multiple truths and views about a similar topic. Museum development pioneers, Frank and Robert Oppenheimer, realized the goal of constructivist exhibits when they opened the Exploratorium, a fully participatory science museum in San Francisco in 1969 (Hein, H., 1990, p.233). This museum used hands-on exhibits extensively. There visitors of all ages achieved "the satisfaction of individual discovery" (Hein, H., 1990, p. 233).

2.3.5 Stimulus-Response

The final educational theory, which is not commonly used in museums, is stimulus-response. The focus of stimulus-response theory is to categorize learning styles by separating cognitive responses with outside influences (Spence, 1950, p. 162). These outside influences such as associations, bonds, and habits, alter the cognitive response of a person's first and natural reactions. In order to increase recognition in a learning environment, such as in a museum setting, it is useful and important to strengthen the stimulus response of people. To strengthen the

stimulus response connections, an atmosphere of belongingness and relation are required, as well as a motivational environment. Being able to relate new experiences with a person's past, keeps them engaged and enhances learning. According to Hull, an American psychologist, there are four variables in his learning factor that promote education (Spence, 1950, p. 162). These include the number of reinforcements on educating a particular topic, the magnitude of the reward based on an assessment of how much knowledge was gained, time of delay of the reward, and the time interval between the stimulus and response. When a museum exhibit uses this kind of learning, there are didactic components with a clear beginning and end (Hein, 1998, p. 29-30). When a user arrives at the correct 'truth' they are given a reward, such as lifting a flap to reveal 'Yes, that is correct'. Many museums do not find this to be a legitimate way of presenting 'truth', so therefore it is not widely used. This approach does not allow for much group learning, therefore most museums do not employ it for activities or exhibits, especially ones which focus on family learning.

2.4 Family Learning in Museums

Families visit museums for both the educational purpose and for a social opportunity (Dierking & Falk, 1992, p. 41). Parents bring their children to museums in order to expose them to an educational environment that is engaging and stimulates interest. Children visit museums in two main groups, with their family and in school groups (Haas, 2007, p. 49). About 40% of museum visitors are family groups, an even higher percentage in science museums, and 18-25% of visitors are school groups (Borun, 2008, p.6). This means that about 60% of museum visitors consist of groups with children, making them a majority of visitors. This is why many museums focus on children, especially in family groups. Museums tend to encourage family discussion, in order for them to learn together in the museum. In fact, studies have shown that during their visit, families usually spend about fifteen to twenty percent of the time interacting with each other (Dierking & Falk, 1992, p. 45). Due to the strong social aspect of museums for families, exhibits should strive to prompt discussion (Haas, 2007, p. 69). Discussion allows for the family to learn more about the exhibit by relating it to their lives (Dierking, Ellengogen & Luke, 2004, p. S51-S54). Studies have shown that many families continue this discussion once at home, continuing the learning which started in the museum, while promoting family identity.

When examining how families learn in museums, it is important to first consider the social aspect of the museum for families. Generally when entering a museum, the father will pick

the exhibit, while the mother will take care of the needs of the children (Dierking & Falk, 1992, p. 42). The parents usually choose an exhibit based on their personal knowledge of the subject, and then the children decide how actively engaged the family will be with the exhibit. Children generally have the same attention span for each exhibit therefore the families spend a similar amount of time at each type of exhibit, "on average, 40 seconds at static exhibits, up to 4 minutes with puzzles and games, and up to 15 minutes with interactive computer exhibits" (Linn, 1983, p. 122). This means that in order for an exhibit to engage families, it must draw the attention of the family initially, not for an extended period of time. Exhibits with interactive elements are better for prolonged family use. Once at the exhibit, the children will play while the parents read and look at the exhibit (Dierking & Falk, 1992, p. 42-48). If the children do not understand a certain part of the exhibit, the parents will explain it to them, encouraging discussion, which is the social part of the museum visit that families prefer (Haas, 2007, p. 68).

2.4.1 Designing Family Exhibits

One challenge arising from designing exhibits for families is the fact that there is a wide range of ages within and between groups, with different learning styles. Children of different ages learn in different ways, and exhibits must accommodate all of their visitors. In order for a family exhibit to be successful, it must address the needs of each age group commonly found in families. When a child is under the age of three, they are just learning motor skills, and hence learn by repetition (Maxima, 2007, p. 174-177). From the ages of four to seven, children learn from physical activities and make-believe exercises. After age seven and until age twelve, children learn best in groups when given questions to find answers by themselves. During the teenage years, freedom allows for the best learning, in choosing the subject matter, and in choosing to work alone or in a group.

In order to design family exhibits, it is important to define 'family'. Many of the common museum definitions state a family is a multi-generational group. The Philadelphia/Camden Informal Science Education Collaborative [PISEC] project team added that there must be at least one child between the ages of five and ten, and an adult over nineteen (Borun, Dritsas, Fadiga, Jangaard, Johnson, Peter, Stroup, Wagner, & Wenger, 1999, p. 10-19). Due to difficulties in tracking large families, PISEC limited their operational definition of a 'family' to six members. The PISEC group found seven characteristics that were essential in the design of successful family exhibits (Borun, et al, 1991, p. 23). Such exhibits should be:

- **Multi-sided**: the family can cluster around the exhibit
- **Multi-user**: interaction allows for several sets of hands and bodies
- **Accessible**: the exhibit can be comfortably used by children and adults
- **Multi-outcome**: observation and interaction are sufficiently complex to foster group discussion
- **Multi-modal**: the activity appeals to different learning styles and levels of knowledge
- **Readable**: text is arranged in easily-understood segments
- **Relevant**: the exhibit provides cognitive links to visitors' existing knowledge and experience (p. 23).

When the exhibit being designed is an interactive program, readable becomes understandable (Borun, 2008, p. 9). When a staff member is leading this program, people learn best through instructions, rather than a long lecture. For multi-user stations, it is important that the participants are working to create a common experience. It is also important to note that families have a limited time at the museum, usually about two hours. After thirty minutes museum fatigue sets in (Allen, 2004, p. S20). Museum fatigue is when people are overwhelmed by the information so they can no longer be extremely focused, and begin to cruise through exhibits looking for something that catches their eyes. Since the time people spend at the museum is short, and the time of extreme focus is even shorter, exhibits should be designed not to teach people, but to stimulate their interest in a subject matter so they want to learn more about it after the museum visit (Linn, 1983, p. 120). This subsequent type of learning is encouraged through the museum's Website, which enables visitors to extend their experience and continue to learn outside of the museum.

In addition to hands-on exhibits, it has been found that minds-on exhibits are necessary to engage visitors (Allen, 2004, p. S25). Visits, which have a minds-on component, are considered by the Exploratorium to be Active Prolonged Engagement [APE] exhibits. The study of average dwell times at the Exploratorium showed APE exhibits were found to keep visitors for twice as long as traditional exhibits. The time spent was observed by dwell times, a method used to evaluate the holding power of an exhibit or the ability of an exhibit to keep visitors engaged. Dwell time is collected by observing an exhibit and recording the time spent at the exhibit. The APE exhibits promoted a wider variety of interactions, which resulted in a wider range of questions. This wider range of questions promotes more discussion, which results in increased family learning (Dierking, Ellengogen & Luke, 2004, S54-S55). Since children tend to ask their parents to explain something they do not understand, it is helpful to allow for parents to learn

with their children, in this way they do not feel the pressure of being expected to know everything. Families also prefer that staff be available to assist in learning, "They [family focus groups] felt strongly that the presence of staff and volunteers improved a museum visit" (Borun, et al., 1991, p. 22).

2.4.2 Overseas Visitors

Overseas family visitors have the same needs as the other families which visit the museum in addition to the possibility that they may encounter a language barrier. This language barrier makes it difficult for them to understand the exhibits and the Learning Team-led on-gallery experiences (London Transport Museum, Sample Job Description, 2011). Some museums have language selections for audio displays, as well as information pamphlets or guides. As world travel increases, foreign visits also increase. With this in mind London Transport Museum has widened its audiences by providing language selections for their visitors. The job description for London Transport Museum prefers workers that are multi-lingual. The museum also stresses that the staff "must be good communicators and are able to deal with a wide range of people and situations without prejudice." LTM has an English for Speakers of Other Languages [ESOL] program, which provides tutoring of English transportation vocabulary for the visitors before coming to the museum (London Transport Museum, ESOL, 2011). This program can be utilized so that foreign families can have a better understanding of the vocabulary used and therefore can have the same experience as English speakers at the Team-led on-gallery activities. Another way LTM is able to assist their foreign visitors is by providing a gallery trail in French that has questions that highlight some exhibits (LTM, Access and Facilities, 2011).

2.5 Evaluations

Evaluations are used by museums to determine what exhibits and types of exhibits teach and engage their visitors the most. Studies such as the PISEC study have determined what promotes visitor learning in museums. Without these studies it would be difficult to design exhibits and activities that meet the needs of the visitors. The PISEC project group evaluated families by recording conversations and then comparing them to how much the family learned. It was proposed that there are three levels of learning: level one being *identifying*, level two *describing*, and level three *interpreting and applying*. Level three showed the greatest understanding of the goals of the exhibit. PISEC found that the longer a family stayed at an

exhibit the more they learned, achieving a higher learning level. Families also learned more at hands-on exhibits. The performance of exhibits was judged using performance indicators. For example, did visitors ask a question, answer a question, comment/explain how to use an exhibit, read text aloud, or read text silently. It was found that these indicators related to learning level. The performance indicators measure visitor engagement and the higher level of engagement shows a higher level of learning. For example, a visitor who silently reads labels learns less than a visitor who is actively asking and answering questions.

Evaluations also help to illustrate the different theories of learning, and how to study these theories in museums (Hein, 1998, p. 41-53). In 1884 the first museum evaluation was recorded by Higgins in the Liverpool Museum. Higgins classified visitors into three major categories in a hope to improve the educational value of the museum. These categories were: students (1 – 2%), observers (78%), and loungers (20%). Even though museums were seen as important educational institutions, from 1900 – 1950 museum evaluations were sparse and often the role of museums were debated. While some early museum pioneers argued that the purpose of a museum is solely for education, others felt that the museum's purpose was simply for pleasure but agreed that museums had educational value. The evaluations, which were produced and recorded in the early period of the 20th century focused on their educational role and how to increase the educational value of museums. However, even though some pioneers ventured towards museum evaluations, it was not until the 1970s that these evaluations became more universal.

In 1967 Michael Scriven, who was one of the leaders of museum evaluations, drew a distinction in formative and summative learning (Hein, 1998, p. 57-60). Scriven stated that formative evaluations where ones done during the development of an exhibit, while summative evaluations looked at a finished exhibit. Formative evaluations are used to improve an exhibit before it is opened to the public, while summative try to describe the impact of a pre-existing exhibit. Front-end evaluations are a form of evaluation used to determine the desirability of a certain type of exhibit or program. Front-end and formative evaluations can be more informal, however summative, the type of evaluations our team performed, generally need to be formal. In these summative evaluations, the groups that are being evaluated include all of the visitor types, which visit the museum.

Evaluations in museums generally are observation based, with three main types: naturalistic observation, structured observations, and event-based observations (Hein, 1998, p. 108-110). Naturalistic observation is when visitors are observed for their entire trip throughout the museum and is used to determine the natural interactions of the visitors in the museum. Structured observations use predetermined coded behavior and then note when a visitor performs one of these actions. Event-based observations are when the visitors' events are recorded, such as their movements through an exhibit, which is done using spatial tracking. The visitors' actions sometimes are also recorded, independent of time.

As museums continued to grow, the importance and need for educational evaluation also expanded. In the US, local schools, state agencies, and academic institutions that received federal funding were required to spend 5 – 10% of the funding to evaluate the effectiveness of the educational intervention they provided (Hein, 1998, p. 55). The growth in museums has created an increased pressure on the museum personnel to prioritize their exhibits and programs by focusing on what is actually happening versus what is intended to happen in the museum (Hooper-Greenhill, 1999, p. 306-309). This increased pressure from the external economic factors and internal forces, led to increased professionalism in the museum and a corresponding need for evaluation of museum activities.

As museums developed and their educational role expanded, the need for exhibit evaluation and understanding became increasingly important. The Museums, Libraries and Archives [MLA] is a British organization that supports museums and their goal to provide visitors with a quality experience that will enrich their lives (Museums, Libraries and Archives Council [MLA], 2008, Our Vision). The MLA created a set of standards called the Generic Learning Outcomes [GLOs]. The GLOs were developed as tools for understanding and describing the learning that takes place in museums (MLA Council, 2008, Generic Learning Outcomes [GLO]). There are five major categories to the GLOs: Activity, Behavior, and Progression; Enjoyment, Inspiration, Creativity; Attitudes and Values; Skills; Knowledge and Understanding (See Table 1, below). Museums generally use the GLOs to help evaluate and improve exhibits.

Generic Learning Outcomes	Detailed Description
Knowledge & Understanding	• Learning new information • Making sense of known information • Deepening the understating of previous knowledge
Skills	• Knowing how to do something • Being able to do new things • Social, communication, or physical skills
Attitudes & Values	• Visitors' feelings and perceptions • Opinions about others • Opinions about experiences • Reasons for personal viewpoints
Enjoyment, Inspiration, Creativity	• Having fun • Being surprised • Innovative thinking and creativity
Activity, Behavior, Progression	• What people do • What people intend to do • What people have done

Table 1. Generic Learning Outcomes
Source Photo: MLA Council, 2008, GLOs

2.6 Background of Learning Team-led on-gallery Experiences

The term 'Learning Team-led on-gallery experiences' refers to the Family Pack, the two exhibits aimed at children, and the holiday activities offered at LTM. These Learning Team-led on-gallery experiences are used by London Transport Museum in order to give families a more rewarding experience at the museum.

2.6.1 Family Pack

The museum provides 'Time traveling moustaches and other great ways to explore London Transport Museum – a manual for inquisitive minds', also called the Family Pack to families that enter the museum. The Family Pack was designed by Amy Marshall, who has since left LTM, and was introduced to the museum around Christmas 2010 (Sian Thurgood, personal communication, May 10, 2011). The Family Pack was made possible by a donation from the Luke Rees-Pulley Charitable Trust.

Inside the Family Pack there is a punch-out horse, a graphic design poster, a foldable doll house, and one moustache that can be worn by children. Also included is drawing space for a 3D bus, word bubble fill-ins (See Figure 5), and city color-ins (see Appendix B). For example, Figure 5 shows people riding the Metropolitan Railway in the 1900s, and asks children to fill in their thought bubbles. The exhibit mentions that the old railways had unpleasant smells and poor

lighting. Each activity in the Family Pack focuses on a certain time period and also a specific section in the museum. As the Family Pack guides the family through the museum, there are recommended stopping points, including the horse drawn buses, the Metropolitan steam train, the Metro-land doll house, Design for travel gallery and the buses, specifically

Figure 5. Family Pack Example (p. 9-10)

the Green Line bus. The activities which go along with the stopping points were designed to encourage children to learn more about the history of transportation while having fun. The Family Pack provides education through discovery learning, because the children are encouraged to interact and draw their own conclusions about the exhibit.

2.6.2 Holiday Activities

The holiday activities are designed with a theme that relates to the current special exhibition offered at LTM (Steve Gardam, personal communication, May 9, 2011). The theme for the holiday activities offered from May 30th to June 3rd, Monday through Friday, was the River Thames. The idea behind the holiday activities is that they should last for at most twenty minutes in order to accommodate a large number of families (Sian Thurgood, personal communication, May 10, 2011). These activities included storytelling, a make and take

workshop, and an illustration workshop. The storytelling holiday activity focuses on children between the ages of three and ten. The storytelling took place at 11:00 on Monday, Wednesday and Friday and at 15:30 on Tuesday and Thursday. Each day there was an announcement made five minutes prior to the start of storytelling. For the five days which these activities ran, the same story was told by one member of the Learning Team. The story which was told was an interactive journey down the River Thames, highlighting the different sights one would see. During the make and take workshop, which ran from 12:00 to 15:00 each day, families where able to make either fantastic fans or fluttering flags. The make and take workshops were primarily ran by either two members of the Learning Team or a one member of the Learning team and a volunteer.

The illustration workshop was the first paid workshop LTM has offered. The cost was ten pounds per children, and parents were encouraged to stay with their child. The children were walked through the River Thames exhibition where there was discussion about the painting between the staff and the families. The children then were able to make their own illustration about how they view London.

2.6.3 All Aboard and Interchange

The final aspect of the Learning Team-led on-gallery experiences are the two exhibits designed for children. All Aboard (See Figure 6) is meant for children under the age of five. The exhibit includes a train set for children to play with, along with a taxi, train, bus, tram, and boat that can be 'driven' by the children. In front of the steering wheel, a monitor displays a street or river to make the driving seem more realistic. The train set is a small model of London with both the Overground and Underground rail systems (See Figure 7). The children are able to play with the model trains throughout the board. Tables are set up

Figure 6. All Aboard

next to the All Aboard play area so parents can watch as their children play. During the weekends and holiday times, a café is also opened so parents can buy foods or drinks.

Figure 7. All Aboard Train Play Set

The second exhibit, Interchange, is located on level one of the museum and is meant for children between the ages of six and eleven (See Figure 8). Activities located in Interchange are designed to encourage discovery learning, in which children interact with the exhibit and come to their own conclusions. The exhibit includes eight sections. The Bus display allows children and adults to climb aboard and sit in either the driver seat, or the passenger seats and listen to an audio recording of current London transportation (Bus). Guess who? is a game played by two people. The two people stand facing each other and have in front of them a selection of 24 characters. Each picks a character, and then in alternating turns asks the opponents a yes or no question about the other's chosen

Figure 8. Interchange (New Location)

character. This process continues, and who ever can guess their opponent's character first, wins (Guess Who?). Try me on is a closet with costumes where children can try on clothing, such as vests and jackets, relating to the workers of transportation (Try me on). Touch objects is a wall with fifteen objects relating to transportation with a set of questions describing an object. To answer the question, the person must touch the object and either a check for correct or X for wrong lights up (Touch objects). Where do you live? has a small map of the parts of London and the rest of the world. The visitors click the button of where they are from and a tally of all the answers recorded appears (Where do you live? buttons). How did you get to the museum? consists of a panel with different modes of transportation. When the buttons are pressed a tally of all the answers recorded appear (How did you get here? buttons). What is the best way to get here? displays a panel with seven modes of transportation and locations in London. When a button is selected the levels of speed, cost, and environmentally friendliness appears (Best Way Buttons). Build a vehicle (See Figure 9) allows children to build a model bus using different combinations of parts. The bus has different blocks that can be added, such an electric or diesel motor and different sizes and shapes of bus cabs. When the bus is built, a button is pushed and lights come on say how many people the bus can safely carry, how environmentally friendly the bus is, how expensive the bus is to build and how fast it can travel. This allows children to see how bus design affects these four factors (Build a bus). Interchange moved to a new location shortly after the completion of the research in order to make room for renovations occurring in the museum.

Figure 9. Build a Bus

3.0 Methodology

The main goal of this research was to assist London Transport Museum [LTM] in evaluating the Learning Team-led on-gallery experiences, which include the Family Pack, All Aboard and Interchange, and the holiday activities. LTM had four main questions which were addressed by our project: (1) Is the Family Pack effective in encouraging movement throughout the museum? (2) How can visitor learning be improved at the Learning Team-led on-gallery experiences? (3) How can learning be improved at Learning Team-led on-gallery experiences for overseas visitors? and (4) How can All Aboard and Interchange be improved? These questions were addressed by establishing three objectives: (1) To study the flow of visitors through the museum with and without using the Family Pack, (2) To observe visitors' engagement at the children's exhibits and holiday activities, and (3) To interview staff members from other museums to see the techniques they use in their activities designed for families. This study used interviews, surveys, visitor tracking, dwell times, and observations of visitor engagement to achieve these objectives. At the completion of the research, the Learning Team-led on-gallery experiences were evaluated and recommendations were made to London Transport Museum about how visitor experience can be improved. The timeline for this research can be found in Appendix Q.

3.1 Family Pack

The 'Time travelling moustaches and other great ways to explore' London Transport Museum, also called the Family Pack, will be formally evaluated in September of 2011. Before the formal evaluation, the museum wanted to evaluate whether the pack was beneficial for the visitors and to look into possible concerns: (1) Families were not using it in the museums and instead just taking it home as a souvenir; (2) Families were purchasing fewer items from the museum store since the Family Pack included many activities that could also be done at home, and (3) Parents and children may not understand what the Family Pack was trying to present. The research analyzed whether the Family Pack encouraged families to visit the specific areas of the museum mentioned in the booklet. The research was also analyzed to see if the Family Pack discouraged families from visiting other parts of the museum that were not mentioned.

The research on the Family Pack was conducted by using spatial tracking, giving surveys, and interviewing staff. These methods were chosen since the Family Pack was already being used in the museum, therefore a summative evaluation was appropriate (Hein, 1998, p. 57-60).

Summative evaluations are more formal due to the fact they are measuring a pre-existing program and evaluating the impact it has had. These formal evaluations require detailed visitor observation, surveys to learn about visitor opinion, and interviews to gain background from before the program was introduced. Evaluations were carried out until patterns were discovered in visitors' visitation through the museum. This took twenty five total tracking, sixteen of which agreed to answer a survey.

3.2 All Aboard and Interchange

The research team also observed the two exhibits, All Aboard, meant for children between zero and five, and Interchange, meant for children between the age of six and eleven. The museum wanted to know if there was room for improvements in these exhibits and asked for recommendations as to how they might be improved. The main points addressed included how efficiently the space in the exhibits was used and whether or not families were encouraged, or discouraged, from visit the exhibits while using the Family Pack. The exhibits were compared to each other to see if the successful aspects from one exhibit could be used in the other exhibits. In order to evaluate the two exhibits, dwell time measurements, visitor entrance tally, observation of visitor's engagement, and surveys were used. These formal forms of evaluations were used because a summative evaluation was necessary to study the impact of the exhibits (Hein, 1998, p. 57-60). Interchange also employed the discovery style of museum learning in which visitors are encouraged to explore and interact with the exhibit and then arrive at accepted conclusions (Hein, 1998, p. 30-33). Detailed visitor observation allowed for data to be collected which could be compared between the two exhibits, and surveys allowed for visitor to provide feedback about their experience at the exhibits. These observations were also used to determine if the users of Interchange were arriving at their own conclusions or just using the area as a play space.

These observations were carried out long enough in order for patterns to be discovered. The data gathered at Interchange included, twenty eight dwell times, five entrance tallies, and sixteen observations of visitors' engagement, twelve of which were willing to take a survey. For All Aboard the data included five dwell times, five entrance tallies, and six observations of visitors' engagement, five of which were willing to take a survey.

3.3 Holiday Activities

The final component of the Learning Team-led on-gallery experiences to be evaluated was the holiday activities that took place between May 30th and June 3rd. These activities

included storytelling, a make and take workshop, and an illustration workshop. The research team was able to evaluate how visitors rated the activities and determine what time was more visited for the storytelling, 11:00 or 15:30. Since the holiday activities were already in place and the museum wished to learn about their impact, a summative evaluation was conducted. This evaluation included the formal observations of visitor entrance tally, dwell times, and the interactions between visitors and the Learning Team in order to determine the level of engagement visitors had at the holiday activities. Surveys were conducted in order to see if people were aware of the holiday activities prior to their museum visit and what visitors thought of the quality of the holiday activity. The research also compared visitation and feedback between the free storytelling and make and take activities compared to the paid illustration workshop.

Since these holiday activities occurred for one week of the research, these evaluations were only done for a short period of time and fourteen observations of visitor's engagement were done for storytelling, ten of which were willing to take a survey. Nineteen visitors were observed for the make and take, seventeen of which were willing to take a survey. All three of the visitors that were observed for their engagement at the illustration workshop took a survey. Entrance tallies and dwell times were done every time the holiday activities were offered, five times for storytelling and make and take, and twice for the illustration workshop.

3.4 Objective 1: Study the Flow of Visitors

To encourage families to transition between exhibits in the museum using the Family Pack, it was important to understand their current movements and transitions between activities. By understanding the current travel patterns in the museum it was possible to make recommendations to London Transport Museum about how to encourage family visitors use the Family Pack in the museum, and to determine if the Family Pack is encouraging, or discouraging, visitation at certain exhibits in the museum. In order to track families, it was necessary to first define what was meant by 'family'. Modifying the Philadelphia/Camden Informal Science Education Collaborative [PISEC] definition, a family was defined as a multi-generational group with at least one child under the age of fifteen and an adult over the age of nineteen (Borun, Dritsas, Fadigan, Jangaard, Johnson, Peter, Stroup, Wagner & Wenger, 1998, p. 10). The PISEC study found it best to cap the number of people in the family group at six, because a larger group becomes difficult to track. For this research, the maximum number of

people in a family was set to six people and if a family has more than six people, they were not observed.

3.4.1 Spatial Tracking

After the definition of a family was established, family movements throughout the museum were recorded using spatial tracking (See Figures 10 and 11), and recording a group's movement on a floor plan (Hein, 1998, p. 102). Spatial tracking combines naturalistic observation, which records the visitors' natural movement through a museum, with event-based observations, which records the visitors' events (Hein, 1998, p. 108-110). Spatial tracking combines both these because researchers are not interfering with the natural movements of the visitors, while still recording these events. Spatial tracking provides the easiest way for the research team to determine how visitors travelled through the museum without the visitors knowing that they are being observed. These natural movements allowed for observations of how families move with and without the Family Pack. One common problem with tracking groups is deciding whether to track an individual member or the group as a whole. Families generally tend to move together in a group (Hein, 1998, p. 105), so they were tracked as a whole group. A team member stood at the top of elevators on the second floor near the elevators (See Figure 10) and the first family group with a Family Pack which entered was tracked. If a family started their visit with a Family Pack, but then stopped using it, this was noted. If a group member was standing at the elevators for over ten minutes without seeing a family with a Family Pack, they then tracked any family. This was helpful for providing data to compare families that used the Family Pack to families who did not use the Family Pack. The D Term IQP 2010 London Transport Museum's report (Ciesynski, McDonnell,

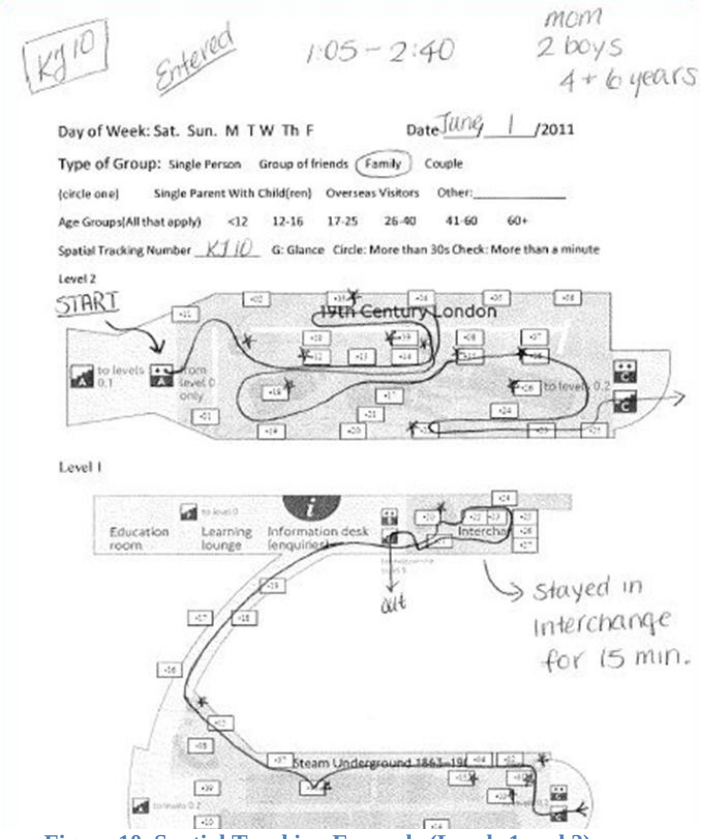

Figure 10. Spatial Tracking Example (Levels 1 and 2)

Mordarski & Rotier, 2010), indicated that it is best to follow visitors through only one floor of the museum since following a visitor from floor to floor increased the chance of the visitor noticing they were being followed. Once visitors are aware they are being followed, they will often alter their behavior, leading to biased results. However, since the research was interested in the transitions of the family throughout the entire museum, the method which was indicated in the D Term 2010 IQP report did not apply. Instead the method of having one member follow the family from a distance throughout the entire museum and appearing to be a normal visitor at the museum was the best choice. An example of a spatial tracking can be seen in Figures 10 and 11. These figures provide a detailed floor plan of the museum with the path which a particular family took through the museum.

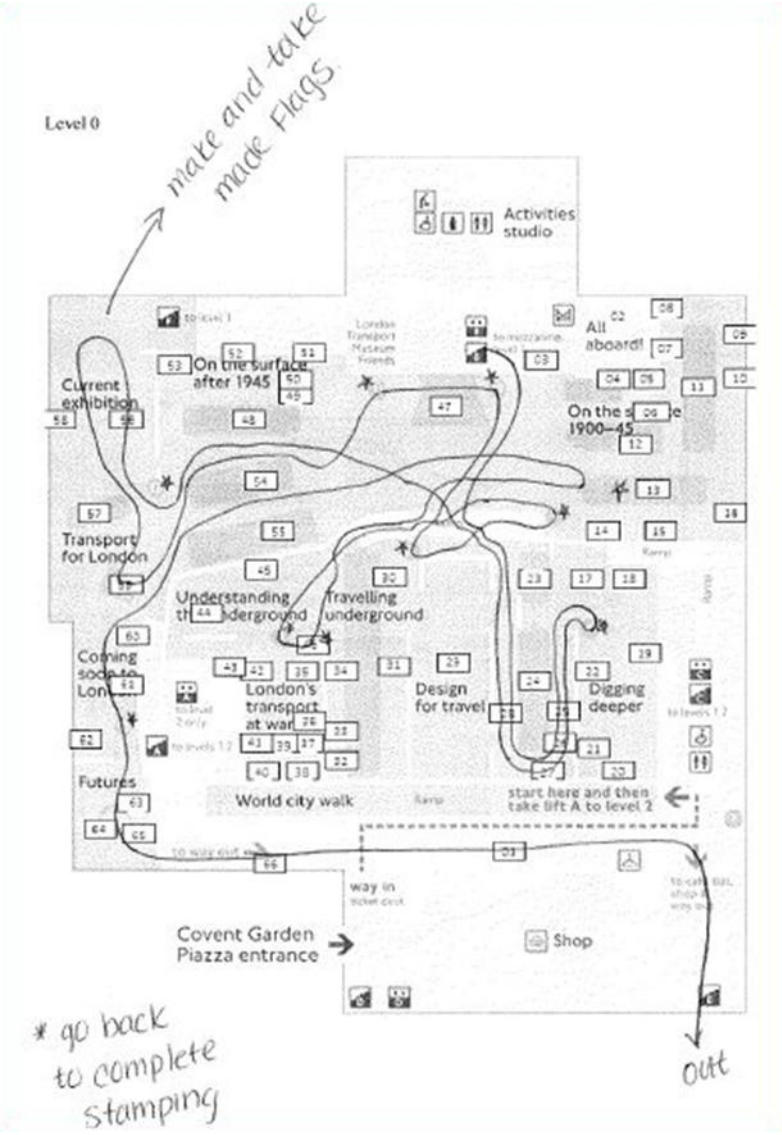

Figure 11. Spatial Tracking Example (Level 0)

When a family was being tracked, their movement through the museum was sketched on a floor plan. It was also noted how long they stayed at each exhibit: a glance, more than thirty seconds, or more than a minute (See Appendix C). This floor plan sheet collected information such as number of members in the family, estimate of age groups, and whether they had a Family Pack and used it. Using what was learned by the D Term 2010 IQP group, the research member continued to track visitors who used the bathroom, while they ceased tracking visitors who entered the café. Families were watched when they entered the museum shop, while the group

member stood by the entrance to note if they bought anything. The families that were tracked were asked to complete an exit survey either when they notice they are being followed or when they were leaving the museum (See Appendix D). The apparent leader of the group was surveyed and it was noted if additional members of the groups commented on a survey question.

Spatial tracking was performed between Friday and Sunday, with generally two families being tracked per day. The research team tracked twenty five total families, with sixteen families that were willing to take the exit survey. Each spatial tracking generally took two to three hours to perform. The research team stopped after twenty five spatial tracking due to time constraints.

In order to turn the raw data into useful information, these tracking sheets were inputted into a spreadsheet (See Appendix E). This was done by first putting details about the tracking on top of the sheet. These details included the researcher who performed the tracking, shown by their initials with their observation number. The observation number was a way for the researcher to know how many data sheets they had filled out, and also to match observations with their surveys. Visitor details such as gender and age of the members of the family were also entered, along with the times the tracking started and finished. Then the exhibits which the family visited were listed in order, using the exhibit codes the research team made upon their arrival to LTM (See Appendix F). It was noted how long a family stayed at an exhibit, either just a glance, for between thirty seconds to a minute, or more than a minute. This was done by marking an X in the appropriate column. Observations about the family, such as if they bought anything from the store or if they used the Family Pack, were also placed on the spreadsheet. The survey answers were entered by numbering the questions and typing the response next to it.

3.4.2 Visitor Entrance Tally

A count of visitors who entered each holiday activity, Interchange, and All Aboard was also recorded. This was done by having a group member stand at the entrance of the holiday activity or exhibit and counting the visitor groups that entered. The groups who entered the exhibits and activities were categorized into segments and assigned a number. The different groups, adapted from LTM D 2010 IQP, were: single person (1), group of friends (2), family (3), couple (4), child(ren) (5), overseas visitors (6) and other (7). Overseas visitors were recorded when possible to identify them. Since the research team was mainly interested in visitors with a language barrier, visitors were considered to be overseas visitors if they spoke another language. This was because it was assumed their primary language was not English, so therefore the

language barrier might affect their experience at the museum. The time which the group entered the activity was also recorded on the data sheet to see if the flow of visitors is steady or varied (See Appendix G). Details of visitors, such as an estimate of ages and number of members in groups, were recorded. If a visitor entered an exhibit and then left immediately, this was considered a glance, and it was marked under the glance column of our worksheets. In order to understand how the exhibits compare for visitation levels, they were observed for an hour during periods of similar activity by having two members of our team watch each of the exhibits at the same time. The exhibits entrance tally was recorded multiple times to give an average of visitation levels. The holiday activities' entrance tally was recorded for every time a holiday activity was run. This kind of event-based observation made it possible to compare visitation levels to give a quantitative analysis of the visitation of one exhibit or one holiday activity, compared to the others.

Entrance tallies were done twelve times for the children's exhibits and all five days the holiday activities were offered. The entrance tally sheets were also entered into a spreadsheet (See Appendix H). The researcher details were again entered at the top of the spreadsheet, along with the exhibit or activity being watched and the times for which it was observed. For each group that entered details were entered, including the visitor code, the number of visitors in an age group, and what time they entered. The time was recorded using a stopwatch. Since the research team was mainly interested in children, the age groups were under five, six to ten, and eleven to fifteen. Parents or additional family members were noted in the 'Additional Members' column. If a group just glanced at the exhibit or activity, then under the age column a zero was entered and an X was placed under the glance column. If two children glanced, then two Xs were placed under the glance column. The total number of visitors from each age group and the glance column was tallied.

3.5 Objective 2: Observe Visitor Engagement

The research team focused on family engagement in London Transport Museum. There are seven characteristics that make a successful family exhibit (Borun, et al, 1998, p.23). One characteristic is to have a 'multi-sided' exhibit so the audience can cluster around all the sides of the site. A 'multi-user' format opens up a wide range of audiences that can interact with the exhibit simultaneously. Another characteristic is that the exhibit must be 'accessible,' in order that it can be used by children and adults, as well as by group members who may need some

special accommodations (wheel chairs, etc.). 'Multi-outcome' allows for people to form questions about the exhibit, have group discussions about what they have learned, or ask questions if any information is unclear. 'Multi-modal' opens the exhibit up to people with different learning styles, as well as to those who already have some prior knowledge about the information presented at the exhibit. The exhibit characteristic of 'readable' is key to the information that is presented at the exhibit and becomes 'understandable' when there is a staff member speaking. The last characteristic of 'relevance', which focuses on relating the exhibit information to the visitors' life, makes the exhibit more engaging for visitors. All Aboard and Interchange were observed to determine how many of the successful characteristics out of the seven are incorporated in their design. The characteristics were recorded for each activity in the exhibit. The visitors were then observed to see how these characteristics helped engage their attention. The holiday activities were also observed for these seven characteristics. The exhibits were coded by stating the floor they are on and then numbering the exhibits (See Appendix F). For example, an exhibit located on the first level and the second exhibit will be coded L1-02. It was also noted if the exhibits were a vehicle, boardable vehicle, diorama, physical interaction, digital interaction, digital display, audio/sound, or had reading material.

3.5.1 Dwell Times

In order to measure family engagement, dwell times, the amount of time a person stays at an exhibit, were recorded at each activity in All Aboard and Interchange (See Appendix I). The researcher recorded the time each person first interacted with a part of the exhibit and the time when they stopped interacting. This was done using a stopwatch, allowing for the seconds someone stayed at the activity to be recorded. For Interchange dwell time observations for each activity in the exhibit were recorded, and for All Aboard the train play set and then the climbing play area with the vehicles were recorded. For the holiday activities, it was noted when visitors left the storytelling activity early. For the workshops, the researchers attempted to observe how long all of the families that entered the activity area stayed. When the area became too chaotic, the researcher recorded as many families as possible. Every person who just glanced at the exhibit or holiday activities was noted. A glance was considered to be when a visitor quickly looked at the activity and then left. These event-based observations allowed for the researchers to be able to see what activities were able to keep a visitor's attention for longer. This was then compared to how many of the seven characteristics PISEC established in order to determine what

characteristics are most successful at encouraging active prolonged engagement and encouraging visitors to interact with an exhibit for longer and therefore, hopefully learn more.

Dwell time observations were run twenty eight times for Interchange, five for All Aboard, and every time a holiday activity was offered. This was five times for storytelling and make and take, and two times for the illustration workshop. For the dwell times, the same details about the researcher were entered, along with the specific exhibit being observed and the start and end times of the observation. The gender and age group was entered for every visitor, along with the total time each spent at the activity. This was done in seconds for the children's exhibits and minutes for the holiday activities. The numbers for each age group were placed together, allowing for decay time graphs to be generated. The graphs were made for the age groups: under five, six to ten, eleven to fifteen, and all children under fifteen (See Appendix J).

3.5.2 Visitor Interactions

The research team observed the interaction between the visitors and staff at the holiday activities, and also the visitors at All Aboard and Interchange. Every fifth family which entered the activity area or exhibit was observed in order to randomize the sample and to avoid bias when choosing a family to observe. A team member observed a group for the performance indicators which were used in the PISEC study. These indicators noted when members of the family: ask a question, answer a question, comment/explain how to use the exhibit, read text aloud, or read text silently (Borun, et al, 1998, p. 18). The team also added a column for play with the exhibit to account for children who did not meet any of the other performance indicators. The team member recorded the visitors' engagement as a whole group, along with the engagement of individual members (See Appendix K). The families that were observed were asked to take a survey (See Appendix L and Appendix M). If the group declined to answer the survey the group member tried to determine if the visitor was a foreign family. This last question presented was answered by whether or not the family was speaking English. This kind of structured observation made it possible to see the level of engagement a family member experienced, and then relate it to the seven PISEC characteristics for a successful exhibit.

Observations of visitor engagement were performed sixteen times for Interchange, six for All Aboard, fourteen for storytelling, nineteen for make and take, and three times for the illustration workshop. The visitor was willing to take a survey twelve times for Interchange, four times for All Aboard, ten times for storytelling, seventeen for make and take, and three times for

the illustration workshop. To enter the data into spreadsheets (See Appendix N), the researcher details were inputted along with family details including number of members and ages. The six performance indicators were inputted across the top, and then every time a group member performed one of these, the member's details were entered, with the number one placed under the appropriate column. It was also noted what specific part of the exhibit the interaction occurred. The number of times the group achieved a certain indicator was tallied at the bottom. The survey responses were entered with the number to the questions, along with the answers.

3.5.3 Site Specific Surveys

A survey was given to the visitors to provide feedback to the museum on their experience with the Learning Team-led on-gallery experiences. In order to distribute the surveys evenly, the group attempted to give surveys to every group that was observed when they exited either the holiday activity site or exhibit. There were two different surveys, one for the exhibits (Appendix L) and another for the activities (Appendix M). Surveying families that were observed allowed for observations to be related to their actual experience and level of engagement with the exhibits or the holiday activities. The surveys were conducted by only asking the questions to the led group member, but answers from other members were also indicated. The surveys were anonymous and voluntary with a single team member asking the questions and recording the families' answers. The fact that some people were unwilling to take the survey was taken into account. The group was able to cover a wide range of visitors from those who were highly engaged in the activity sites, to those that were not as engaged. By interviewing families that were observed, it was possible to relate their engagement to their feedback, allowing the research team to see the different feedback from families who were highly engaged to those who had minimal engagement.

3.6 Objective 3: Interview Staff from Other Museums

Through interviews with key personnel at other museum, the research team was able to learn how other museums determine which of their on-gallery activities are the most effective at engaging an audience, and how they measure visitor engagement (See Appendix O). Once at London Transport Museum, the sponsor liaison contacted these museums to see if they would be willing to provide information about their family activities to assist with the research. The sponsor liaison, Steve Gardam, and the Head of the Learning Team, Sian Thurgood, were able to

connect the research team with several of their contacts. If the museum staff was willing to be interviewed, the research team visited the museum, when possible, and conducted interviews with staff involved with activities offered at the museum. When more convenient for the interviewee, the research team conducted a phone interview. The staff members which the research team interviewed can be seen in Table 2. The goal of the interviews was to learn more about family activities at other museums and compare these approaches and lessons learned with those at LTM.

Staff Member	Position	Museum
Lucy Trotman	Schools and Families Officer	Sir John Soane's Museum
Jenny Wedgbury	Education Officer	Kensington Palace
Dan Ferguson	Education Officer	Hampton Court
Grant Rogers	Informal Learning Manger	Imperial War Museum

Table 2. Interviews with Other Museum Staff

The research team asked if they had anything comparable to the Learning Team-led on-gallery experiences, and if so how they evaluate it. The interviews were intended to learn about techniques the other museums deploy to draw visitors from popular activities to other activities, techniques they find successful for family engagement and how they improve overseas visitors' experience. One of these interviews was conducted over the phone, out of convenience for the interviewee.

3.7 Summary

From the methods of spatial tracking, dwell times, surveys, interviews with museum staff, observation of visitor engagement and visitor entrance tally, the research team was able make observations about the Learning Team-led on-gallery experiences at London Transport Museum. These observations enabled the answering of the four questions posed by LTM at the beginning of the project: (1) Is the Family Pack effective in encouraging movement throughout the museum? (2) How can the visitor's learning experiences be improved at Learning Team-led on-gallery experiences? (3) How can learning be improved at Learning Team-led on-gallery experiences for overseas visitors? and (4) How can All Aboard and Interchange be improved? Also the observations allow for recommendations about how to improve their Learning Team-led on-gallery experiences, and give LTM with a baseline for any future evaluations.

4.0 Results and Analysis

After the completion of the data collection, the research team was able to evaluate the Learning Team-led on-gallery experiences and make recommendations to London Transport Museum [LTM]. These Learning Team-led on-gallery experiences included the 'Time traveling moustaches and other great ways to explore London Transport Museum', also called the Family Pack, the two exhibits designed for children, and the activities held during the holiday periods. The research team collected data using the methods of spatial tracking, observations of visitor engagement, dwell times, visitor entrance tally, and surveys, as well as interviews from other museums. Each method produced a different form of data which was helpful in answering and achieving the three objectives: (1) Study the flow of visitors throughout the museum, with and without using a Family Pack, (2) Observe visitor engagement at the stations, and (3) Interview staff members from other museums to see techniques used in anything comparable to LTM's Learning Team-led on-gallery experiences. These methods allowed the research team to determine how visitors rated the different aspects of the Learning Team-led on-gallery experiences and what Learning Team-led on-gallery experiences are more visited. The research team was able to identify what parts of each exhibit had the greatest holding power. The research team gave insight on the four main questions posed by LTM: (1) Is the Family Pack effective in encouraging movement throughout the museum? (2) How can visitor learning be improved at Learning Team-led on-gallery experiences? (3) How can learning be improved at Learning Team-led on-gallery experiences for overseas visitors? and (4) How can All Aboard and Interchange be improved?

4.1 Objective 1: Study the Flow of Visitors

The methods of spatial tracking and visitor entrance tally were used in order to determine the flow of visitors within the museum and to see if the Family Pack affected these movements. Spatial tracking provided the research team with a detailed pathway of the families followed in the museum. Visitor entrance tally provided the team with a quantitative way to compare the two exhibits for children and the holiday activities. The research team was able to examine the graphs produced from the spatial tracking and visitor entrance tally in order to find patterns in visitors' paths and visitation through the museum. These patterns allowed for the research team to determine which of the holiday activities, children exhibits, and exhibits throughout the whole

museum are most visited. These comparisons were done for the families that were tracked, both with, and without, the Family Pack. This allowed for the research team to see if the Family Pack effected the movements of families throughout the museum by increasing visitation at the mentioned exhibits.

4.1.1 Spatial Tracking

In order to produce comparable data, the twenty-five spatial tracking sheets were entered into a spreadsheet (See Appendix E). The data was entered by listing, in order, the exhibits that a family visited. The exhibits were entered by using the codes determined when the research team first arrived at LTM (See Appendix F). The research team then tallied how many of the tracked families visited each specific exhibit in order to produce a visitation density map. This visitation density map is colored coded in order to show what percentage of the families tracked visited a specific exhibit. The visitation density map allowed for the research team to compare travel patterns between families with and without the Family Pack. It also allowed the research team to see if the exhibits mentioned in the Family Pack were more visited by families which used it in the museum.

The visitation density maps (See Figures 12 and 13) show what percentage of visitors tracked visited each exhibit. The legends show the percentage that each color represents. For families that used the Family Pack there are two, 50% and 100%. For families without the Family Pack, the interval increases by ten percent. For example, yellow is for 61-70% of visitors.

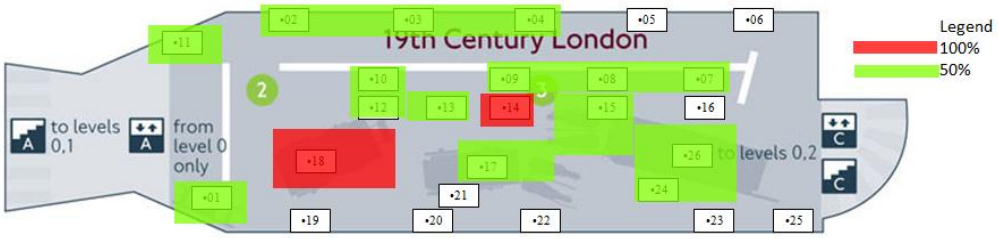

Figure 12. Level 2 Visitation Density Map With the Family Pack

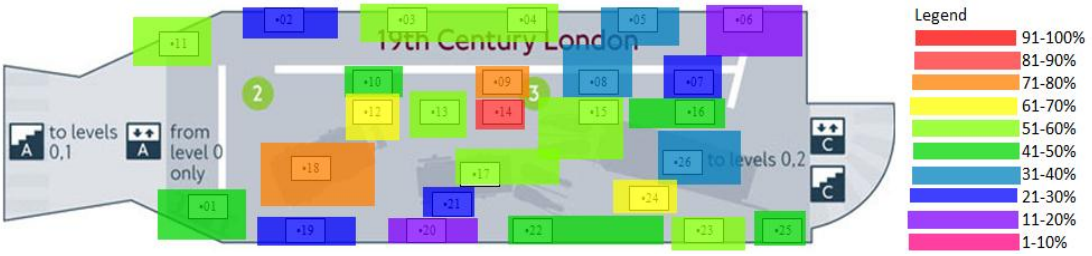

Figure 13. Level 2 Visitation Density Map Without the Family Pack

The maps showed that roughly 50% of the families both with and without the Family Pack in the museum visited the horses on level 2, which are indicated by the numbers fifteen and seventeen. The Metropolitan steam train on level 1, shown by number 5, was visited by both of the families that used the Family Pack (See Figures 14 and 15). The train was highly visited by 81 -90% of

Figure 14. Level 1 Visitation Density Map Level 1 With the Family Pack

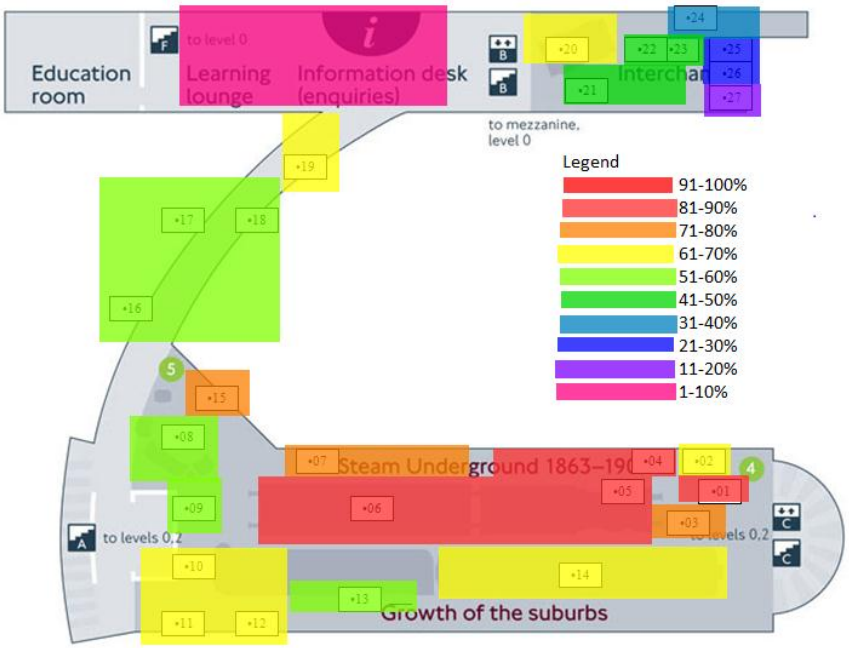

Figure 15. Level 1 Visitation Density Map Without the Family Pack

families without the pack. The Doll House, also on level 1 and indicated by the number 8, was visited by roughly 50% of families both with and without the Family Pack. The Design for travel gallery on level 0 was visited by roughly 50% of families both with and without the Family Pack (See Figures 16 and 17). The Green Line bus, which is currently not in the museum to make room for the New Bus for London, is also mentioned in the Family Pack. The New Bus for

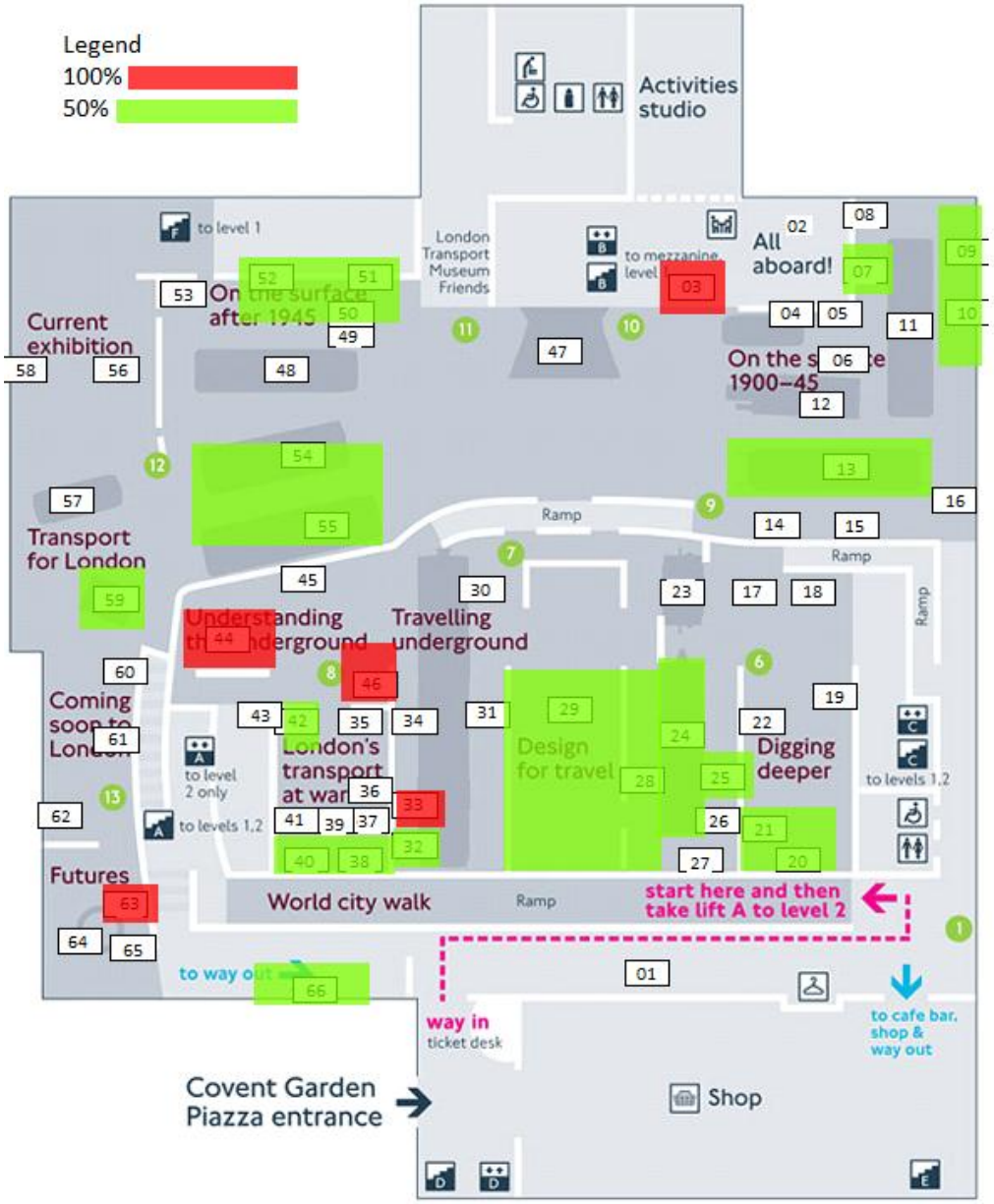

Figure 16. Level 0 Visitation Density Map With Family Pack

London, shown by number 48, was not visited by any of the families with the Family Pack, but was visited by 21-30% of the families without the Family Pack. These results indicates that the Family Pack does not increase visitation at the exhibits mentioned.

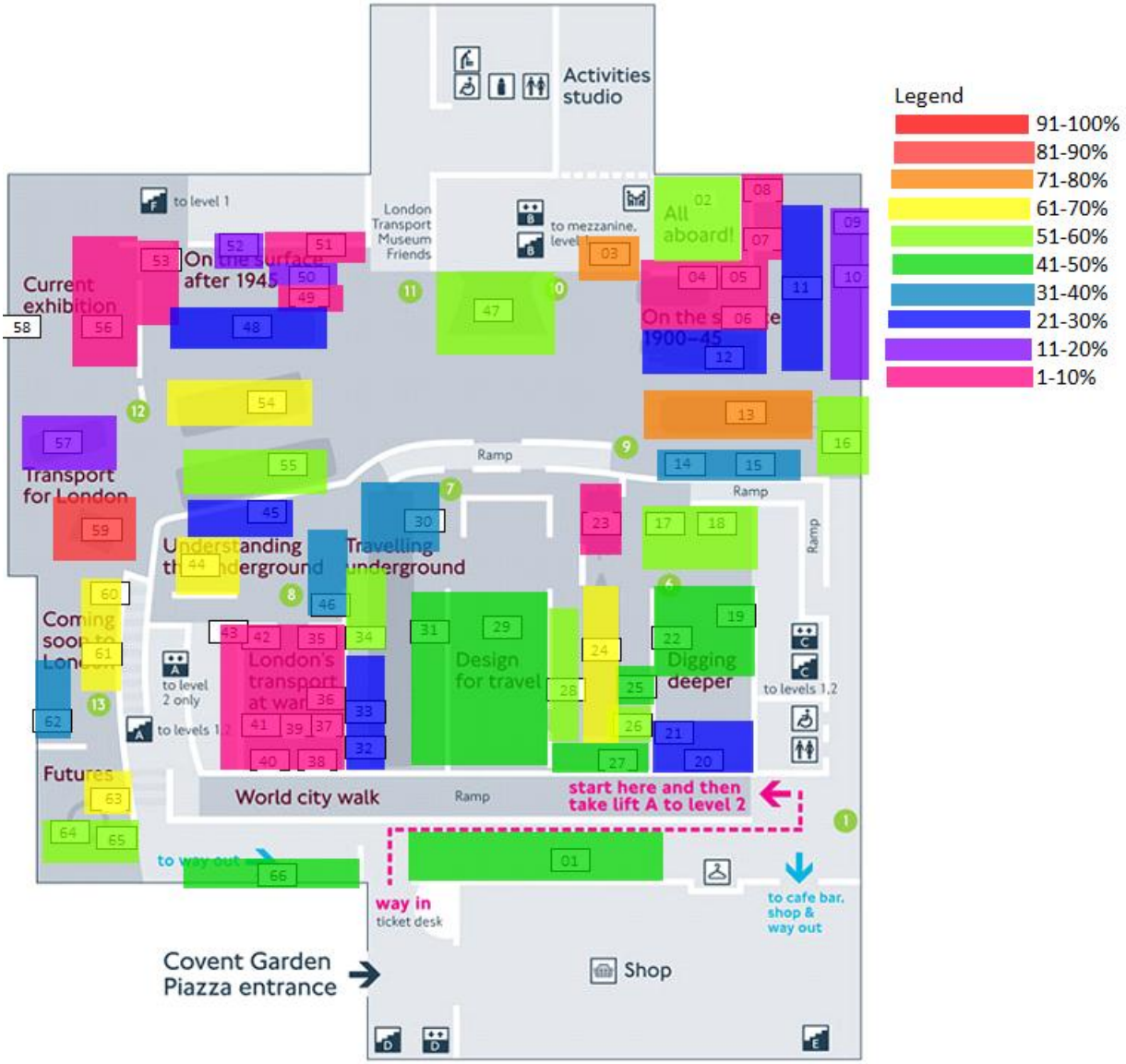

Figure 17. Level 0 Visitation Density Without Family Pack

The level 2 visitation density maps (See Figures 12 and 13) showed that the exhibits along the walls were less visited by families with the Family Pack. Only 50% of the families with the Family Pack looked at two exhibits, while eight were unvisited. Although the visitation of these exhibits was not high for families without the Family Pack, none of the exhibits were unvisited. On level 1 it was found that Metroland (9), Metro-land leisure (10), Leisure travel

(11), Poster Parade (12), Train Guard (13), Destination Plates (16), Bus blinds (17), Trading every day Christmas (18), Bloomin' marvelous (19) were not visited by any of the families with the Family Pack (See Figures 13 and 14). These exhibits were visited by 51-70% of families without the Family Pack. On the ground floor, all of the exhibits in the Coming Soon to London gallery were unvisited by families with the Family Pack (See Figures 15 and 16). The Doing our bit (64) and Challenge of climate change (65) exhibits in this gallery were visited by 61-70% of the families without the Family Pack. The research team tracked two families that used the Family Pack in the museum and based on the research team's observations it appears that the Family Pack may discourage people from visiting some exhibits that are not mentioned. Given the small sample size, the research team was not able to come up with definite conclusions. However since the research team was only able to track two families with the Family Pack, this suggests that overall it is not being widely used in the museum.

Figure 18. Level 2 Visitation Density Map

The overall visitation density (See Figures 18-20) showed that exhibits located next to 'stampers' are generally visited by more than half of the visitors. The one exception is stamper

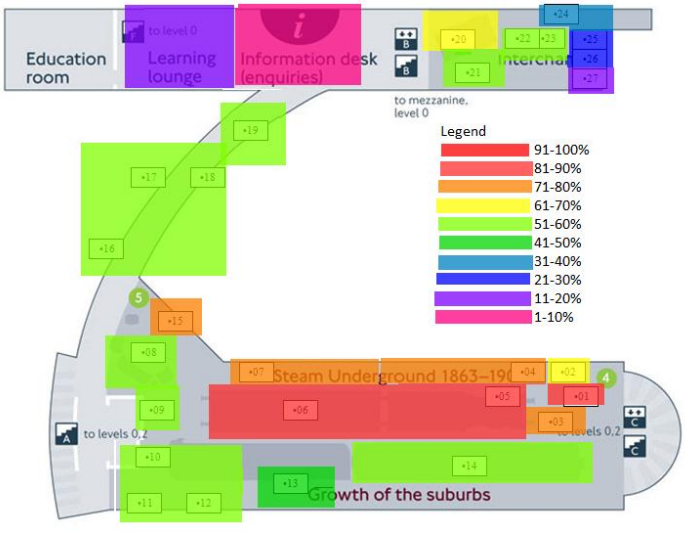

Figure 19. Level 1 Visitation Density Map

number 7 and the Electric Tube car, located on the ground level and shown by the number 30, that is only visited by 31-40% of visitors (See Figure 20). (Note: A stamper is where people go to punch a design out of a card called the Stamper Trail. There are thirteen stampers located throughout the museum. They are indicated on the floor plan by a number in a green circle.)

Figure 20. Level 0 Visitation Density Map

It was also found that the boardable vehicles in the museum are visited by more than 61% of visitors, making them some of the most visited attractions in the museum. The one exception is the Routemaster Motorbus 1963 and the 1970s bus, located on the ground level and shown by number 54 and 55, which were visited by 51-60% of visitors (See Figure 20). This may be caused by the fact they are located towards the end of the museum.

The exhibits that were visited by 71-80% of visitors, that were not boardable vehicles, were found to mainly have physical interaction. The two exceptions were Visions of the future (65, ground level) and Traveling on the Steam Underground (04, level 1). Visions of the future is located near the exit, so every family passes by it, and it has a digital display (See Figure 20). Traveling on the steam underground is located next to the Metropolitan Steam Train, which is a highly visited location (See Figure 19). The exhibits that were visited by 61-70%, that were not boardable vehicles, were found to have either a digital interaction or a digital display.

The answers from the surveys, given at the end of tracking, were categorized and responses were compiled into graphs in order to compare families with and without the Family Pack. This was also done to gather general opinions about the Family Pack. Graphs were made comparing purchases at the store for families who received, and did not receive, the Family Pack (See Figures 21 and 22). This was only done for families that were known for sure to have, or not have, the Family Pack. The ratio of purchase to no purchase is 1:5 for families with the Family Pack and 1:4 for families without the Family Pack. This suggests the Family Pack does not affect sales in the museum.

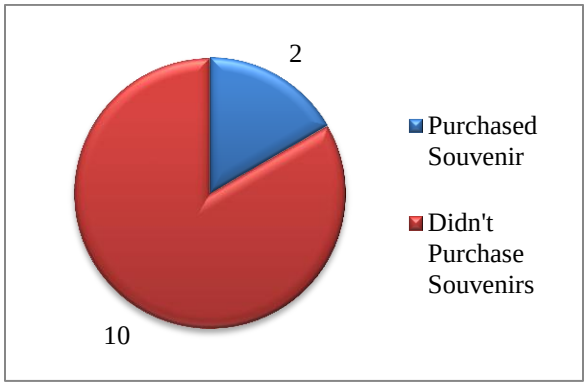

Figure 21. Sales With The Family Pack

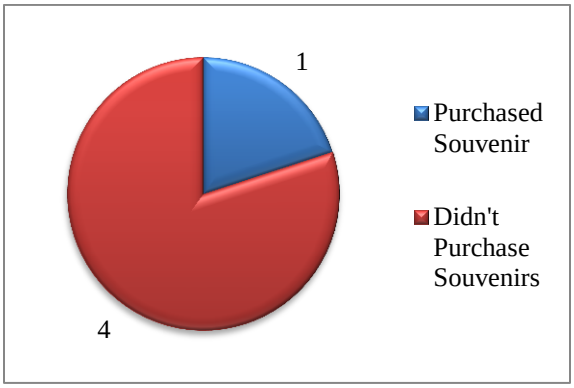

Figure 22. Sales Without the Family Pack

A graph was also produced showing how many of the tracked families used, partially used, or did not use the Family Pack at all (See Figure 23). It was assumed, for this graph, that the families that were not surveyed received the Family Pack. This is because every family that enters that museum is intended to get one. The graph shows that not many families are using the Family Pack, and few people even look at it in the museum. Given that most visitors do not look at the Family Pack in the museum, it appears that families do not understand what the Family Pack is presenting to them. Also, since four out of the six families that did look at the Family

Pack put it away instead of using it, this also suggests that families do not understand the Family Pack is supposed to guide them through the museum while highlighting five key exhibits.

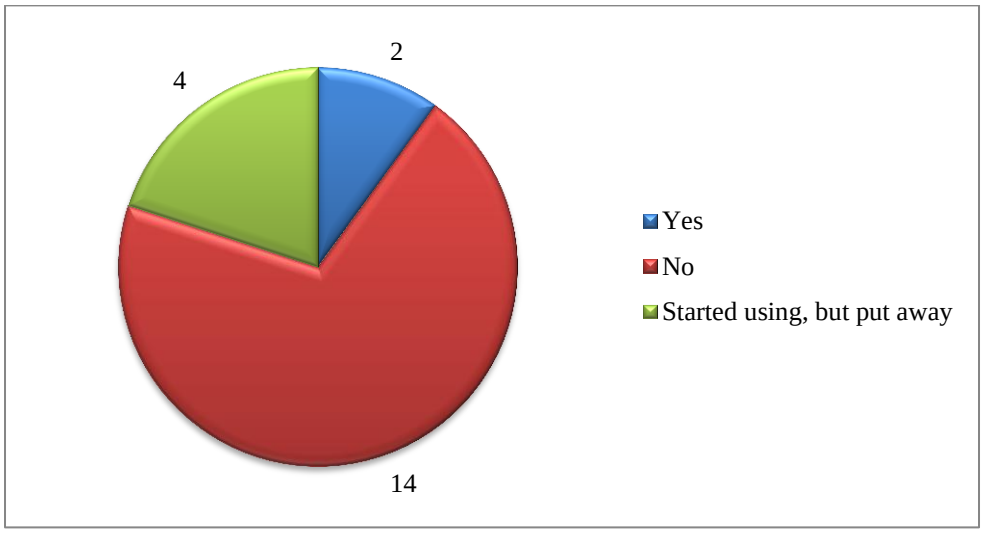

Figure 23. Usage of the Family Pack

4.1.2 Visitor Entrance Tally

By counting the number of visitors that entered the two exhibits and the holiday activity area, the research team was able to make quantitative comparisons. The number of visitors was entered into a spreadsheet, and broken down into age groups (See Appendix H). Since numbers for the two exhibits where collected at the same time, the team was able to determine which was more visited. This was also done for every holiday activity offered. Storytelling and make and take were offered for five days, while the illustration workshop was offered for two days. Given the fact the exhibits are designed for different age groups, an overall visitation level was compared, broken down by the age groups of under five, six to ten, and eleven to fifteen. This comparison was done by making a chart comparing the number of visitors for the two exhibits by age group. A graph was made, for each age group, comparing the visitation by day. The graphs for the visitation levels of the children's exhibits for ages 0 to 5 can be found in Figure 24. These graphs were able to supply the research team with a quantitative analysis of the number of visits. For the children's exhibits, All Aboard was more visited by children under the age of five. There was one day, May 15th, where more children under the age of five visited Interchange, possibly because the observations were done during lunch time, and All Aboard is next to tables which are used by parents to eat lunch. This may have caused All Aboard to become very crowded and that could have caused parents to bring their children to Interchange instead.

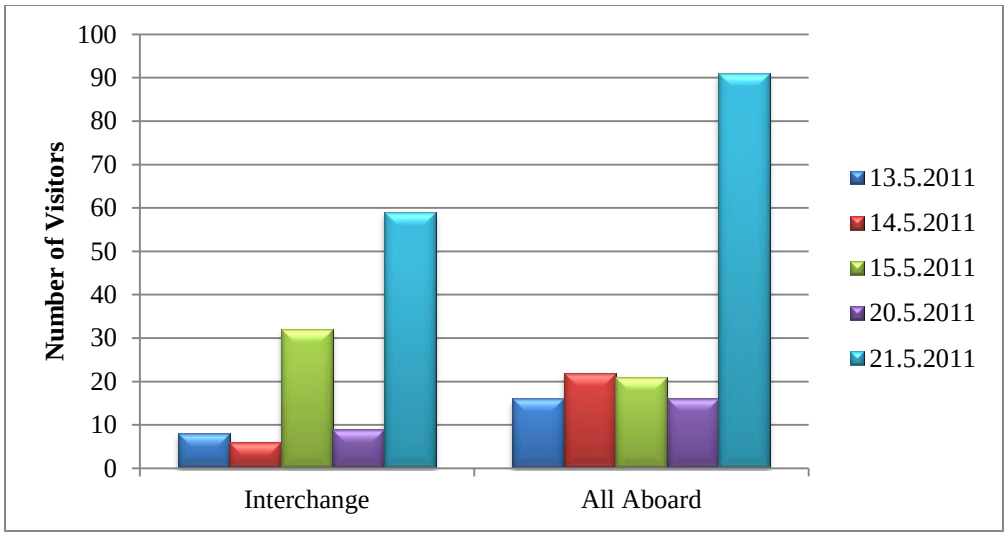

Figure 24. Entrance Tally for Children's Exhibits (Ages 0-5)

Interchange was found to be more visited by children between the ages of six and fifteen (See Figures 25 and 26). When All Aboard was the more visited exhibit for the age group of six to ten, it was by no more than four people during the given period of observation. However, when Interchange outnumbered All Aboard for the same age group, it was by eight to ten

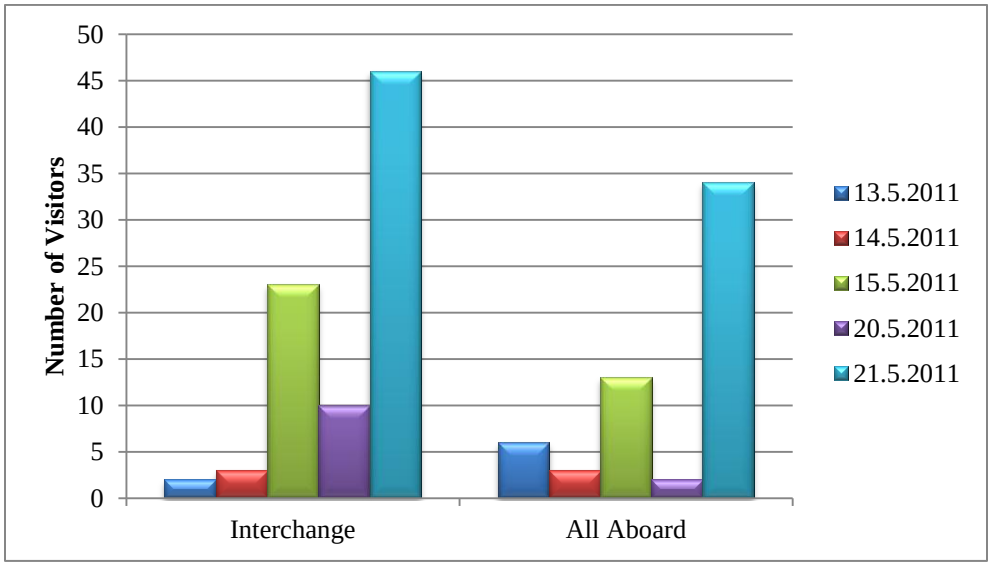

Figure 25. Entrance Tally for Children's Exhibits (Ages 6-10)

visitors. There was only one day where All Aboard was more visited by age group of eleven to fifteen year olds. This was on May 20, 2011, when seven school children visited All Aboard.

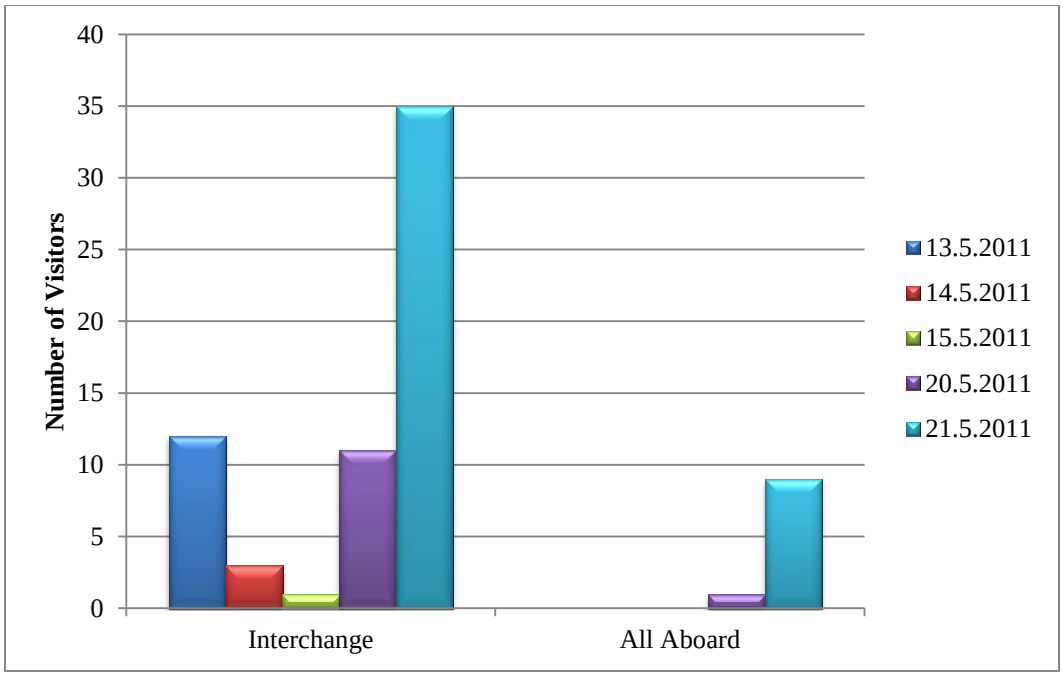

Figure 26. Entrance Tally for Children's Exhibits (Ages 11-15)

The overall number of children in the museum for everyday an entrance tally were performed can be found below in Table 3. Although it indicates no children came to the museum on May 14th, a Saturday, this could have be due to error at the front desk. There is an entrance for season ticket holders and first time visitors, and one of these entrances may not have been counted. Despite this error, it can be assumed there was very low attendance for children on that day. The overall visitation for the children's exhibits can be compared to the overall visitation of the museum by children. The lowest attendance days at the museum corresponds to the lowest attendance at the exhibits. The day that had the highest visitation overall, May 21st, was the same day that Interchange and All Aboard achieved their highest visitation.

Day	May 13th	May 14th	May 15th	May 20th	May 21st
Number of Children in Museum	158	0	205	162	213

Table 3. Overall Museum Visitation by Children

For the holiday activities it was found that both the storytelling and make and take activities are more visited by children in the age groups of zero to five. For the storytelling (See Figure 27), it was found that the 11:00 time slot was generally more visited than the 15:30 time slot. The one day, June 3rd, when the 11:00 session was less visited than a 15:30 session was a Friday when museum attendance overall was the second lowest of the week, (See Table 4).

Day	Monday	Tuesday	Wednesday	Thursday	Friday
Number of Children in Museum	502	267	457	565	320

Table 4. Overall Museum Visitation by Children During Half Term Holiday

For the age groups, the 11:00 time slot was more popular for children under five, and the 15:30 time slot was more popular for children between the ages of six and fifteen. The age group that visited storytelling the most was children under the age of five.

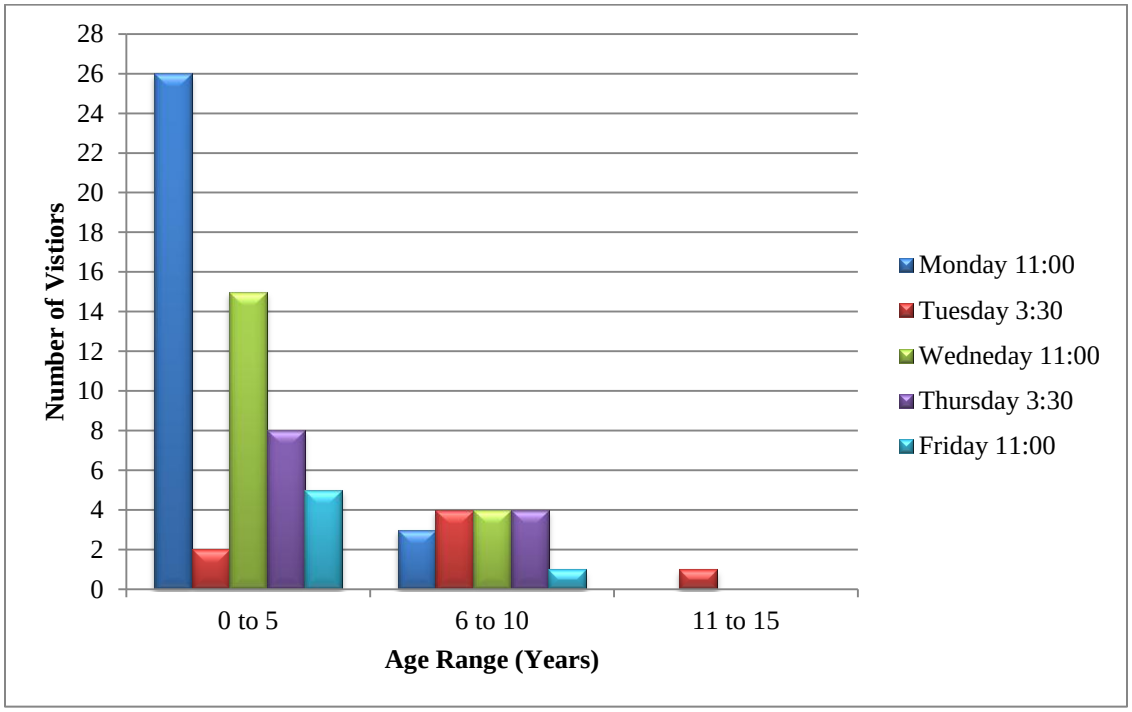

Figure 27. Storytelling Entrance Tally by Day

The make and take activity was more visited by children in the age group of zero to five (See Figure 28). This age group outnumbered the other two every day, except for Tuesday, May 31st. On this day, the age groups of zero to five and six to ten had the same visitation, thirty five. Tuesday had the lowest visitation of children in the museum for the week. Even though this was the lowest visitation of the week, it was still comparable to the visitation of make and take on Monday, Wednesday and Thursday. Friday had the lowest visitation for make and take, which may have been caused by the low visitation to the museum.

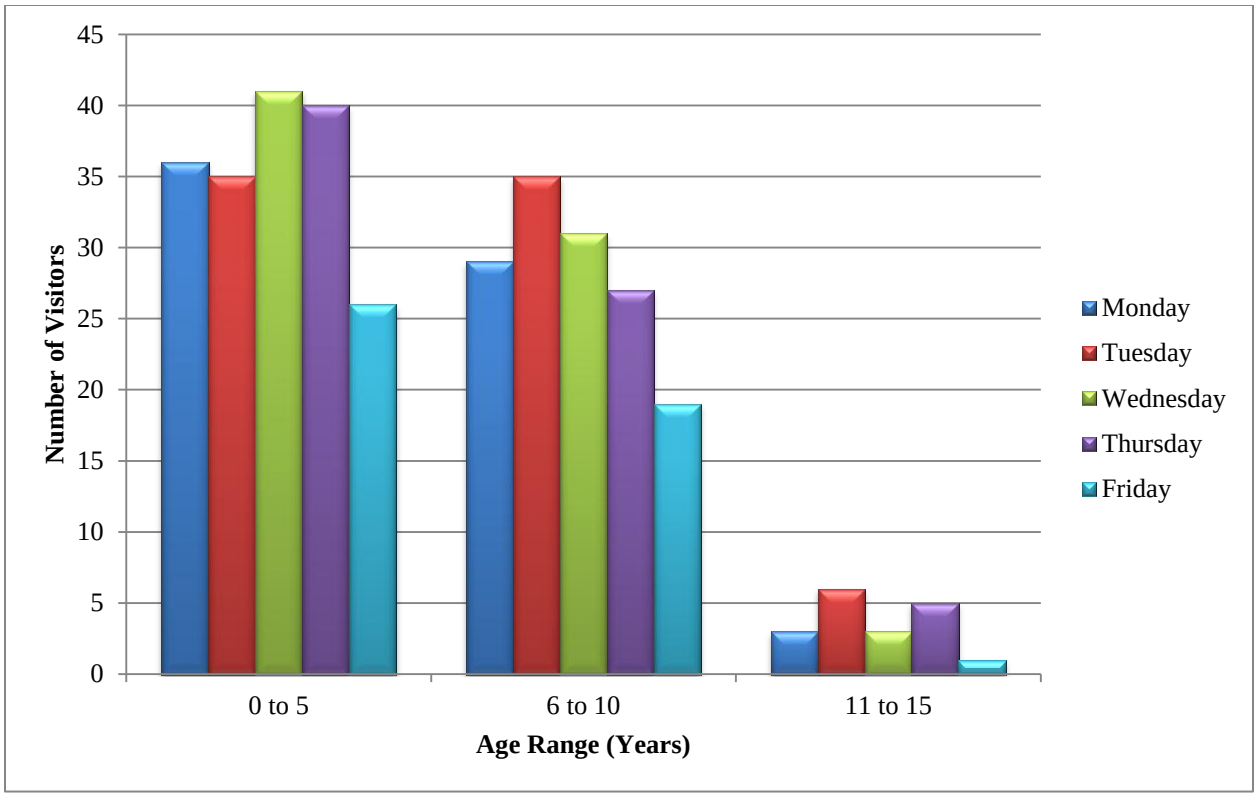

Figure 28. Make and Take Entrance Tally by Day

4.2 Objective 2: Observe Visitor Engagement

The research team recorded visitor engagement throughout the museum in multiple ways. The methods used were dwell times, observing visitor engagement, exhibit specific surveys, and activity specific surveys. Dwell times were used to see how long visitors stayed at a specific part of an exhibit. Observations of engagement were done using performance indicators set by PISEC. The surveys were done to correlate visitors' experiences to their feedback. By observing the dwell times of the holiday activities and each activity in the children's exhibit, the research team was able to determine the relative holding power and popularity of the activities. By observing visitor engagement coupled with surveys, the research team was able to determine which aspects of the activities are most successful in engaging the visitor and giving them a positive experience at the activities.

4.2.1 Dwell Times

By comparing the holding power at specific activities, both in the exhibits and the holiday activities, it was possible to see which are better at engaging visitors. The forty four dwell times were entered into a spreadsheet (Appendix J). The dwell times were entered in seconds for the children's exhibits and in minutes for the holiday activities. The visitors were

broken down by age, and graphs of decay times were produced. A decay time graph shows what percentage of visitors remained at an exhibit after a set period of time. From the decay time graphs the research team was able to determine which of the activities in the children's exhibits and holiday activities have greater holding power.

From the thirty three dwell times of the children's exhibits, the two activities in All Aboard, the vehicles and the train play set, were found to have greater holding power than all of the activities in Interchange (See Figure 29). For Interchange it was found that the Bus had the greatest holding power for children. It was found that the Where do you live? buttons and the How did you get here? buttons have the least holding power.

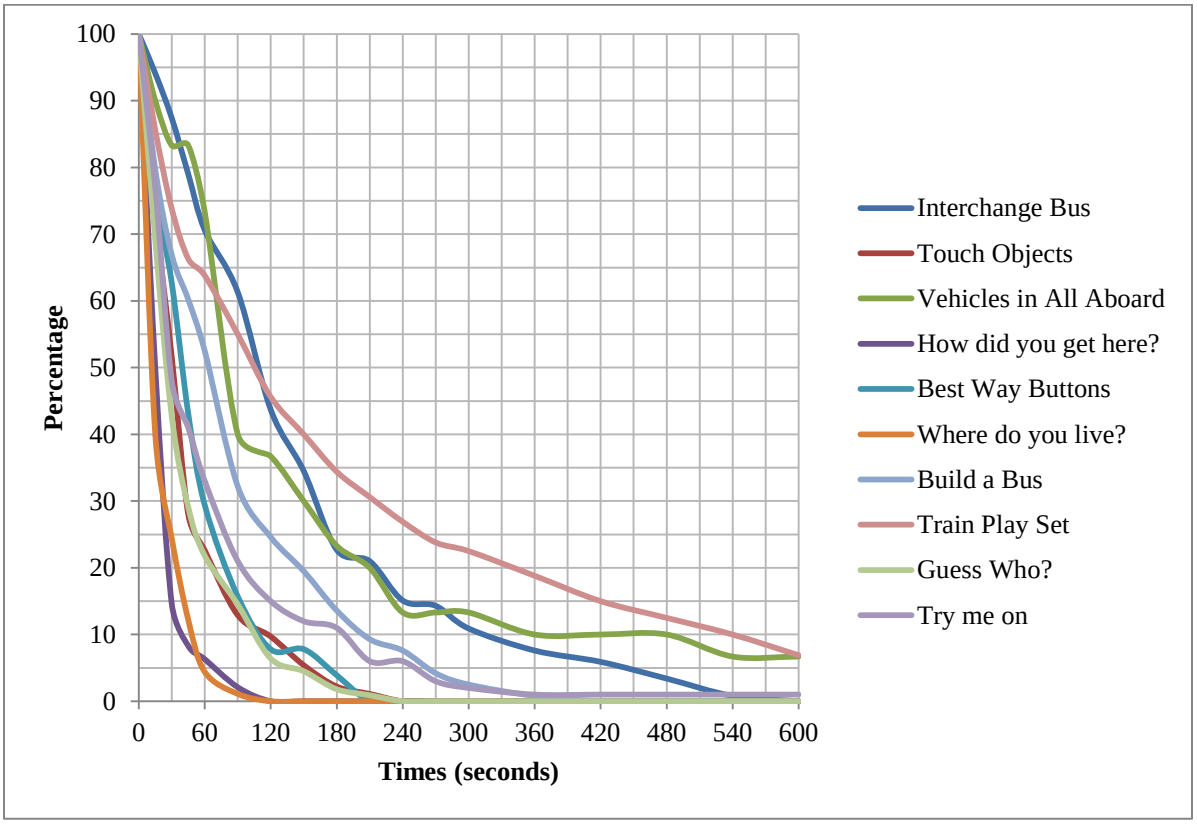

Figure 29. Decay Time for Children's Exhibits

Decay curves were also made for the target age range for both exhibits. When looking at the graph for children six to fifteen Interchange, it was found the Bus had the greatest holding power, and How did you get here? and Where do you live? buttons had the least holding power (See Figure 30). The bus having the greatest holding power could be due to the fact it is an activity that both parents and children can use together. The child can drive the bus while

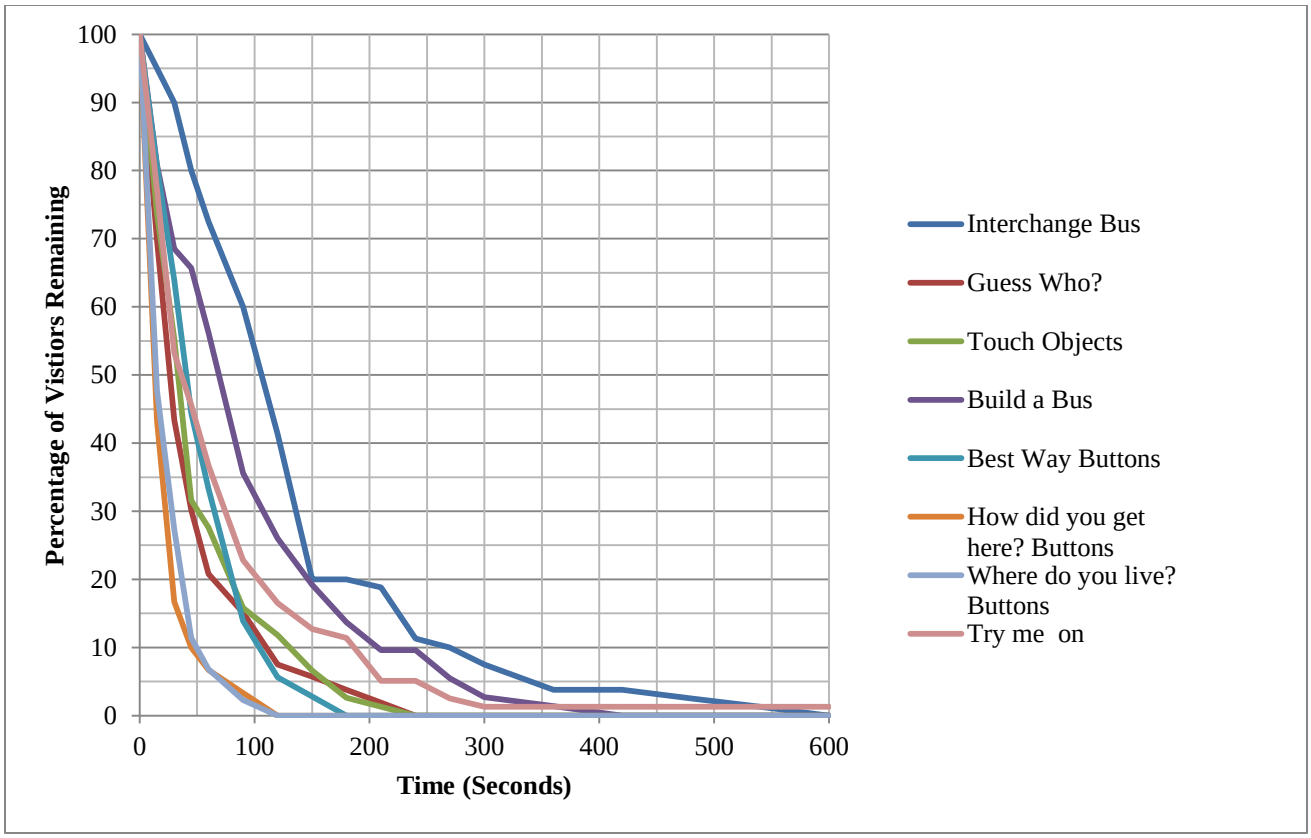

Figure 30. Decay Curve for Interchange (Children 6 to 15)

the parent is a passenger. Also the audio on the bus can allow for parents and children to ask questions and receive the answers together. The exhibits with the least holding power, How did you get here? and Where do you live? Buttons, have the children answer those questions by pushing a button. Although the results are tallied and presented on a screen above, this is not easily noticed. Touch objects, Best Way Buttons, and Guess Who? may have a similar holding power because they all depend on children understanding what is being presented in the activity. This holding power may be moderate due to the fact some children understand how to interact with the activity, while others do not.

When looking at the decay curve graph for children 0 to 5 in All Aboard, it was found that both activities had a strong holding power (See Figure 31). Both of the exhibits had children remaining after 600 seconds (10 minutes). The vehicles had a higher holding power, possibly given the fact more children can play in the vehicles at the same time and there are a variety of vehicles for children to play with instead of just trains.

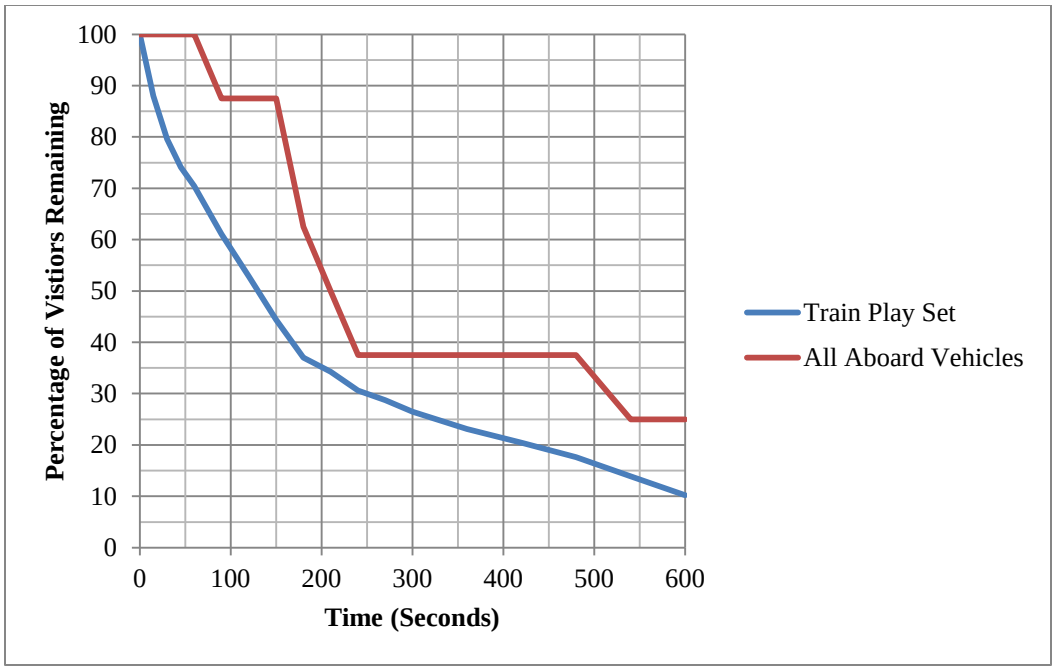

Figure 31. Decay Curve for All Aboard (Children 0 to 5)

For the storytelling activity (See Figure 32), it was found that four out of five times, more than seventy percent of the children remained until the end (Note: The lines for Wednesday and Thursday overlap.) For three out of the five days, Wednesday through Friday, 83% of the children remained to the end, which was thirty minutes. On Tuesday, 71% of children remained

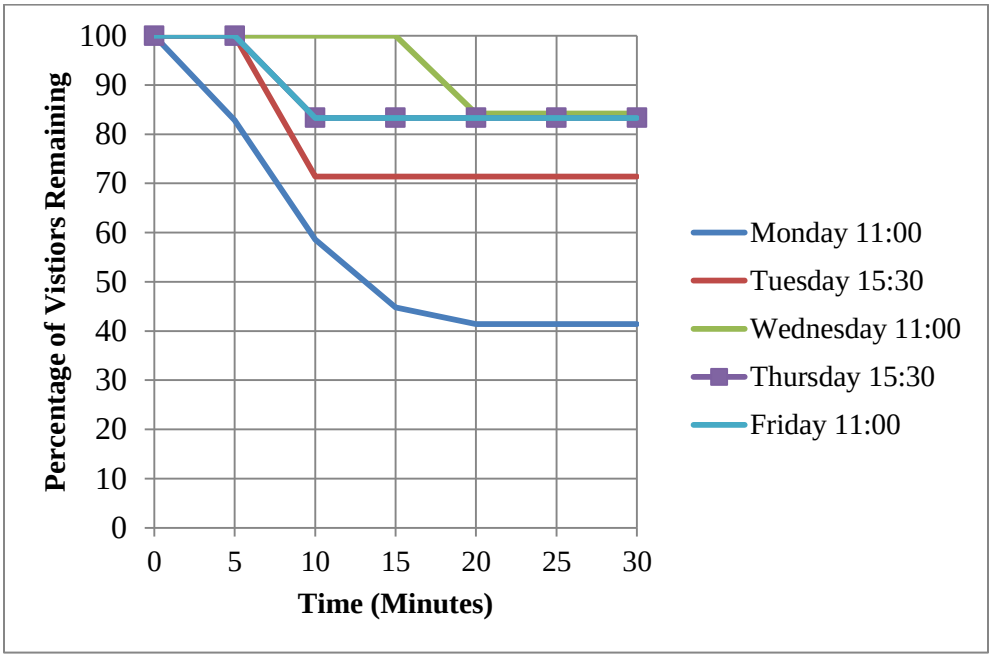

Figure 32. Decay Curve for Storytelling (Children)

to the end. For Monday, 41.4% remained until the end, possibly because this was the busiest storytelling, therefore visitors may have left due to the crowded space.

All five days of the make and take activity have a similar decay curve (See Figure 32). This graph shows that the goal of the museum to have the make and take activity take twenty minutes is being achieved by approximately 75% of children. This graph also shows that 50% of children remained for about twenty seven minutes. This indicates that make and take has a strong holding power for children.

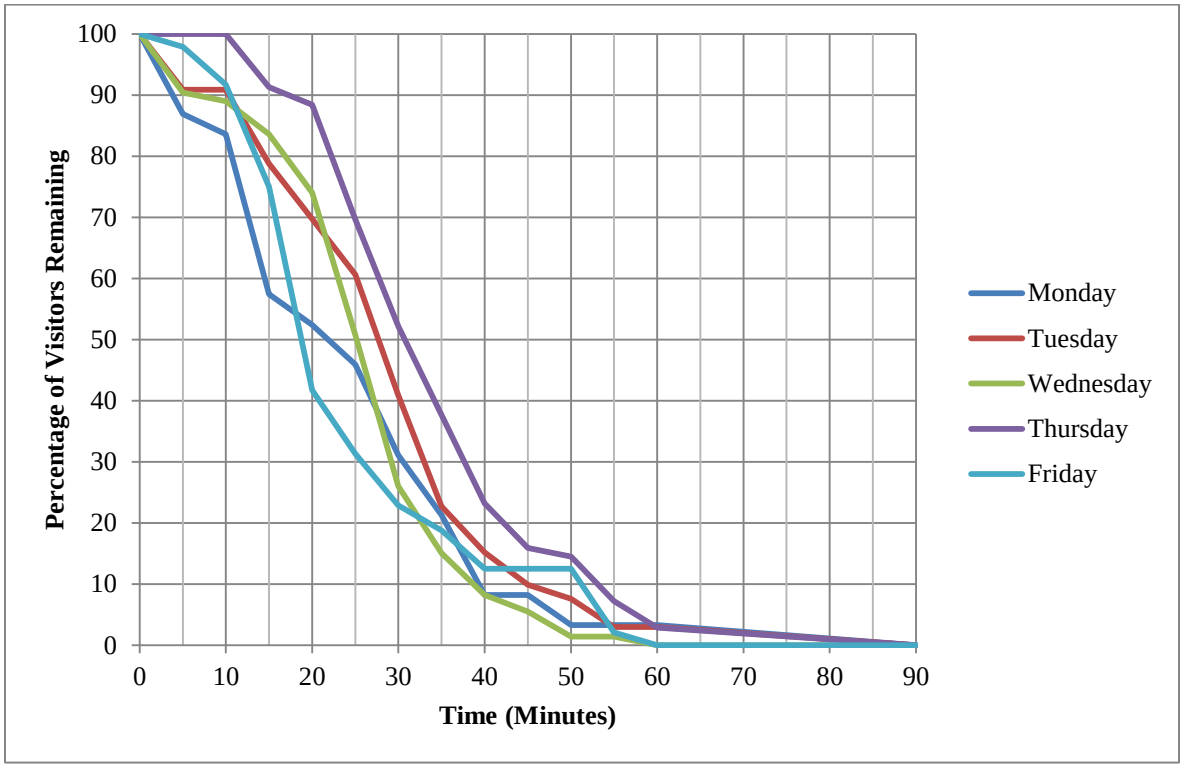

Figure 33. Decay Curve for Make and Take

4.2.2 Observation of Visitor Engagement

The visitors were observed for their performance indicators: ask a question, answer a question, comment/explain the exhibit, read text aloud, read text silently and play with the exhibit. This was done for all members of a family. The results were entered into a spreadsheet (See Appendix N). These performance indicators were assigned to a the learning levels set by PISEC: level 1 identifying, level 2 describing, and level 3 interpreting and applying (See Table 5). A graph was made that showed how many times a learning level was achieved at each activity.

Performance Indicator	Level 1 Identifying	Level 2 Describing	Level 3 Interpreting and Applying
Ask a Question	**X**		
Answer a Question		**X**	
Comment/Explain			**X**
Read Text Out Loud		**X**	
Read Text Silently	**X**		
Play with Exhibit	**X**		

Table 5. Performance Indicators and Their Relation to Learning

From the charts of learning level achieved in the children's exhibits (See Figure 34) it was found that the bus in Interchange achieved learning level 3, the most. The Bus also achieved the learning level 1, the most. This shows that the bus can engage a large range of learning abilities. Since the bus also had the greatest holding power, this agrees with what the PISEC study found, that when visitors stay at an activity longer they learn more. Out of the three button displays, the Best way to get there from the museum? buttons achieved all the learning levels the most. They were also the only buttons that achieved learning level 3. The How did you get here? buttons constantly had the lowest achievement, in Interchange, across all three levels of learning. This could be caused by people not realizing that the buttons caused a tally to form on top of the display. Try me on only achieved level 1, therefore making it more of a fun activity than a learning activity. Touch objects, Guess Who? and Build a bus learning levels depended on the parents engaging the children. This is why most of the children achieved learning level 1, identifying. The children who achieved the highest learning levels had parents asking questions and trying to use the activity with their children. The train play set, which was mainly used by children in the age range of zero to five, is mostly used as a fun play activity.

Make and take was found to achieve learning level 1, identifying, the most often, in both children and adults (See Figure 35). Learning level 3, interpreting and applying, was achieved the most by adults, while the other two levels were achieved the most by children. Although learning level 1, identifying, was achieved the most by children, learning level 3, interpreting and applying, was achieved by fifty children. This suggests that when adults achieve a high learning level they engage their children, therefore encouraging them to achieve a higher learning level. This graph shows that make and take is mainly an entertaining activity, but is being used as an educational activity by some of the visitors.

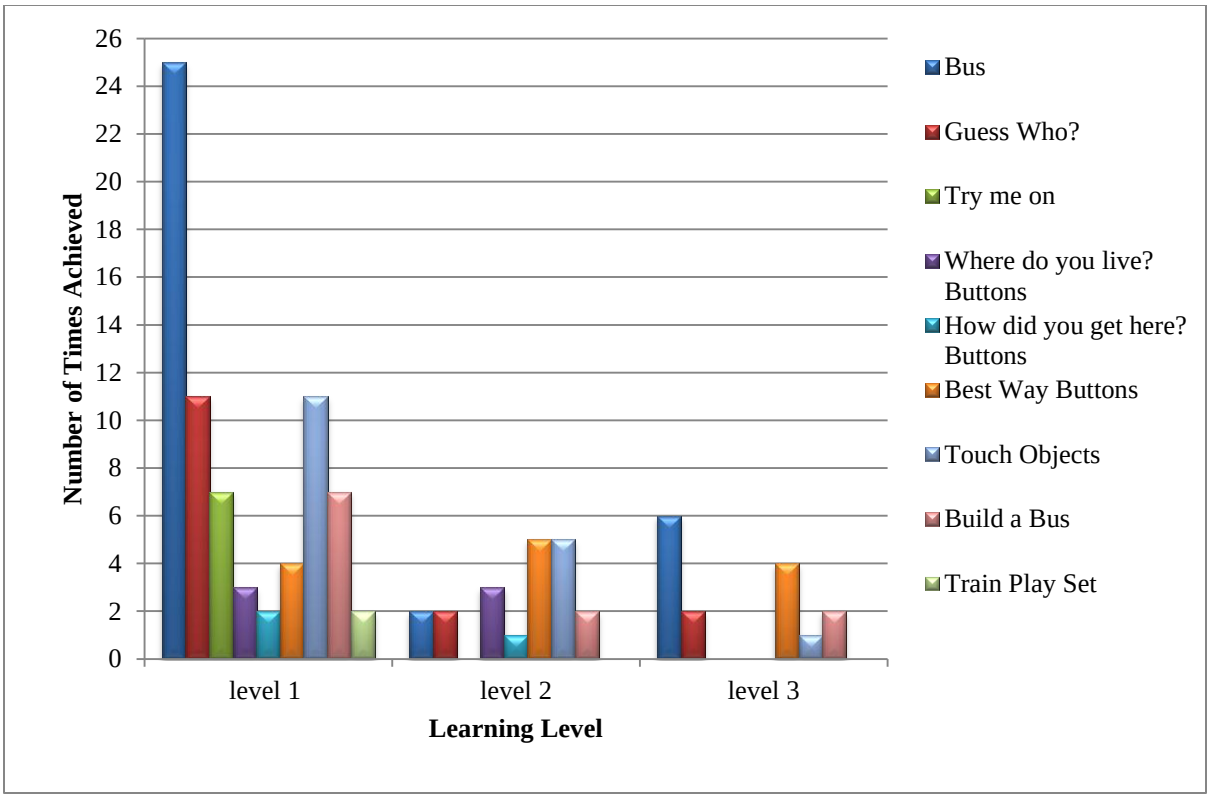

Figure 34. Learning Levels in Children's Exhibits (Children)

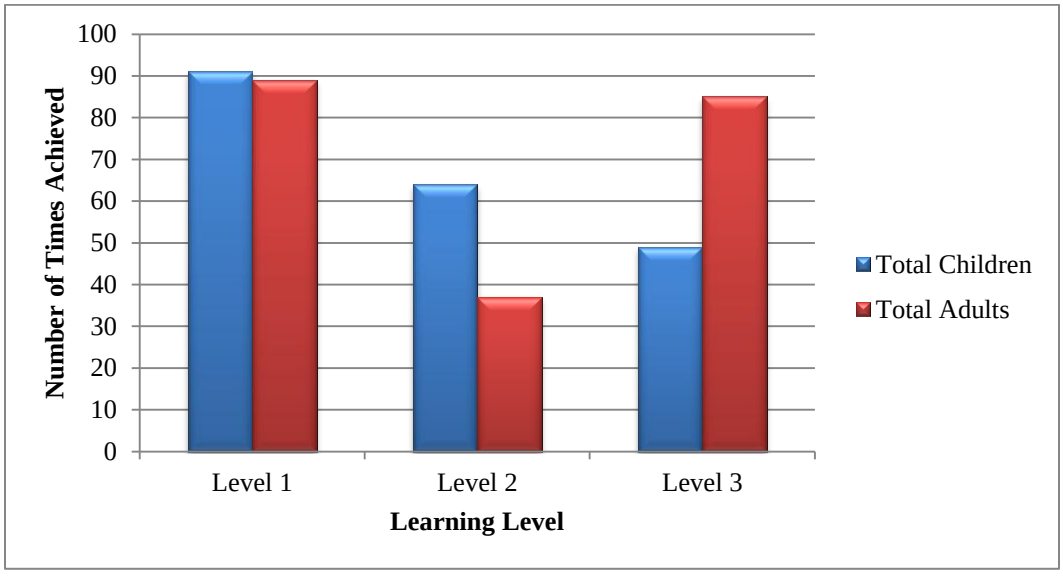

Figure 35. Learning Levels for Make and Take

Storytelling was found to achieve learning level 1, identifying, the most in children and adults (See Figure 36). Adults were found to have lower level learning than children, possibly due to the fact many parents just watched their children engaging in the storytelling. The fact that

learning level 1, identifying, was achieved 120 times, while learning level 3, interpreting and applying, was achieved 20 times, shows that storytelling is mainly an entertaining activity.

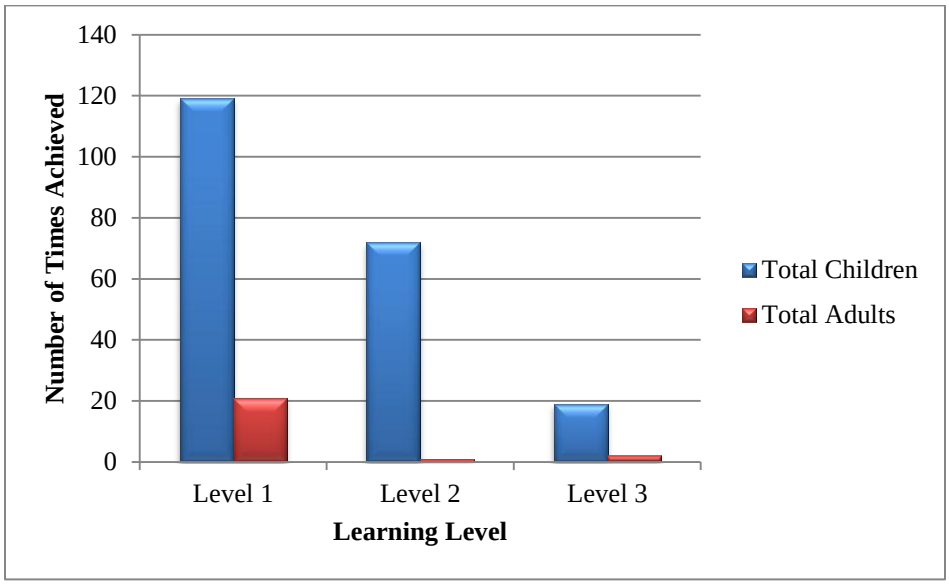

Figure 36. Learning Levels for Storytelling

The illustration workshop was found to achieve learning level 3, interpreting and applying, and learning level 2, describing, the most (See Figure 37), probably since it was given to older children, between the ages of seven and fourteen. The workshop was also more of a class room type of activity, encouraging one-on-one discussion and learning. This activity was successful in encouraging a higher level of learning, although only five children in total attended the illustration workshop.

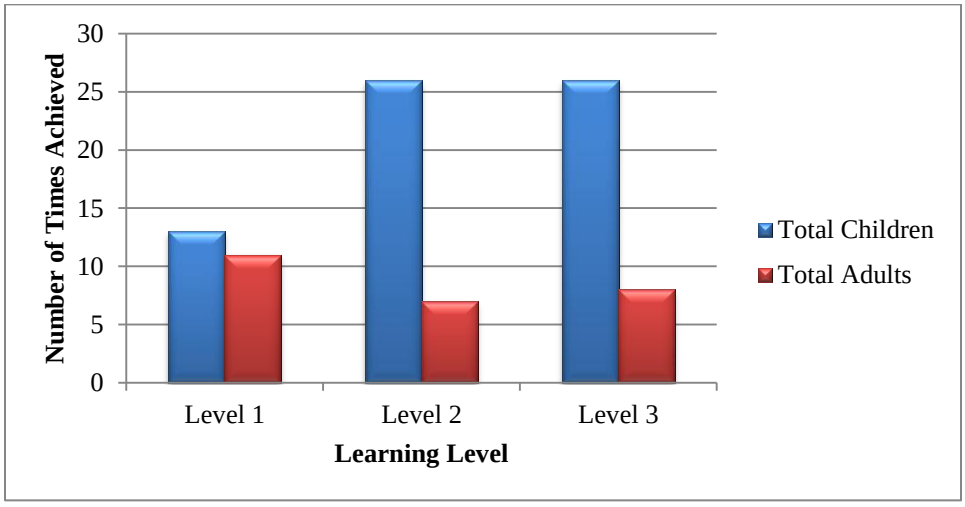

Figure 37. Learning Levels for Illustration Workshop

4.2.3 Site Specific Surveys

The site specific surveys were used to determine the general feedback the visitors had about the activities, both at the exhibits and the holiday activities. When these answers were compared with the dwell times and observation of engagement at the specific exhibits, the research team determined which parts of the exhibits best engaged the visitor and whether or not the exhibit was successful in engaging children of the targeted age range. The researcher noted the dwell time of the visitor in the exhibit as a whole, not the individual activities. The surveys asked questions that targeted the visitor's favorite and least favorite parts of the activity. A graph was made to see how many times a specific activity was said to be a visitor's favorite or least favorite. When the answers were compared with the visitor's observed engagement, the research team determined which parts of the activities worked well and whether or not the activity was successful in encouraging family learning.

After coding the answers to the surveys, it was found that the bus was the majority of the visitors' favorite part of Interchange (See Figure 38). The activities that were never mentioned as a visitors' favorite activity were the three buttons and the Touch Objects. The dwell times and learning level observations agree with the Bus being visitors' favorite part of Interchange.

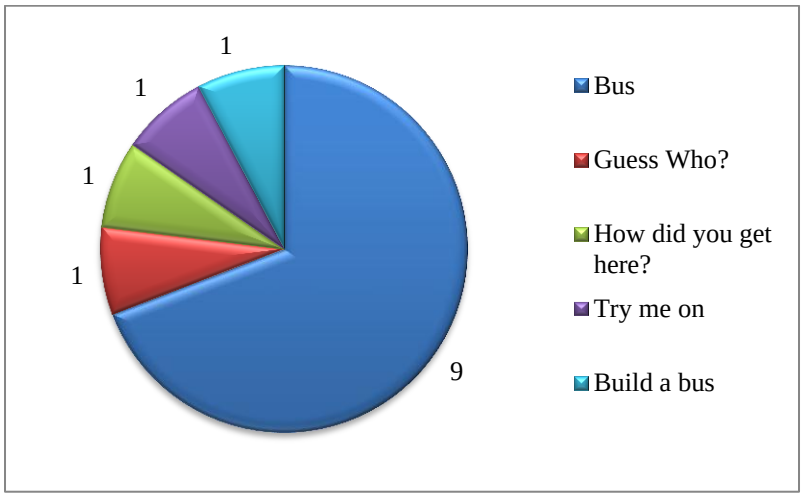

Figure 38. Favorite Part of Interchange

Of the responses for the least favorite part of Interchange, the most common answer was the activities that were broken, or Guess Who? (See Figure 39). One visitor said touch objects was their least favorite part. Neither Guess Who? or Touch Objects had the lowest achievement of learning levels or the least holding power. Visitors may have not seen the tally screen on the

How did you get here? and Where do you live? Buttons, and therefore assumed they were broken. These two activities were found to have the least holding power in Interchange.

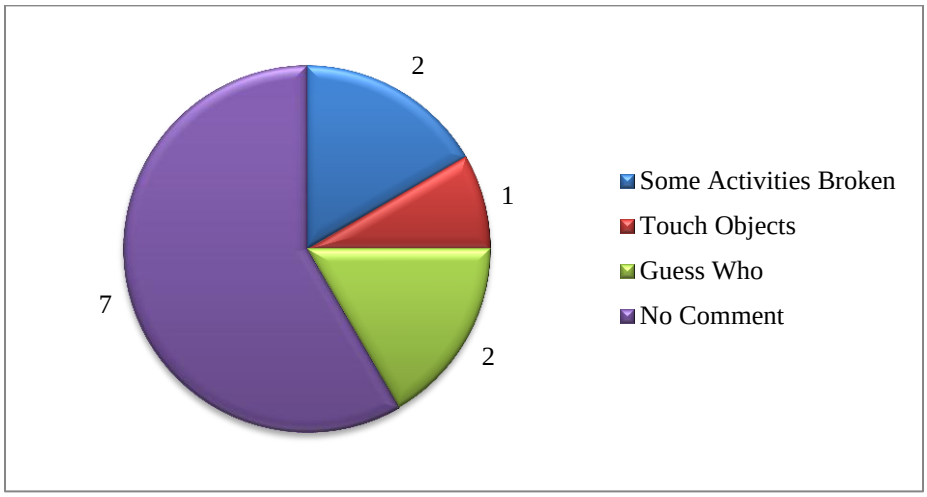

Figure 39. Least Favorite Part of Interchange

The least favorite part of All Aboard, for the two comments given, was found to be the Taxi screen not working. It was found that driving the vehicles in All Aboard was the favorite part for most of the visitors (See Figure 40). The train play set did have greater holding power, however this was done for a larger sample size. There is no data on the learning level of the vehicles due to the inability of the researchers to watch children in the vehicle play area.

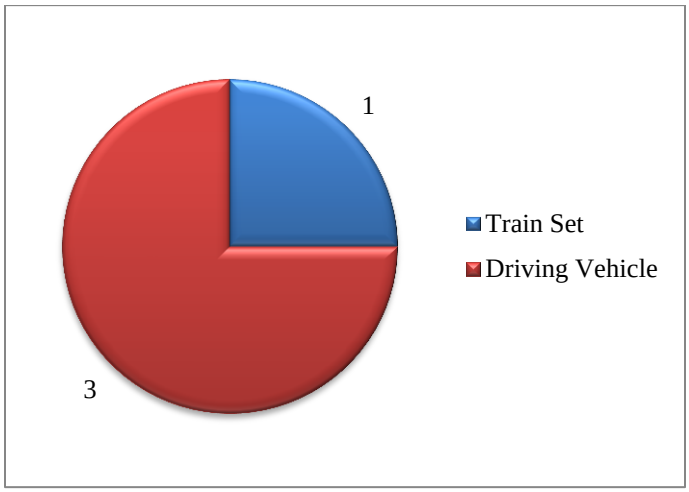

Figure 40. Favorite Part of All Aboard

4.3 Objective 3: Interview Staff from Other Museums

The research team conducted interviews with members of the Learning Department at various local museums to note different techniques for the evaluation of exhibits and activities.

The research team interviewed: Grant Rogers at the Imperial War Museum, Lucy Grace Trotman at the Sir John Soane's Museum, Jenny Wedgbury at Historical Royal Palaces [HRP] Kensington Palace, and a phone interview with the Dan Fuergson at HRP Hampton Court. These interviews revealed how a museum uses gallery space and how they conduct, design, and determine the success of an activity or exhibit. The research team also inquired about activities similar to the Learning Team-led on-gallery experiences offered at London Transport Museum. When possible, the research team went through the museums in order to compare what was learned from the interviews to the actual exhibits. The key points were put into a graph (See Table 6), and the successful methods that could best be applied to LTM were noted.

The interviews with staff from other museums were analyzed to see patterns in what they found successful for their activities comparable to LTM's Learning Team-led on-gallery experiences. It was found that the trails, if the museums had them, were not written to children specifically, but rather to families or the adults. Writing to the adults allowed for them to teach their children, and therefore encouraging family discussion. For overseas visitors the museums offered either audio trails or print materials in multiple languages. The Imperial War Museum also found it helpful to focus on visual exhibits. The Sir John Soane's Museum was the only museum that charged for their family activities, although the museum has free admission. All of the museums' activities encourage hands-on interaction, and all but the Sir John Soane's Museum were meant to encourage family interactions.

Taking what was learned from the other museums, it was found that the best received trails are not written to children, but to the family as a whole. This opposes what LTM Family Pack does, which is written towards children. LTM currently offers the ESOL [English for Speakers of Other Languages] program, like the Sir John Soane's Museum, but does not have audio trails or print material in multiple languages. The Sir John Soane's Museum is visual, which is helpful for visitors with a language barrier. Like most of the other museums, the activities at LTM are geared towards families. One of the activities, the illustration workshop, charged ten pounds per child, like the Sir John Soane's Museum. Kensington Palace and the Hampton Court Palace were the only museums the research team interviewed that also charged admission, as does London Transport Museum.

	Trails	Overseas Visitor	Holiday activity	Family activity
Imperial War Museum	-no set trail -information geared towards adults for them to read and explain material to children -require children to remain with adults at all times	-visual exhibits -multilingual staff	-vary in location (classroom, gallery area) -staff run -encourage family and child interaction -hands on activities attract children -free, drop-in style	-staff runs sessions -focus on interaction between parent and child -community based -encourage family learning: parents ask questions to child to stimulate child's interest
Sir John Soane's Museum	-no set trail -limited space so limit number of visitors at entering to 60 at a time	-not much available -ESOL group -sign language	-geared towards children since parents usually leave kids at museum -charge 10 pounds per child -staff run -take place in classroom	-education program -term used: children's activities over family activities since geared towards children -staff run activity, each staff assigned 10 children
Kensington Palace	-trail map handed out at entrance -find the names of the seven princesses, encourages travel throughout the galleries -trail follow 1/3 of museum -character actors travel throughout museum providing explanations	-trail maps available in 6 languages -poem in each room available in six languages (English, Spanish, French, German, Russian, Japanese)	-hands-on activity attracts children -themes relate to holiday -free -geared towards children	-encourage parents and children interaction -drop-ins for 30-45 minutes -workshops: offer talks and lectures -craft activities family friendly -intergenerational learning needs to be engaging to adults
Hampton Court Palace	-trails written for children and not families	-audio trails in 5 languages, one specifically for children -paper trails are all in English	-hands-on activity attract visitors - some workshops outside paid barrier -activities free	-family trails, help explore the palace, have make and take, storytelling, adult learning events and courses -geared towards children, but want the museum pack to encourage whole family to explore -want to make activities available for all age groups

Table 6. Key Points on Family Activities from Other Museums

5.0 Conclusions and Recommendations

At the completion of the data collection and analysis, the research team was able to evaluate the Learning Team-led on-gallery experiences at London Transport Museum [LTM] and make appropriate recommendations. The research team was able provide insight on the four questions posed to the research team by LTM: (1) Is the Family Pack effective in encouraging movement throughout the museum? (2) How can visitor learning be improved at the Learning Team-led on-gallery experiences? (3) How can learning be improved at Learning Team-led on-gallery experiences for overseas visitors? and (4) How can All Aboard and Interchange be improved? The evaluations of the Learning Team-led on-gallery experiences were completed by achieving the three objectives: (1) To study the flow of visitors through the museum with and without using the Family Pack, (2) To observe visitors' engagement at the children's exhibits and holiday activities, and (3) To interview staff members from other museums to see the techniques they use in their activities designed for families.

5.1 Family Pack

Based on the observations of the research team combined with the survey answers, the Family Pack is not widely being used in the museum. Out of the seventeen people who were tracked and received a Family Pack, only six used it in the museum. Of those six families, four put the Family Pack away while on the second floor. However, the two families that did use the Family Pack throughout the museum found it to be helpful. It was also found that the Family Pack did not increase visitation at the exhibits mentioned within it. Although the sample size was too limited to make definite conclusions, it appears that the Family Pack may discourage visitation to exhibits that are not mentioned in the Family Pack. Also, the Family Pack was found not to affect sales in the museum store. Overall the Family Pack does not seem to currently be successful in encouraging families to transition between exhibits.

The research team recommends that to make the Family Pack more widely used it may be helpful to remove the Family Pack from the bag it is usually enclosed in. By placing the Family Pack in a bag families may get the notion it is a take home object. The bag may also make the Family Pack less accessible to visitors, therefore deterring the use of it in the museum. Another way to improve use in the museum, as recommend by Stephen Moorhouse, is to tie the exhibit to the Family Pack by placing a sign on the exhibit saying 'Open to page X of your Time traveling moustaches and other great ways to explore' London Transport Museum pack. When the Family

Pack is given to families at the front desk, the staff should explicitly tell the visitor that it highlights some key exhibits in the museum and contains activities for children to do in the museum. For future family trails, as per lessons from other museums, the Family Pack should be written towards the entire family, and not just towards children.

5.2 Children's Exhibits

Based on entrance tallies for the two children's exhibits, it was found that during the time of our research each exhibit was most visited for its intended age group. These age groups were zero to five for All Aboard, and six to eleven for Interchange. For this research it was found that the seven successful characteristics for exhibits, set by PISEC, did not affect holding power or learning levels achieved at the activities in the exhibit.

5.2.1 All Aboard

All Aboard had the greatest holding power out of the two children's exhibits, which implies that it requires fewer improvements than Interchange. Families used it as a lunch area, allowing for parents to sit down and relax while watching their children play. Because of this, the exhibit only had to engage children. One possible way that the exhibit could be improved is to fix the taxi and boat screens. The research team observed that occasionally families left due to the child falling and crying. To prevent this from happening and to increase safety, the research team recommends installing foam padding on the floor. The activities in All Aboard only promote learning level 1, identifying. To improve learning, more components could be added that encourage parents to play with the children and thus increasing the learning level achieved. It was found in Interchange that information presented with physical interaction achieves the highest learning levels. This could be employed in All Aboard to encourage higher learning levels as well. Making the play area bigger would also allow for more parents to interact with their children. Overall the research team found All Aboard is a successful in engaging children between the ages of zero and five, and giving families a positive learning experience at London Transport Museum.

5.2.2 Interchange

For Interchange, the Bus had the greatest holding power, while How did you get here? and Where do you live? Buttons had the least holding power. In order to increase the holding power at the buttons, the team recommends making the results more accessible to the visitor.

One way this could be done is by adding a screen that has a tally of the results right in front of the visitor since many people do not wait for the scrolling tally at top or notice it at all. This is supported by the fact that the Best Way Buttons, which presented information right in front of the visitors, achieved learning level 3, interpreting and applying, and had greater holding power. Touch objects board, Best Way to Get There from the Museum, and Guess Who? all had similar holding power. In order to increase the holding power at Guess Who? and Touch Objects, it is recommended that the directions be made larger and more visible. To improve visitor experience at Interchange, the research team recommends making sure all the components of Interchange are working. For example, the button displays commonly had broken buttons. Since Interchange is being renovated, the research team recommends moving Guess Who? to the back of the exhibit to encourage families to play the game. At the entrance, the exhibit tends to encourage children hit buttons and then leave, discouraging people from attempting to play. Since this exhibit focuses on children ages six to eleven, providing an area for parents to sit could allow families to stay longer and for children to able to explore and learn more at the exhibit. Interchange was found to have many components that were educational and entertaining, but also had areas for improvement. Possible improvements included more visible directions and outcomes of activities, replacing parts of activities that are missing, maintaining the working order of the exhibit, and adding seating for parents.

5.3 Holiday Activities

In order to increase visitation at the holiday activities, the research team recommends better advertisement. Also, the team recommends having signs in the museum to tell families where and when the activities are taking place. Having signs that guide the families to the activities throughout the museum would also be helpful. For this research it was found that the seven successful characteristics for activities, set by PISEC, did not affect holding power or learning levels achieved at the holiday activities.

5.3.1 Storytelling

The 11:00 time slot for storytelling was more visited than the 15:30 time slot. However the 15:30 time slot was more visited by children over the age of six. Considering that storytelling is most visited by children under five the team recommends that storytelling should occur earlier in day. Twenty five minutes is a good length for storytelling due to the fact a high percentage of children remained till the end. Allowing for the children to interact with the storytelling was well

received. Future storytelling should focus on engaging the children with more interactions. Learning level 1, identifying, was achieved the most at storytelling, therefore there is room for improvement by having the staff ask more questions to the children. Overall storytelling was found to be a successful activity for engaging children and providing families with a positive experience at London Transport Museum.

5.3.2 Make and Take

The research team recommends better advertisement of these activities. The staff was found to be very helpful, although having one staff member greeting visitors and another staff member assisting visitors would improve visitor and staff interactions. The research team recommends having one staff member greet the visitors, and having another staff member help visitors with the activity. Learning level 1, identifying, was found to be achieved the most by visitors for make and take, implying there is room to increase learning, perhaps by having more background information about the theme of the workshop. The staff could provide questions that parents could ask their children about the activity, which would also encourage family interactions. Overall make and take was found to be successful and engaging children and giving families a positive learning experience at London Transport Museum.

5.3.3 Illustration Workshop

Although the illustration workshop only had three families attend over the course of two days, these families rated it very highly. In order to make the workshop more visited, more advertisement should be done beforehand. The illustration workshop was the first paid workshop the museum has ever offered, so it may take visitors some time to get used to paying for a workshop at LTM. The illustration workshop achieved learning level 3, interpreting and applying, of learning the most, therefore showing it was an educational experience for families. Overall visitation was low, but the learning level achieved was much higher than the other activities and children's exhibits. For the families that visited the illustration workshop, it was a success at giving families a positive learning experience.

5.4 Overseas Visitors

Overseas visitors were considered visitors whose primary language was not English. Given the nature of the Family Pack, it is difficult to present the materials to overseas visitors. However, a way to overcome this is to make audio trails in multiple languages highlighting some

key exhibits in the museum. Since there is no text in All Aboard, it is equally enjoyed by overseas visitors and visitors who speak English. Interchange could be improved by adding activities, such as the Bus and Try me on, that do not heavily rely on reading. For example, the buttons and Touch Objects are difficult for overseas visitors to use. Since storytelling heavily relies on the child understanding English, it would be difficult to make storytelling accessible for overseas visitors. The make and take activities could be improved by having more examples for overseas families to copy. Picture directions could also improve this activity, and the staff could also demonstrate the activity for the overseas visitors. The staff should focus on assisting the parent, so they can teach the child. Having a wide range of materials so the family can choose their own activity would promote family interaction, even if it is not the goal of make and take.

5.5 Summary

The research team was able to achieve the three objectives established for this project and provide insights on the four questions proposed by London Transport Museum. For the first objective, to study the flow of visitors, it was found that the Family Pack does not encourage movement throughout the museum. By achieving the first objective, the research team was able to answer the first question LTM had regarding the Family Pack being effective in encouraging movement throughout the museum. The second objective, observing visitor engagement, found that All Aboard achieved the lowest learning level but has the greatest holding power, while Interchange achieved all levels of learning. The fourth question, how can All Aboard and Interchange be improved, was addressed by making recommendations to increase learning and family experience. For All Aboard, the research team suggested adding components that encourage family interactions and learning. For Interchange, the research team suggested making information more accessible and fixing the broken displays. Concerning the second question LTM had about increasing learning at the Learning Team-led on-gallery experiences, the research team suggested that learning can be improved by posing more questions to the children at the holiday activities. For answering the third question about improving learning for overseas visitors, the team suggested focusing more on pictures and examples to convey information, and therefore allowing them to learn at the Learning Team-led on-gallery experiences. The third objective, interviews with other museums, allowed the research team to suggest that the Family Pack would be more used if written towards families instead of towards children. Overall, it was found the Family Pack is currently unsuccessful in encouraging movement throughout the

museum. The children's exhibits and holiday activities were found to be successful in engaging families and providing them with a positive experience at London Transport Museum.

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Appendices

Appendix A: The History and Development of London Transport Museum

London Transport Museum is located in Covent Garden, London. The museum's mission is to be both an "educational and heritage preservation charity whose aims are to conserve and explain London's transport heritage, to offer people an understanding of the Capital's past development, and to engage them in the debate about its future" (Charity Commissions, 2011b). The museum has a variety of exhibits with a wide range of interests in hopes that people of every age and background can learn and benefit from the museum (Charity Commissions, 2011b). The museum works to achieve this goal by displaying the detailed history of the past, the issues of the present, and the opportunities of future transportation for London (London Transport Museum [LTM], 2011, Our Mission). Many means of transportation are displayed, including London's famous Tube, as well as its iconic red double-decker bus. The museum's educational role is supported by a collection of over 12,000 books and magazines, as well as the museum's on-site schools programme. "The museum not only offers public talks, lectures, activities and events but also engages with transport industry professionals via programmes such as Thought Leadership to encourage debate about issues affecting transport in London and beyond" (Charity Commissions, 2011b). The museum also tries to educate visitors with many interactive exhibits that allow them to experience the transportation equipment and technologies that have moved London (LTM, 2011, Engineering Collection). One particular interactive exhibit is the simulations, which allows visitors to virtually operate the Tube controls. (Olson, 2008, p. 220).

In 2007, the museum opened a new gallery at the top of its building, which encompasses learning zones, simulators, and a play area for children under the age of five, making it a place of exploration for all age groups (LTM, 2011, Online Museum). In addition, the internet has increased access to its permanent display objects through the Online Museum, thus expanding people's understanding of how urban transport systems affect their social history and their daily lives (LTM, 2011, Online Museum).

The Transport Museum was founded in the 1920s when the London General Omnibus Company wanted to preserve two Victorian horse buses and a motorbus for future generations (LTM, 2011, About Us). Originally named the Museum of British Transport, it was located in an old bus garage in Clapham, South London during the 1960s. In 1973, the museum was renamed the London Transport Collection and relocated to Syon Park in West London. In March 1980,

the museum saw its final move to the Flower Market building in Covent Garden and was renamed again as London Transport Museum.

The Flower Market building was built in 1871, and had been used primarily as a marketplace for flowers until 1974. In order to make the building more energy efficient and environmentally friendly, the building was substantially renovated between 2005 and 2007, and photo-voltaic cells were placed on the roof to generate power for the museum (LTM, 2011, About Us). These renovations cost approximately £22 million, and were funded primarily through a grant of £9.4 million from the Heritage Lottery Fund. The remainder of the funding came from donations from corporations, trusts and foundations. The renovations refurbished the building but also brought a change in focus of the exhibits from technology to social history. The reopening also brought a change in types of visitors the museum wished to attract. Prior to the renovations nearly half of the annual visitors, amounting to 200,000 people, were family groups (Divall, 2008, p. 1012). Recognizing that family groups will continue to be the mainstay of the museum, many of the exhibits in the renovated space have been designed to accommodate children. Nevertheless, the museum is trying to reach out to new audiences. For example, in order to appeal to people in their 20s and 30s, who are especially interested in art and design, the new museum incorporated more technology based visual displays, such as touch screens and a Tube train simulator, and offers special adult programs during 'Friday lates' (Case, 2008, p. 58). The new London Transport Museum has been a success, exceeding goals that were set, as well as obtaining the Museum, Libraries, and Archived Council's Full Accreditation in September 2008, and maintaining it for the 2009/10 year (Charity Commission, 2011b). Visitation in the fiscal year of 2010 surpassed the goal of 270,000 visitors with more than 287,000 visits, with over 16,000 of them being educational visits, as well as 900,000 website visits. In FY2010 the revenue was more than £12 million, with the support of 104 employees and 170 volunteers. This also left the museum in a good financial standing at the end of 2010, with assets of £26.3million and cash balances of £3.2 million. Today, London Transport Museum comprises two major parts: the museum itself which is open to the public throughout the year, and the museum's depot which houses the majority the museum's collection and is open only for special events (LTM, 2011, Opening Times and Tickets). Admission to the museum is £13.50 for adults, and children under sixteen are free. The museum comprises three levels (see Figures 41-43) which

illustrate the history of transportation in London from the 19th century through the development of the underground and to the present day. LTM visitors are strongly encouraged to enter at the top level of the museum and work their way down to the ground level (Divall, 2008, 1013). The levels are designed in such a way that if visitors begin on the top floor the exhibits will be seen in chronological order, starting with the 19th century, on level two, and ending with the present day, on level zero. The museum offers a small library which is available for use by appointment, and holds literature on transportation as well as family history for staff, dating back to 1913 (LTM, 2011, Opening Times and Tickets). Other features of the museum include the Upper Deck café and bar and the museum store, both of which hold their own hours and can be visited without entering the museum itself.

Figure 41. Level 0 Floor Plan
Source Photo: http://www.ltmuseum.co.uk/visit/plan-your-visit/museum-floor-plan

London Transport Museum Limited operates a registered charity, which aims to educate the public about heritage of transport (LTM, 2011, Governance). The museum is run by a Board of Trustees, headed by Sir David Bell. The Memorandum and Articles of Association governs the museum as a company limited by shares. The majority of the museum's funding comes from Transportation for London, which is a group of supporteres and funders (LTM, 2011, Yearbook 2008/09). Although the museum is run primarily by paid employees, a large number of people

volunteer as ‘friends’ of London Transport Museum. During the 2008/09 fiscal year, 6,900 hours of volunteer work was given by 160 individuals supporting the museum. The volunteers gave tours, organized the library, and helped at the museum depot.

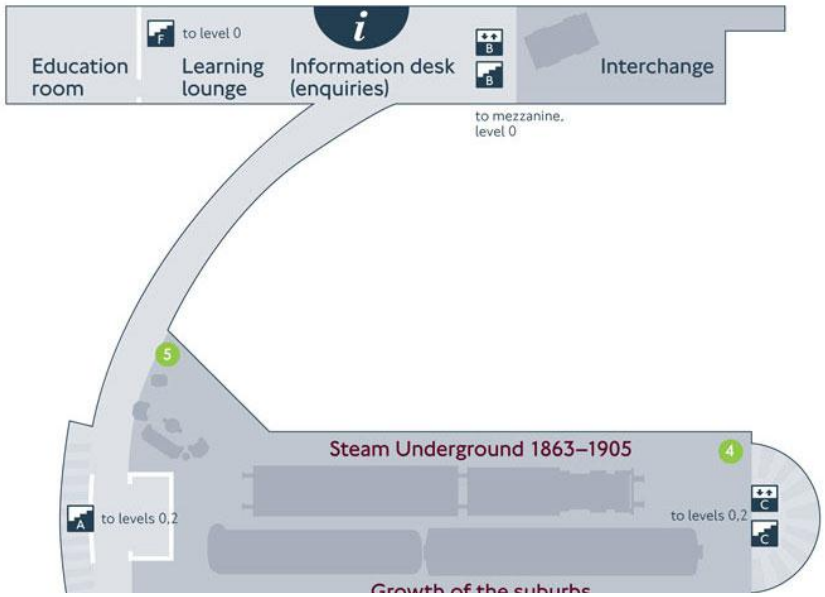


Figure 42. Level 1 Floor Plan
Source Photo: http://www.ltmuseum.co.uk/visit/plan-your-visit/museum-floor-plan

London Transport Museum was evaluated by BDRC Continental, an independent research consultation firm, from July 2010 to January 2011. The evaluation noted that the museum was rated very highly from users of activities, but also searched for possible improvements. The goal of our project is to assist London Transport Museum in evaluating Team-led on-gallery activities to see if any improvements are necessary. The BDRC report suggested three questions for improvements, based on the fact that LTM is strong on visitor interaction: Is there capacity to increase usage of specific activities, and if so can orientation efforts draw visitors from one to another? What can be done to enhance visitor experience at staff touch-points? What can be done to optimize LTM’s interpretation for overseas visitors whose knowledge of London may be narrower and shallower?

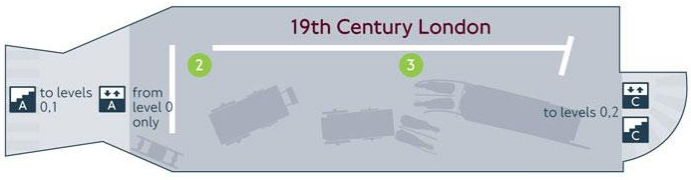
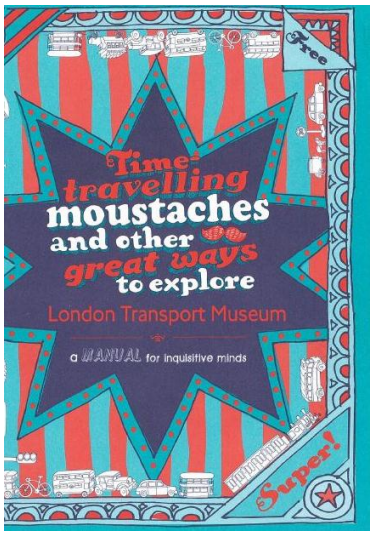
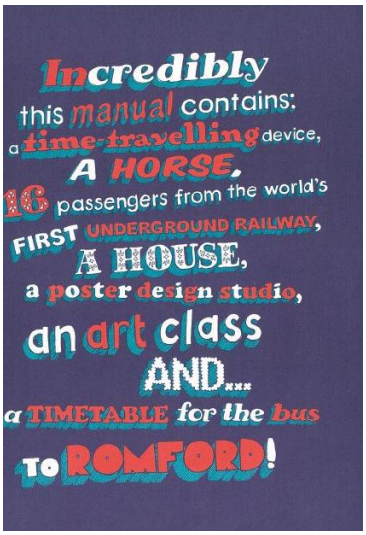


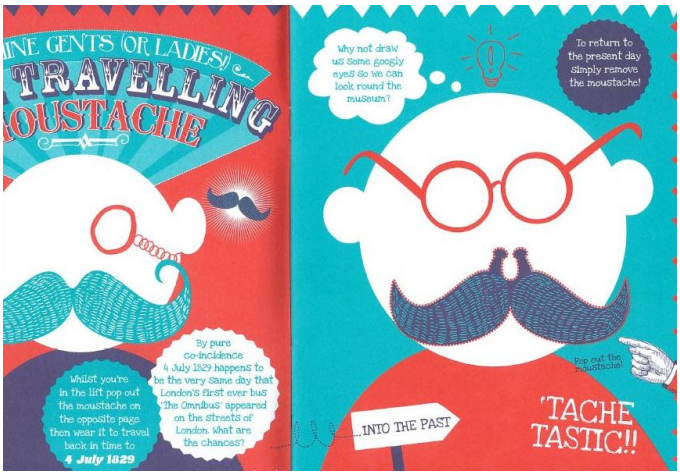
Figure 43. Level 2 Floor Plan
Source Photo: http://www.ltmuseum.co.uk/visit/plan-your-visit/museum-floor-plan

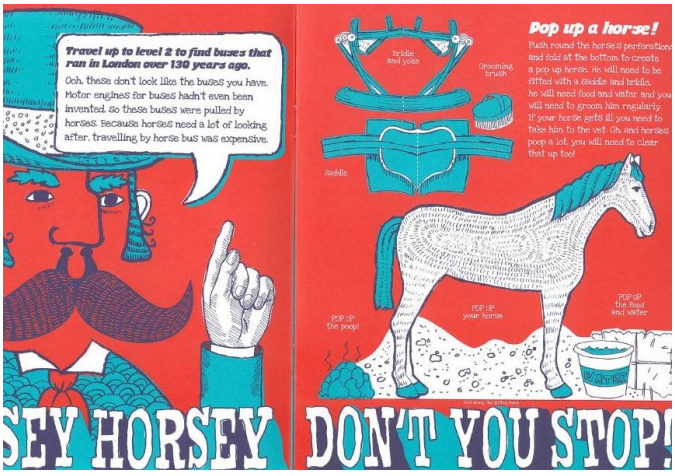
Our project will develop a baseline of visitor interaction, navigation, and foreigner interpretation to help London Transport Museum determine whether improvements are needed. This way LTM will be able to compare the outcome of any possible changes that may take place in the future with the baseline created by our team.

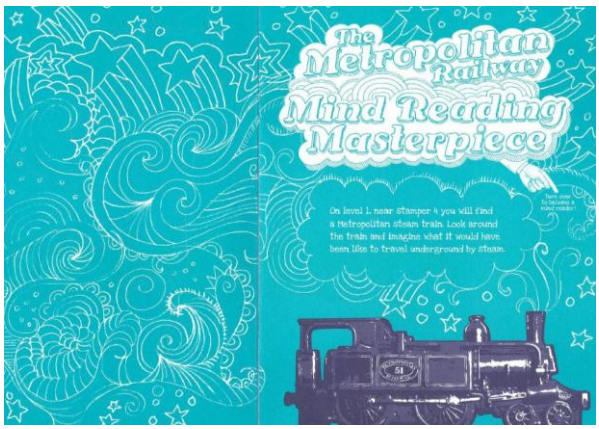
Appendix B: Family Pack





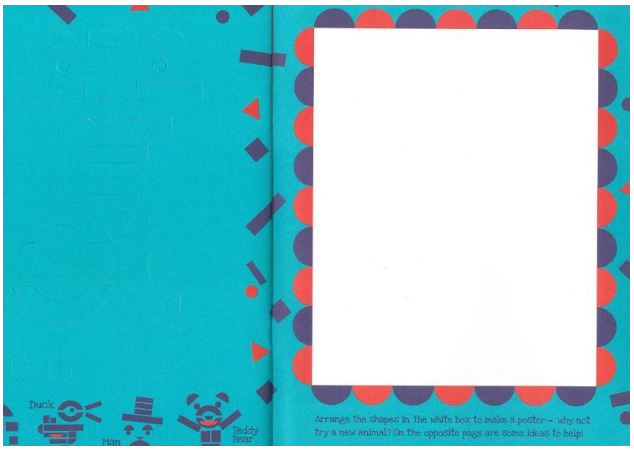







Home Sweet Home
Just before you cross the bridge on level 1, look out for our doll's house.
Our doll's house is over 50 years old when the first children to own this house were busy playing with it. The Metropolitan Railway Company was busy building similar, full-sized houses on the land it owned along the railway tracks. These houses, situated because known as Metro-land.
Stand next to the doll's house, if you listen very carefully you can hear a song about living in Metro-land.
To make your own doll's house to play with at home... tear off this sheet and follow the pictures below
1
2
3
4


Perfect Posters
Here's an activity for when you're looking around the Design for travel gallery, Level 0
Artist Abram Games* designed lots of posters to jolly up journeys on London's buses and trains. He was very good at making simple posters that were easy to understand. You can find one of Abram's posters in the design gallery – it's the big one with a stripy tiger on, what is the poster advertising?
Pop these shapes out to design an Abram Games-style poster. Turn to the next page to see how...
*The Estate of Abram Games have very nicely let us copy Abram's Zoo poster so that you can try your hand at graphic design.


Duck
Man
Teddy Bear
Arrange the shapes in the white box to make a poster – why not try a new animal? On the opposite page are some ideas to help!


Green!
bus activity for when you're on Level 0
love buses! Find the Green Line Coach
paper 11.
Green Line coaches ran services between
the countryside. It was quite expensive
Green Line coach because they travelled
es and
they
tylish
h tech.
You can tell where a bus or coach is going by looking at the destination blind on the front.
Name one place our Green Line coach is going to?
Instead of a route number this bus has a letter, what letter is it?
Have a look at the timetable on the red board below. It shows part of the Route X timetable from 1938.
Check your watch, what time is it now? When is the next coach to Romford Mawneys due?
TIMETABLE
London-Wanstead-Romford
Route X
Aldgate 8.30am 12.00am 4.00pm 7.00pm
Whitechapel 8.40am 12.10am 4.10pm 7.10pm
Leyton 8.50am 12.20am 4.20pm 7.20pm
Wanstead 9.07am 12.37am 4.37pm 7.37pm
Granbrook Park 9.13am 12.43am 4.43pm 7.43pm
Newbury Park 9.19am 12.49am 4.49pm 7.49pm
Little Heath 9.27am 12.57am 4.57pm 7.57pm
Romford Mawneys 9.30am 01.00pm 5.00pm 8.00pm
hop on board and have fun on your trip to Romford!
Goodbye

Appendix C: Spatial Tracking Sheet (Adapted from D 2010 LTM Group)

Day of Week: Sat. Sun. M T W Th F Date ____/_____/2011 Time Start:

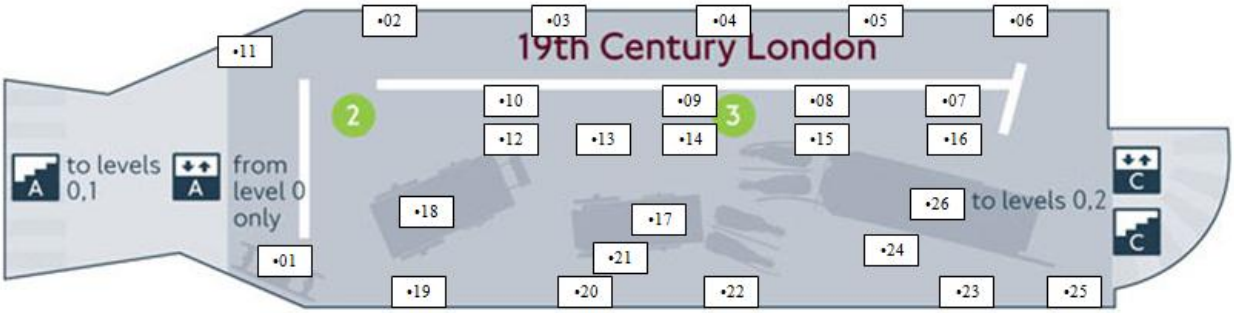
Type of Group: Single Person Group of friends Family Couple Time End:

(circle one) Single Parent With Child(ren) Overseas Visitors Other:_____

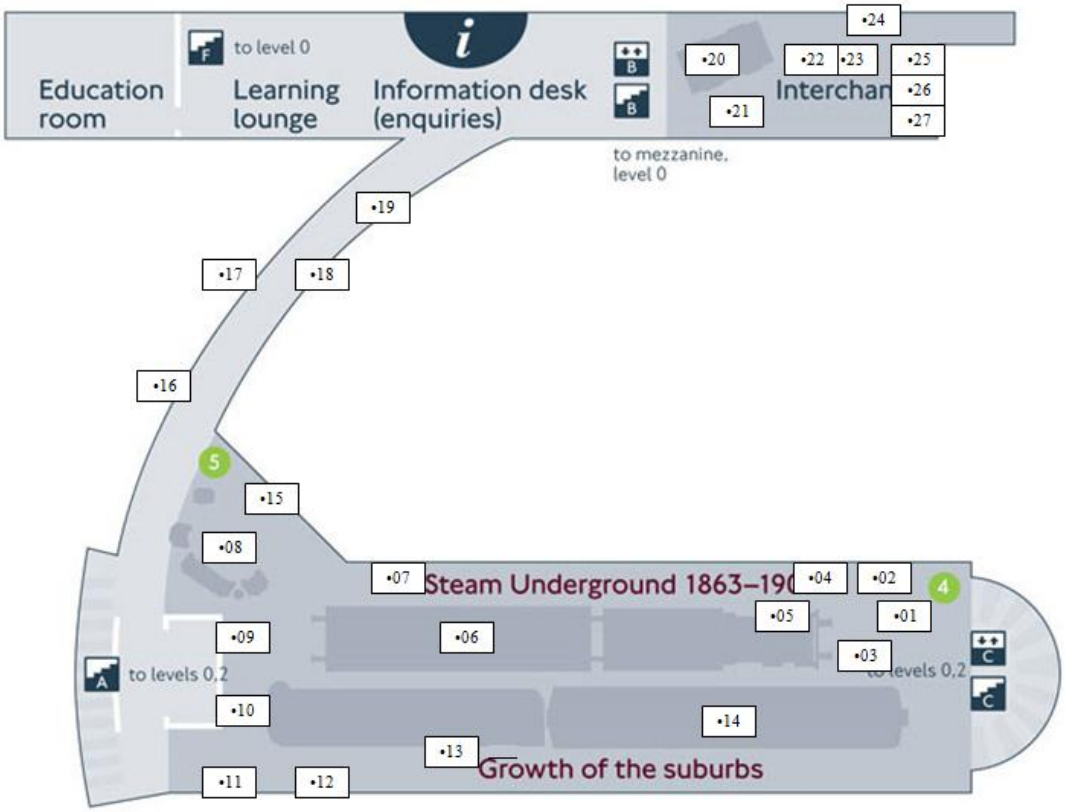
Age Groups(All that apply) <12 12-16 17-25 26-40 41-60 60+

Spatial Tracking Number _____ Circle: More than 30s Check: More than a minute

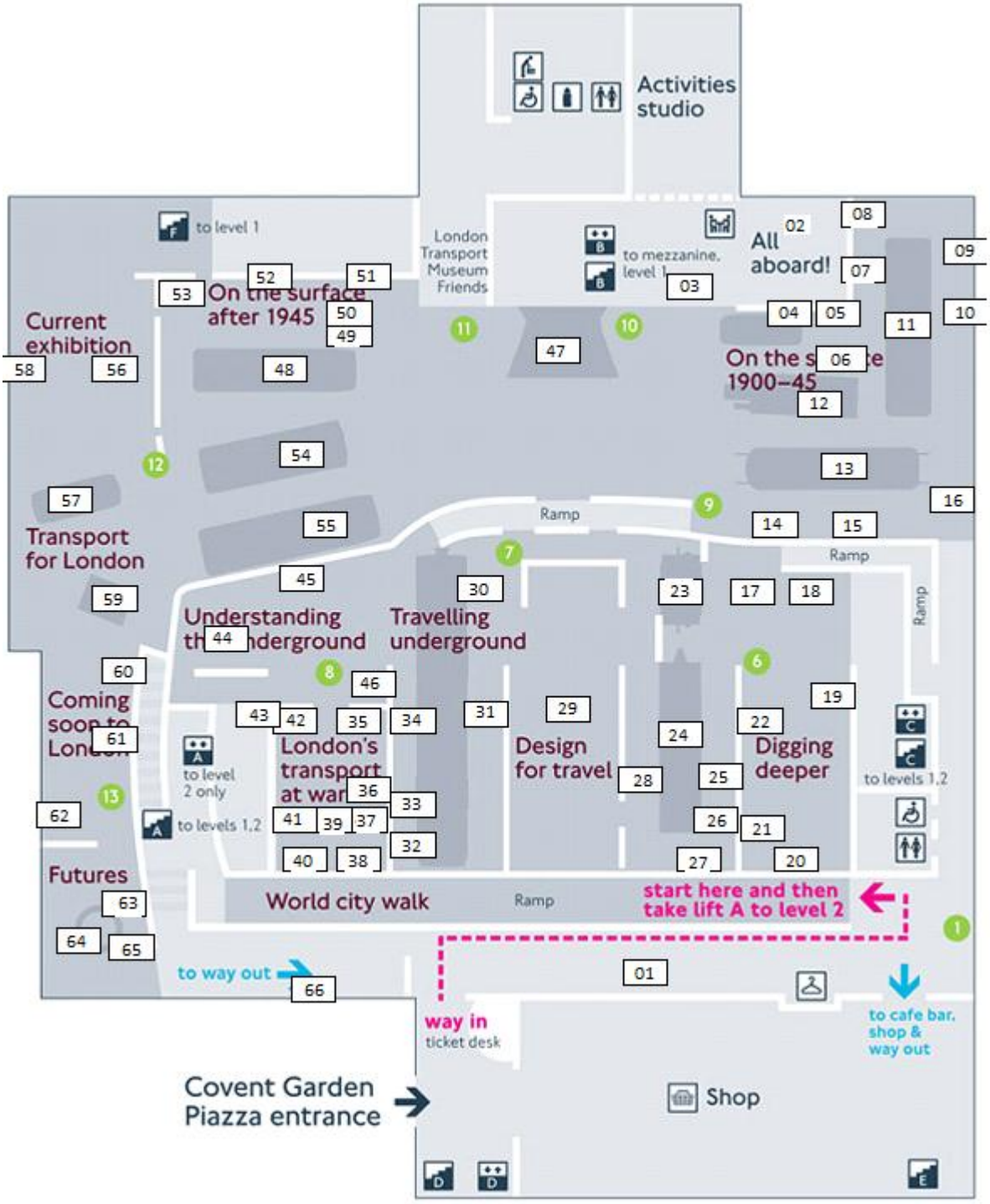
Level 2



Level 1



Level 0


Activities studio
to level 1
London Transport Museum Friends
to mezzanine, level 1
All aboard!
On the surface after 1945
Current exhibition
On the s ce 1900–45
Ramp
Transport for London
Understanding th derground
Travelling underground
Coming soon to Lond n
to level 2 only
to levels 1,2
London's transport at war
Design for travel
Digging deeper
to levels 1,2
Futures
World city walk
Ramp
start here and then take lift A to level 2
to way out
way in
ticket desk
to cafe bar, shop & way out
Covent Garden Piazza entrance
Shop

Appendix D: Exit Survey (Adapted from D 2010 LTM Group)

Spatial Tracking Exit Survey

Hello, my name is _____. I am working with London Transport Museum conducting surveys on visitor experience. This survey is completely anonymous and voluntary. If you are uncomfortable answering a question please tell me and I will skip to the next question. Can I take a few minutes of your time to ask you questions on your experience today?

Day of Week: Sat. Sun. M T W Th F Date ____/_____/2011

Type of Group: Single Person Group of friends Family Couple

(circle one) Single Parent With Child(ren) Overseas Visitors Other:_____

Age Groups

(All that apply) 0-5 5-10 10-16 17-25 26-40 41-60 60+

Spatial Tracking Number _____

Did they buy something from the store? Yes No

1. If you are comfortable, could you tell us your nationality?_____
2. Is this your first visit to London Transport Museum? Yes No
3. What exhibit was your favorite and why?

   _____

   _____

   _____

4. Did you receive a "Time Traveling Moustaches Pack"? Yes No
   a. If Yes did you use it? Yes No
   b. Did you find this pack helpful or useful? Yes No
   c. Did it improve your visit? If so how?

      _____

      _____

      _____

   d. How do you think feel the pack can be improved?

Thank you for taking a few minutes of your time to answer these questions, your feedback is greatly appreciated. Are there any additional comments you would like to add about your visit today?

5. Additional Comments

Appendix E: Example of Spatial Tracking Spreadsheet

ATM 5	Boy 4 Boy 6 Mom and Dad	1:55-3:35			
Order	Glance	30 seconds	Over a minute		
L201		X			
L217	X				
L209		X		Buy	No
L205		X		1	British
S4				2	No
L101			X	3	Kids: Trains
L103			X	4	Yes
L105		X		4a	No
L104	X			4b	
L106		X		4c	
L108			X	4d	
L115		X		5	Very good, likes the year's pass
S5					Kids loved the stamper trail
L116	X				
S2					
L218		X			
L217		X			
L214		X			
S3					
L019	X				
S6					
L017		X			
L020		X-CA			
L021		X			
L022		X			
L024			X		
S7					
S9					
L013			X		
L002			X		
L003			X		

Appendix F: Exhibit Codes

Key: **V**- Vehicle **BV**- Boardable Vehicle **D**- Diorama **PI**-Physical Interaction
DI- Digital Interaction **DD**- Digital Display **A**- Audio/Sound **R**- Reading Materials

Level 0 Exhibits:

Number and Name	V	BV	D	PI	DI	DD	A	R
L0-01: Metropolis of the world						X	X	
L0-02: All Aboard		X		X				
L0-03: Train play set				X				
L0-04: Taxi!	X				X			X
L0-05: Uniform delivery								X
L0-06: Bus driver: 'Jamaican Joe'								X
L0-07: Big bus boom of the 1920s				X		X		X
L0-08: Best buses on the world			X					X
L0-09: Congestion and safety								X
L0-10: Trolleybuses overtake London's trams			X	X				X
L0-11: Trolleybus	X				X			
L0-12: Liverpool St. Bus	X				X			
L0-13: Stratford Tram		X						
L0-14: The mechanical Revolution			X	X				X
L0-15: Trams for everyone			X					X
L0-16: Tram metropolis			X					X
L0-17: Display of Tram/Underground			X				X	
L0-18: Providing the power						X	X	X
L0-19: How to get passengers up and down			X	X		X	X	X
L0-20: Going deeper underground			X	X				X
L0-21: How do you tunnel deep underground?				X		X		X
L0-22: How to power trains underground			X	X				X
L0-23: Electric underground	X							
L0-24: Underground train		X			X			
L0-25: The new electrics								X
L0-26: Tube mania								X
L0-27: An American saves the Tube						X	X	X
L0-28: Filling up the Tube								X
L0-29: Design for travel				X		X		X
L0-30: Electric Tube car 1938	X				X			
L0-31: Taking the Tube				X				X
L0-32: Small Tube simulator				X	X		X	
L0-33: A century of the underground			X	X				X
L0-34: Time Tube Map						X		
L0-35: First World War 1914-18						X	X	X
L0-36: Travelling in wartime								X
L0-37: Women and war						X		X
L0-38: First World War ends								X

L0-39: Sheltering in the Tube						X	X	X
L0-40: Second World War 1939-45				X				X
L0-41: The system keeps running			X					X
L0-42: End of the war								X
L0-43: Getting the most from the London Underground								X
L0-44: Large Tube simulator				X	X		X	
L0-45: These rails will kill				X				
L0-46: Practice Tube simulators				X	X			
L0-47: Travel map						X		
L0-48:New Bus for London	X							X
L0-49: After the Second World War								X
L0-50: Diesel triumphant								X
L0-51:London's biggest employer						X	X	X
L0-52: Will cars rule?								X
L0-53: Long-distance commuting			X	X	X			X
L0-54: 1970s Bus		X						
L0-55: Routemaster Motorbus 1963		X			X			
L0-56: Family Activity Area								
L0-57: 2007 Taxi	X				X			
L0-58: Current transportation			X			X	X	X
L0-59: Bus cab		X		X	X			
L0-60: The challenge of climate change						X	X	X
L0-61: Doing or bit						X		X
L0-62: Coming to London						X		X
L0-63: Visions of the future						X	X	X
L0-64: Future generator					X			
L0-65: Moving in new ways						X	X	X
L0-66: Have your say					X			

Level 1 Exhibits

Number and Name	**V**	**BV**	**D**	**PI**	**DI**	**DD**	**A**	**R**
L1-01: Building the first Underground			X			X	X	X
L1-02: World's first underground railway				X				X
L1-03: Steam Underground			X	X				X
L1-04: Traveling on the steam underground								X
L1-05: Fireman and the train driver: George Spille							X	X
L1-06: Steam Engine		X			X			
L1-07:Suburban commuting				X				X
L1-08: Living room			X			X	X	
L1-09: Metro Land								X
L1-10: Metro-land leisure								X
L1-11: Leisure travel				X				X
L1-12: Poster parade								X
L1-13: Train guard					X		X	X

L1-14: Train		X						
L1-15: Suburban revolution				X				X
L1-16: Destination plates								X
L1-17: Bus blinds								X
L1-18: Trading every day Christmas								X
L1-19: Bloomin' marvelous								X
L1-20: Halfway Street bus		X		X			X	
L1-21: Guess who?				X				
L1-22: Build a vehicle				X				
L1-23: Try me on				X				
L1-24: Touching objects				X				X
L1-25: Where do you live?				X				
L1-26: Leaving from London Transport Museum				X				
L1-27: How did you get to the Museum?				X				

Level 2 Exhibits

Number and Name	**V**	**BV**	**D**	**PI**	**DI**	**DD**	**A**	**R**
L2-01: Chair to anywhere								X
L2-02: River Thames							X	X
L2-03: On the water			X					X
L2-04: Panoramic picture			X	X				X
L2-05: River traffic declines								X
L2-06: Reshaping the river								X
L2-07: London's Railway Network			X					X
L2-08: Closer to the centre								X
L2-09: London's first passenger railway			X	X				X
L2-10: Early Railways								X
L2-11: New Perspectives								X
L2-12:Before the bus			X					X
L2-13: Rise of the horse bus			X	X				X
L2-14: Rails in the road			X	X				X
L2-15: Horsing around in London								X
L2-16: Looking after the horses			X					X
L2-17: Horse bus driver: Cast-iron Billy	X				X		X	X
L2-18: Omnibus		X			X		X	
L2-19: Crowded city								X
L2-20: Reshaping the city								X
L2-21: The passenger experience				X			X	X
L2-22: Panoramic Photo								X
L2-23: Big version for a better city				X			X	X
L2-24: Advertising starts early	X				X			X
L2-25: Healthy heart of Europe					X			X
L2-26: Horse tram conductor								X

Appendix G: Visitor Entrance Tally Sheet

Day of Week: Sat. Sun. M T W Th F Date ____/_____/2011

Time Start Counting:_____ Time Finished:_____

Activity/Exhibit_____

Visitor Type Codes: Single Person (1) Group of friends (2) Family (3) Couple (4) Group of Child(ren) (5) Overseas Visitors (6) Other (7)

#	Visitor Code	Time In	Visitor Details	Glance
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				

Appendix H: Example of Entrance Tally Spreadsheet

MG 2	Friday	Interchange				
Time Start 2:25	Time end 3:25					
Vistor Code	Time in	0-5	6 to 10	11 to 15	Additonal Members	Glance
3	6:25	1			Mom	
3	7:55	1			Mom Gma Gpa	
3	8:00	1			Mom	
2	9:45					
3	12:20		1		Mom	
1	13:25					X
3	14:40	1			Gma	
1	18:00					
3	24:37:00	1			Dad	
5	27:25:00			4		
3	28:10:00		1		Dad	
3	28:10:00	1			Mom	
3	29:17:00	1			Mom Dad Friend	
1	30:04:00				Gma	
2	31:07:00				Older	
2	32:02:00				Older	
3	32:00:00			4	Mom Friends	
3	37:25:00			1	Dad	
3	37:45:00			2	dad	
3	41:40:00			1	Mom	
3	56:10:00	1			Mom Gma	
Total:		8	2	12		1

Appendix I: Dwell Time Sheet (Adapted from D 2010 Group)

Day of Week: Sat. Sun. M T W Th F Date ____/_____/2011

Time Start Counting:_____ Time Finished:_____ Exhibit/Activity_____

#	Gender	Age Range						Time in	Time Out
1	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
2	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
3	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
4	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
5	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
6	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
7	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
8	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
9	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
10	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
11	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
12	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
13	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
14	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
15	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
16	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
17	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
18	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
19	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
20	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
21	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
22	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
23	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
24	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
25	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
26	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
27	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
28	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
29	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
30	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
31	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
32	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
33	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
34	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
35	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
36	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:
37	M F	0-5	5-10	10-15	15-20	20-50	50+	:	:

Appendix J: Example of Dwell Time Spreadsheet

JS 2 Week 2	Interchange: Best way to get to the museum	12.13 to 1.13 pm					
Gender	0 to 5	6 to 10	11 to 15	15 to 20	20 to 50	50+	Total (seconds)
M					1		1
M					1		51
F					1		8
M	1						8
M	1						18
F						1	18
F					1		68
M					1		68
F					1		68
Total	2	0	0	0	6	1	34.22222222
9							Average Time

Appendix K: Visitor Engagement Sheet

Day of Week: Sat. Sun. M T W Th F Date ____/_____/2011

Type of Group: Single Person Group of friends Family Couple Time_____

(circle one) Single Parent With Child(ren) Overseas Visitors Other:_____

Age Groups Number of Males_____ Number of Female_____

(All that apply) 0-5 5-10 10-15 16-25 26-40 41-60 60+

Team-led on-gallery activity/Exhibits_____Observation Number:_____

Group Member	Ask ?	Answer ?	Comment/ Explain Exhibit	Read Text Aloud	Read Text Silently	Play with Exhibit

Appendix L: Exhibit Specific Survey

Hello, my name is _____. I am working with London Transport Museum conducting surveys on visitor experience. This survey is completely anonymous and voluntary. If you are uncomfortable answering a question please tell me and I will skip to the next question. Can I take a few minutes of your time to ask you questions on your experience today?

Day of Week: Sat. Sun. M T W Th F Date ____/_____/2011

Type of Group: Single Person Group of friends Family Couple

(circle one) Single Parent With Child(ren) Overseas Visitors Other:_____

Age Groups

(All that apply) <12 12-16 17-25 26-40 41-60 60+ Gender: **(M /F)**

Exhibit_____ Observation Number: Time in: Time Out:

1. If you are comfortable, could you tell us your nationality?_____
2. Is this your first visit to London Transport Museum? **Yes No**
3. Did you receive a "Time Traveling Moustaches" Pack today? **Yes No**
4. What was your favorite part of this exhibit?

   _____

   _____

   _____
5. What was your least favorite part of this exhibit?

   _____

   _____

   _____
6. How do you think the exhibit could be improved?

   _____

   _____

   _____

Thank you for taking a few minutes of your time to answer these questions, your feedback is greatly appreciated. Are there any additional comments you would like to add about your visit today?

7. Additional Comments

Appendix M: Activity Specific Survey

Activity Specific Survey

Hello, my name is _____. I am working with London Transport Museum conducting surveys on visitor experience. This survey is completely anonymous and voluntary. If you are uncomfortable answering a question please tell me and I will skip to the next question. Can I take a few minutes of your time to ask you questions on your experience today?

Day of Week: Sat. Sun. M T W Th F Date ____/_____/2011

Type of Group: Single Person Group of friends Family Couple

(circle one) Single Parent With Child(ren) Overseas Visitors Other:_____

Age Groups

(All that apply) 0-5 6-10 11-15 16-26 26-40 41-60 60+ Gender: **(M /F)**

Team-led on-gallery activity_____ Observation Number: _____

1. If you are comfortable, could you tell us your nationality?_____
2. Is this your first visit to London Transport Museum? **Yes No**
3. Did you know about the activities before you came to the museums? If so how did you find out about it?

   _____

   _____
4. Was this family activity the reason you visited this gallery? **Yes No**
5. Did you enjoy the family activity? Why or why not?

   _____

   _____

   _____
6. Did you interact with the staff at this activity? **Yes No**
7. If yes, how was the quality of the activities and/or staff in charge?

   _____

   _____

8. What was your favorite part of this activity?

Thank you for taking a few minutes of your time to answer these questions, your feedback is greatly appreciated. Are there any additional comments you would like to add about your visit today?

9. **Additional Comments**

Appendix N: Example of Visitor Engagement Spreadsheet

KJ 5	Saturday	Family	1 Son 4 y/o	Son 1 y/o	Dad				
Interchange	Ask a ?	Answer a ?	Comment/Explain	Read Silenty	Read Aloud	Play with Exhibit	Specfic Exhibit	1	Spanish
Group Member								2	No
Boy (4)/Dad			1			1	Bus	3	Yes, but didn't open it or look at it yet
Boy (4)/Dad						1	Build a Bus	4	Yes
Boy (4)/Boy (1)Dad						1	Bus: Boy (4) in driver seat	5	7 minutes
Boy (1)/Dad							Build a Bus	6	Yes, Dad liked the 2nd floor displays the most,
Boy (4)						1	Build a Bus	7	Nothing in particular
Total			1	0	0	4			

Appendix O: Interview for Other Museum Staff

Hello, my name is _____, and my group is visiting London Transport Museum from Worcester Polytechnic Institute, to evaluate their Learning Team-led on-gallery activities in order to see how they can be improved for families, overseas visitors, and how they can be used to encourage transitions between one activity to another. We are conducting these interviews to better understand how similar activities are run in surrounding museums. Participation is voluntarily. Would you be willing to answer some questions for us? If you are uncomfortable answering any question, please just tell us so and we will move onto the next question. Could we quote you in our final research paper? [If no, could we quote you using a pseudonym?]

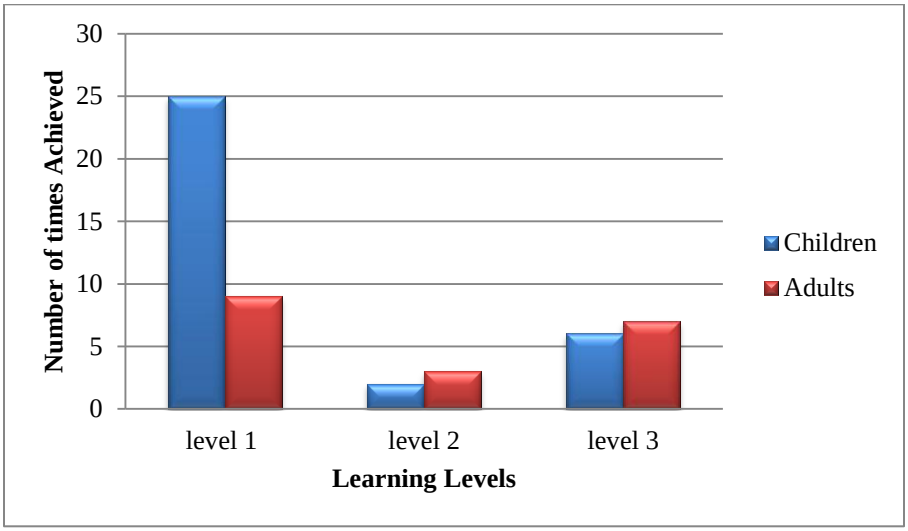
1. How do you draw your audiences' attention to the activities?
2. On average how many visitors attend your museum per day (week day and weekends)?
3. What makes your museum unique from other museums?
4. How do you advertise new activities to try and attract customers?
5. How do you tell if an activity is successful or not?
6. Do you have any forms of feedback from your visitors such as survey questions?
7. What do you feel is the best way to educate your audience, such as reading text, audio systems, or visual displays and monitor screens?
8. Do your staff members highly interact with the visitors?
9. Do you have any tour routes in your museum?
10. Are you able to tell if you have foreign visitors, and do you have any special services for those that may not speak English (such as translators, language selections, multi-language pamphlets)?
11. Do you do anything special to attract families to your museum?
12. Are there any family oriented activities?
13. Is your museum set up to encourage the visitors to travel through all of the galleries?
14. How do you know how much of the museum your visitors experienced?

15. How do you know how engaged or interactive your visitors were with the exhibits or activity sites?
16. Can you tell us about your personal experiences running these activity sites?

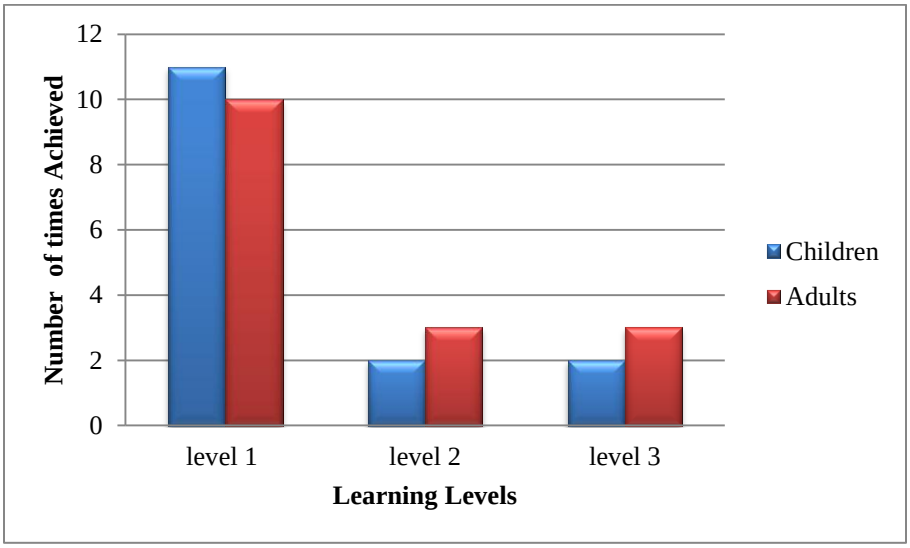
Thank you for your time in answering our questions? Could we contact you if we have any further questions? Can we use you for a reference in our final paper? [If yes, can we have your contact information?]

Appendix P. Results Graphs and Tables

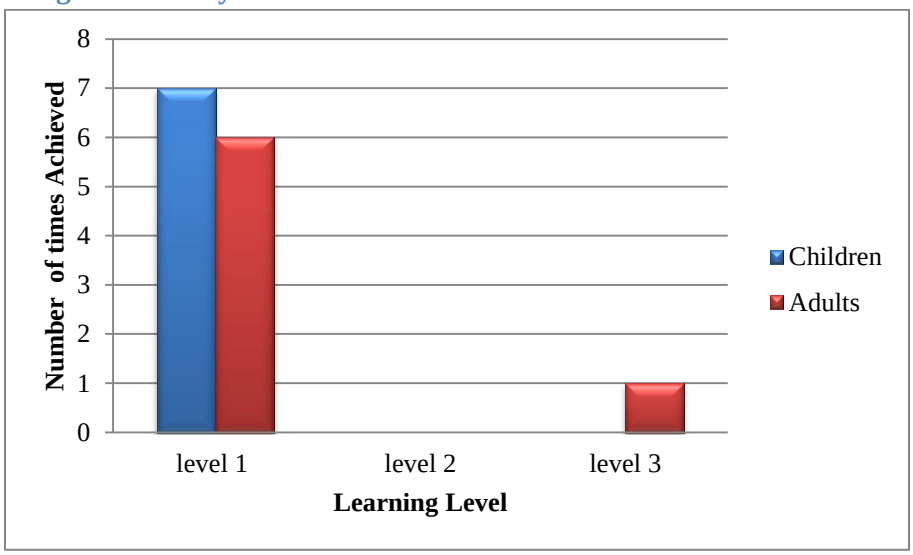
Graph 1. Learning Level of Interchange Bus



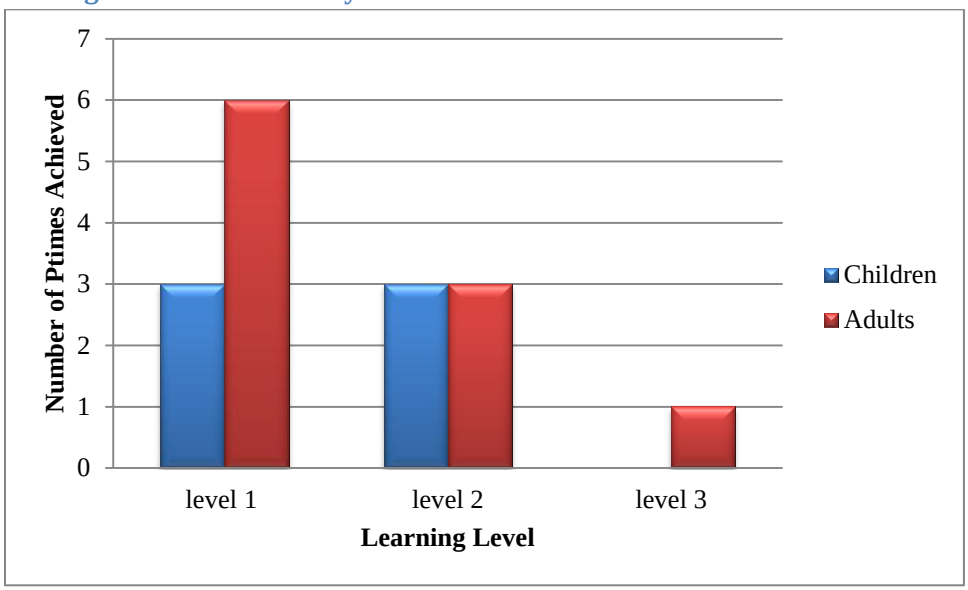
Graph 2. Learning Level of Guess Who?



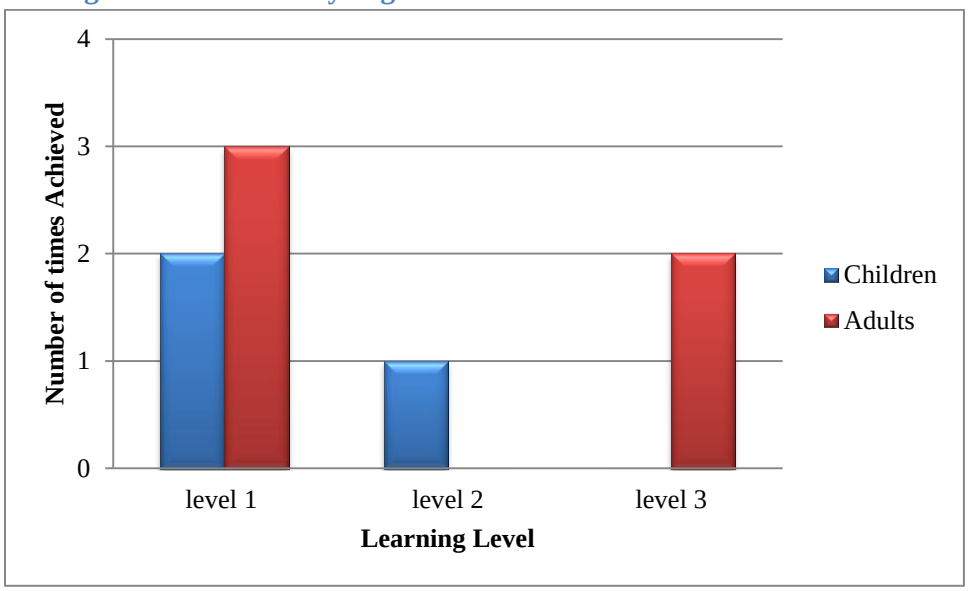
Graph 3. Learning Level of Try me on



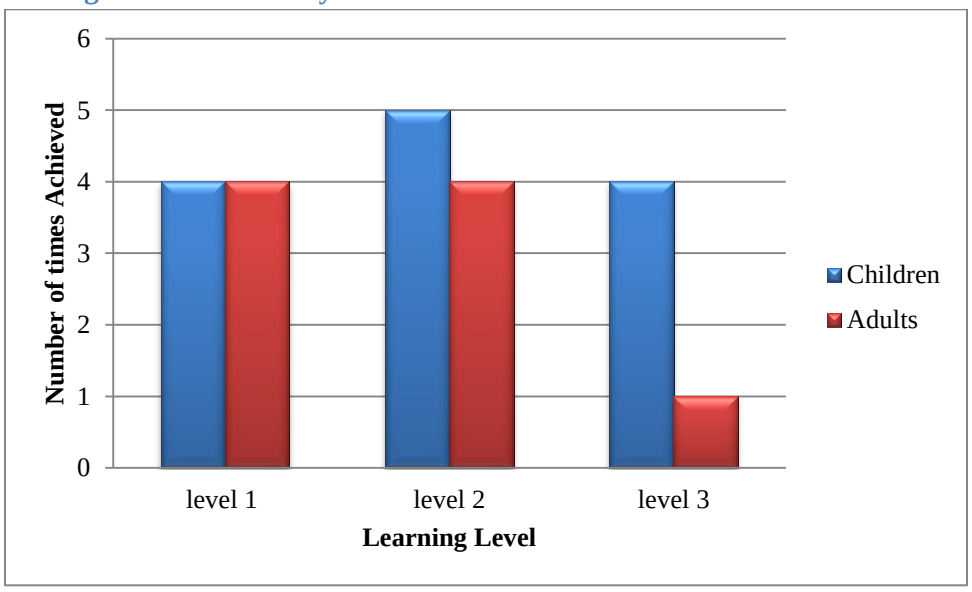
Graph 4. Learning Level of Where do you live? Buttons



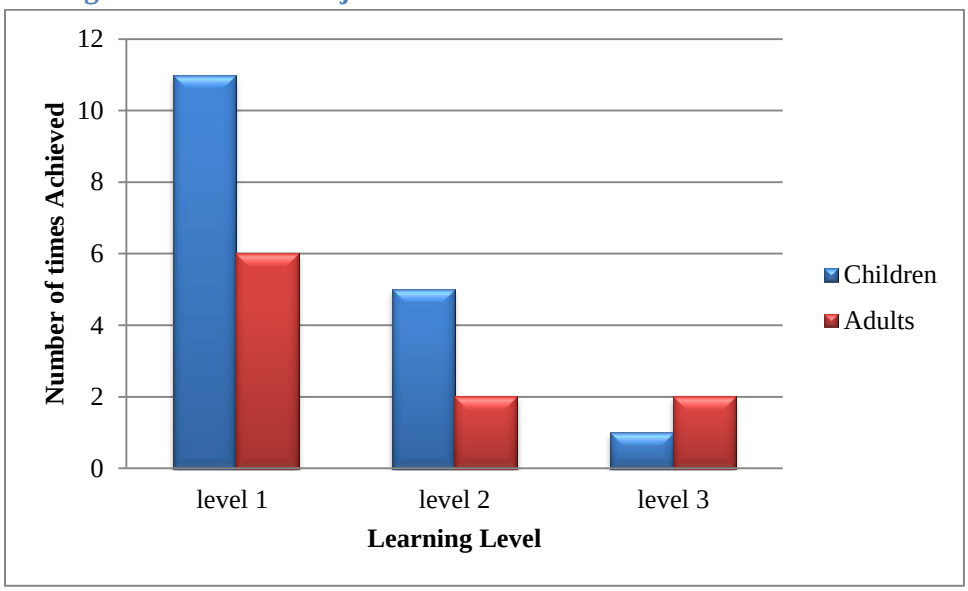
Graph 5. Learning Level of How did you get here? Buttons



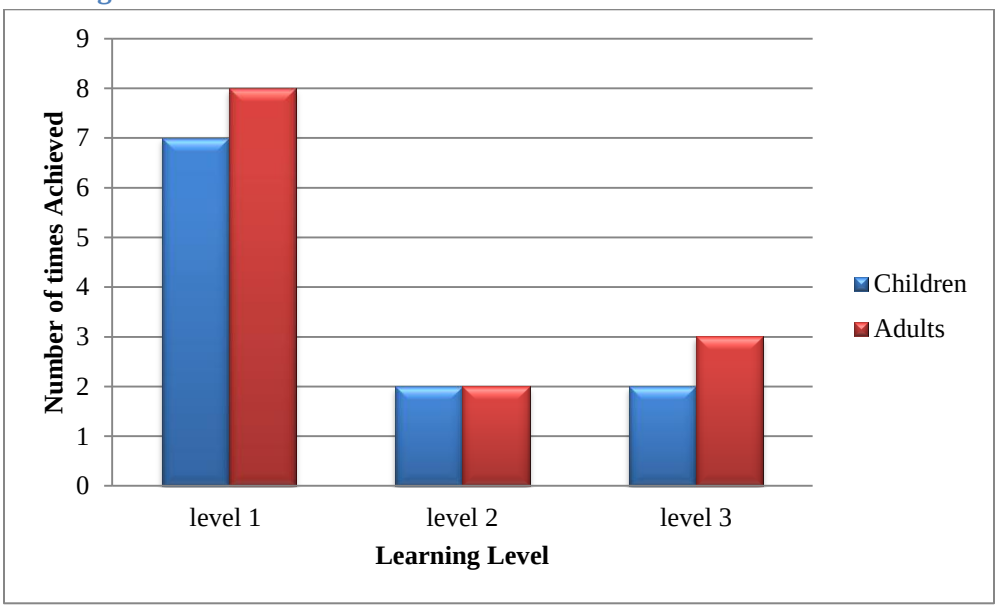
Graph 6. Learning Level of Best Way Buttons



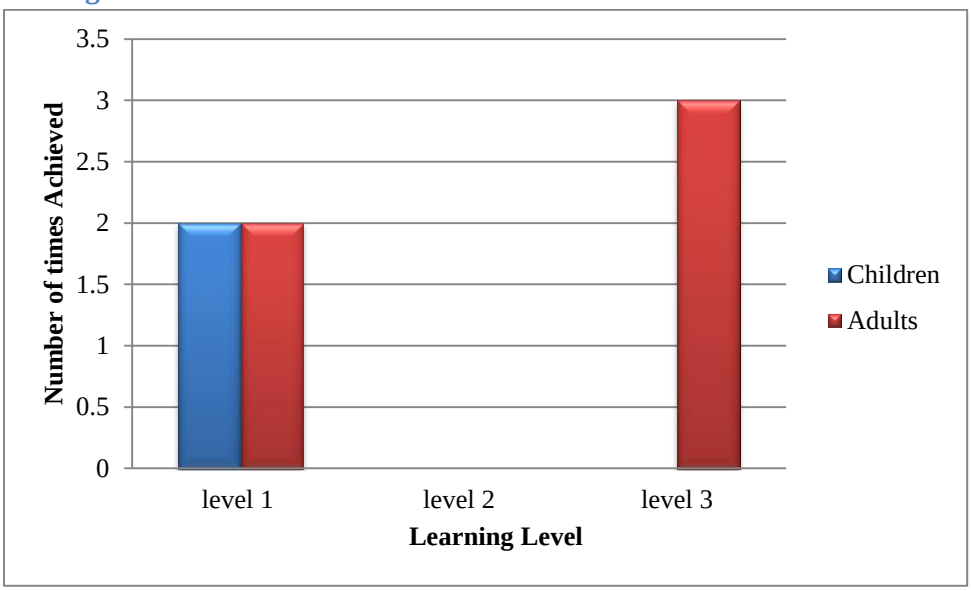
Graph 7. Learning Level of Touch Objects



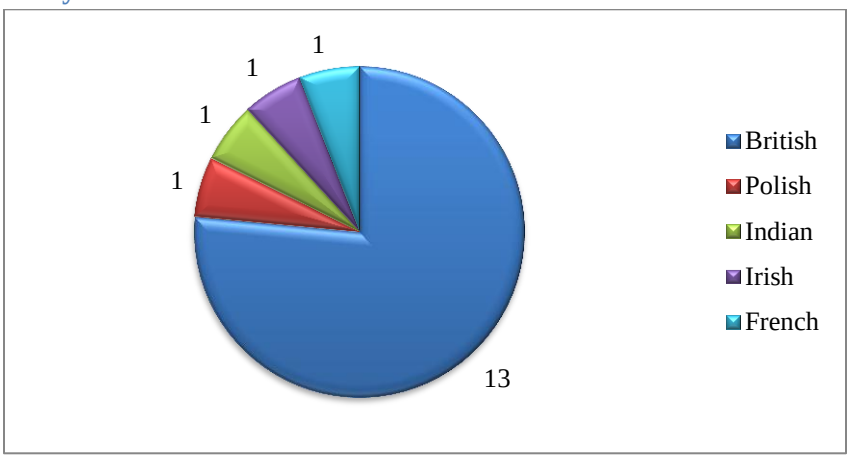
Graph 8. Learning Level of Build a Bus



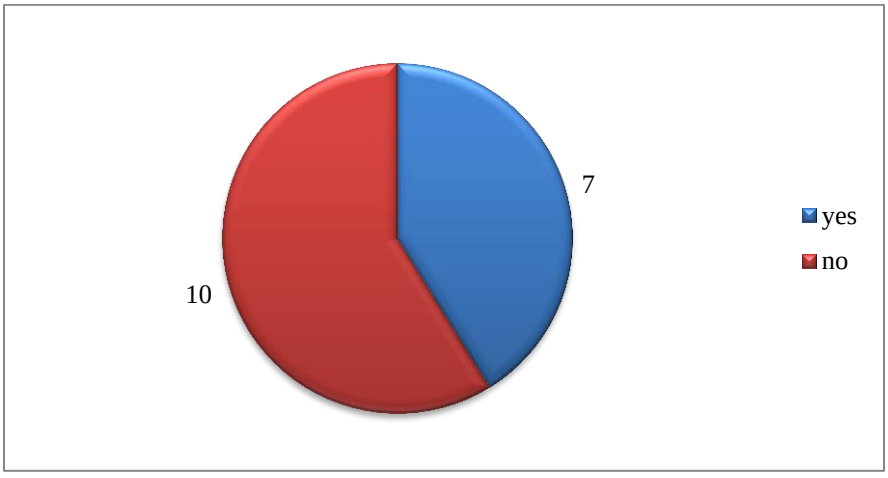
Graph 9. Learning Level of Train Set



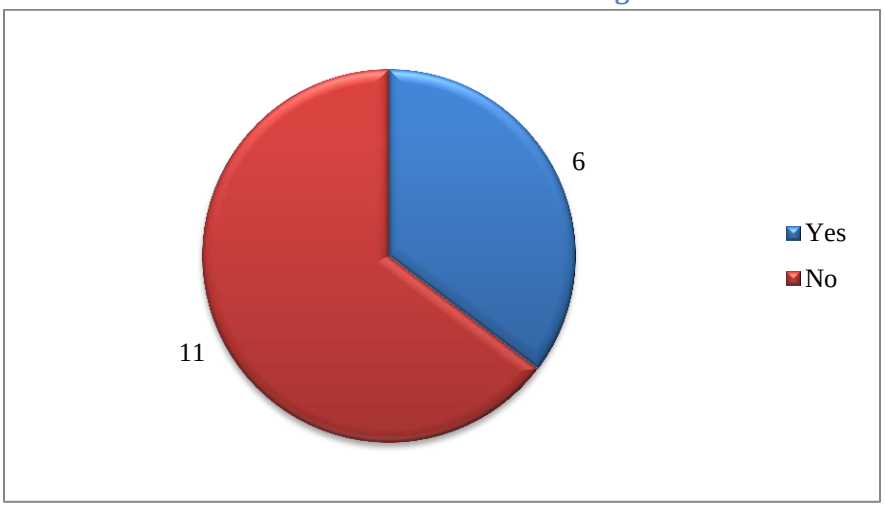
Graph 10. Nationality of Visitors at Make and Take



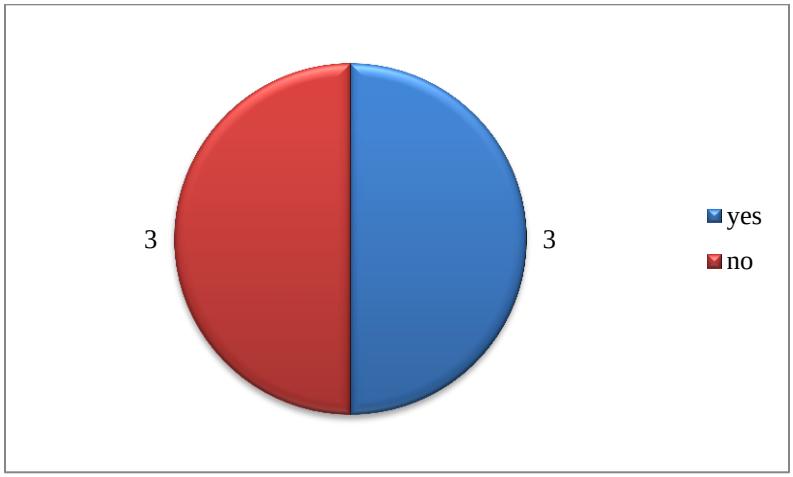
Graph 11. Was This Your First Visit to LTM? (Make and Take)



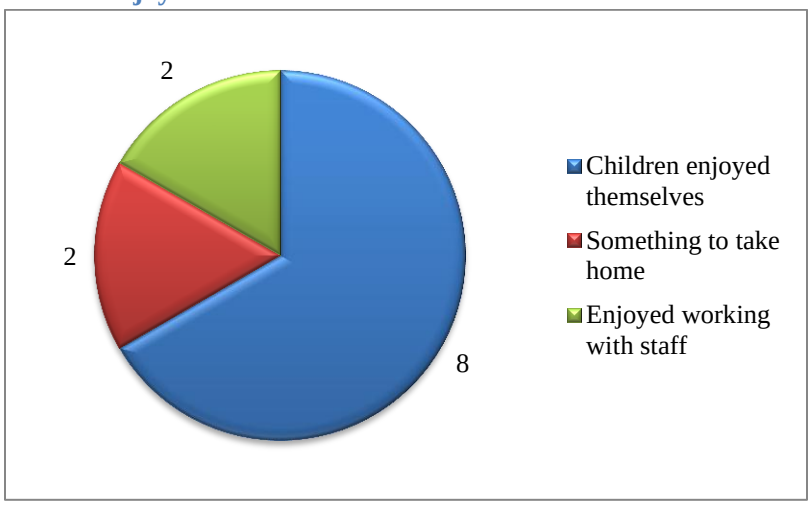
Graph 12. Did You Know About Make and Take Before Coming to LTM



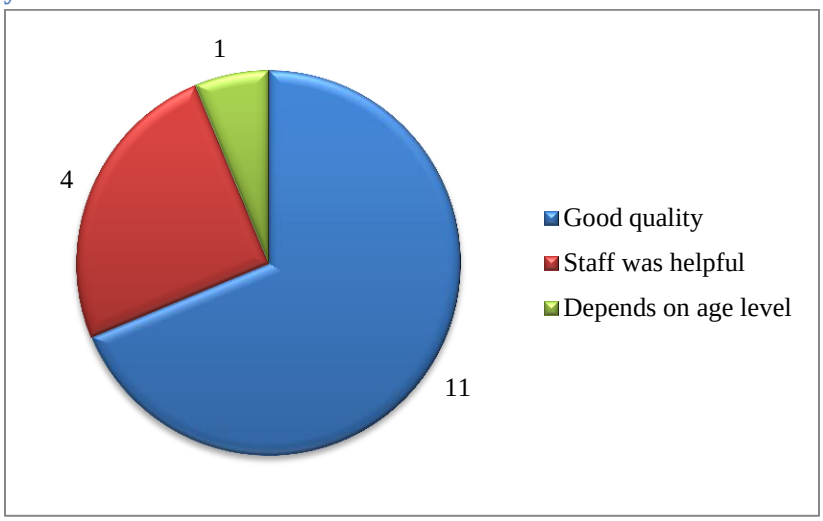
Graph 13. If Known Beforehand, Was Make And Take Reason for Coming to LTM



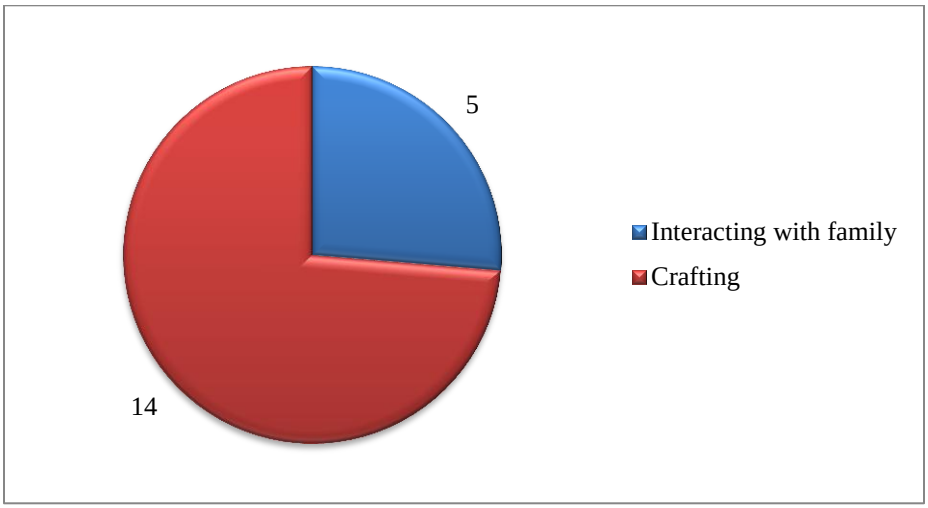
Graph 14. Why Did You Enjoy Make and Take



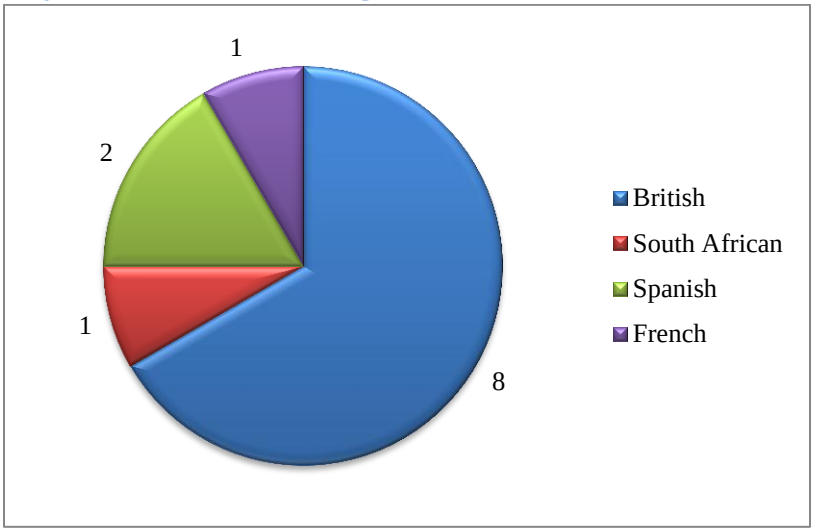
Graph 15. Quality of Make and Take



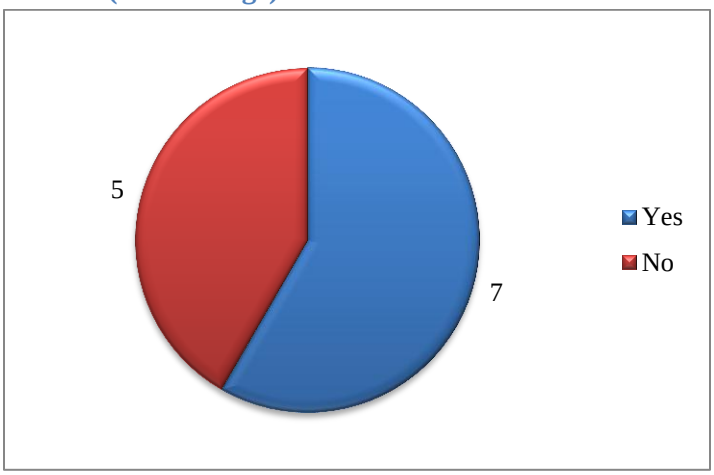
Graph 16. Favorite Part of Make and Take



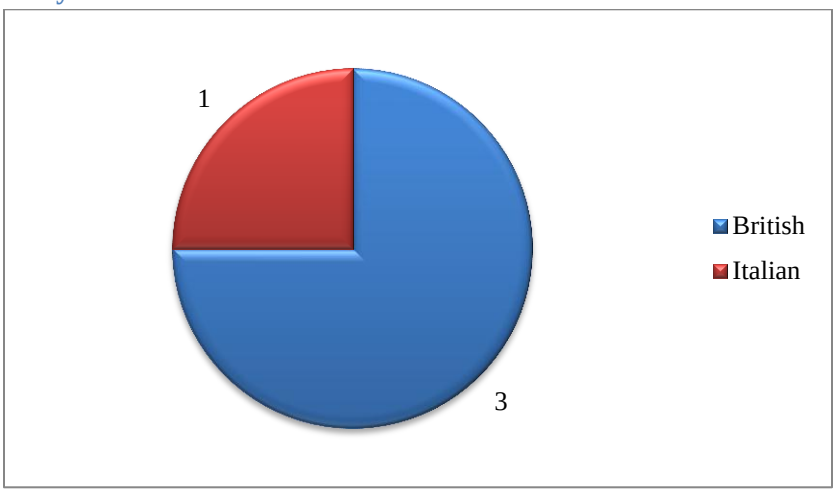
Graph 17. Nationality of Visitors at Interchange



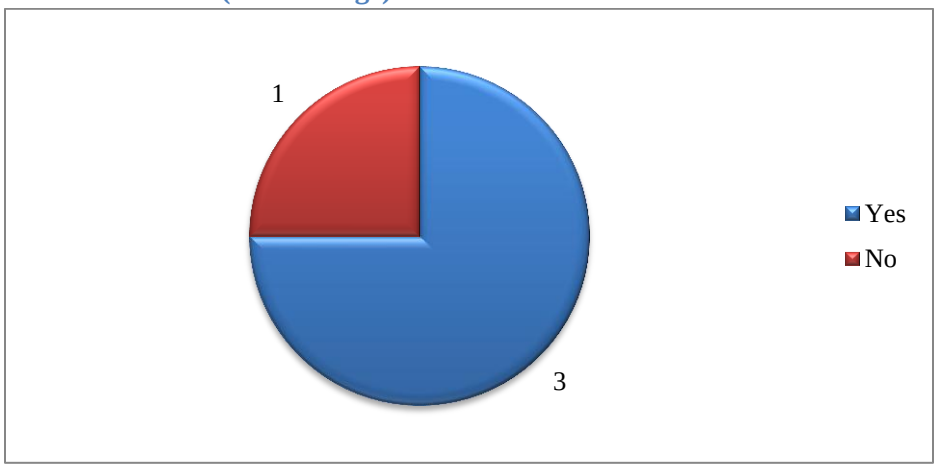
Graph 18. First Visit to LTM (Interchange)



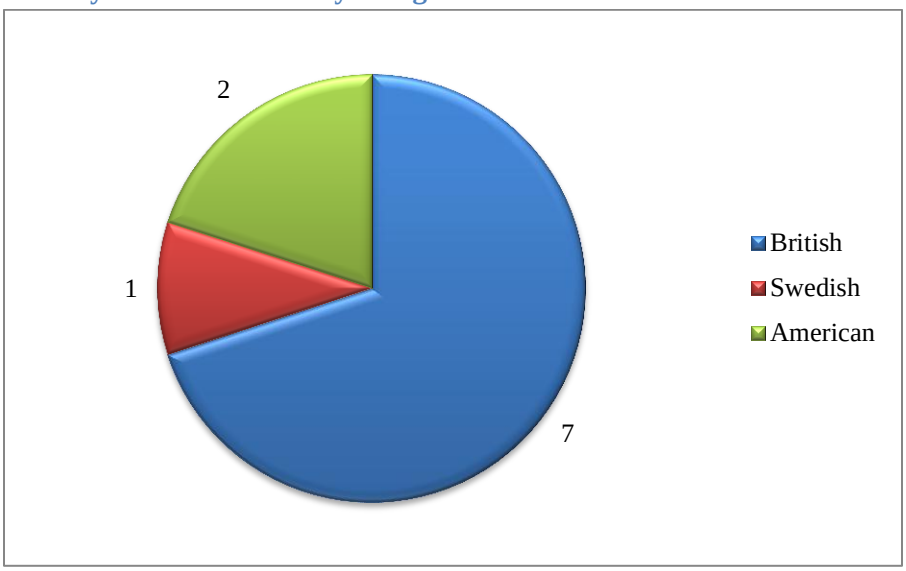
Graph 19. Nationality of Visitors at All Aboard



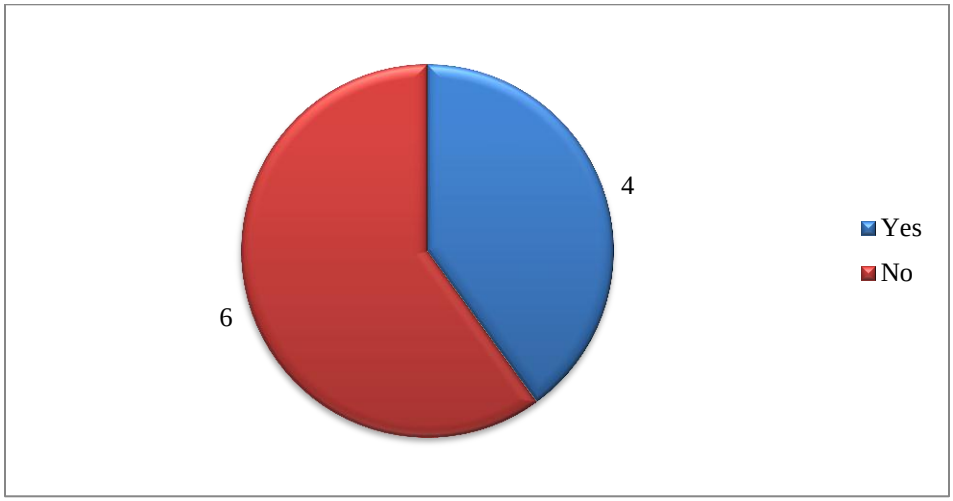
Graph 20. First Visit to LTM (Interchange)



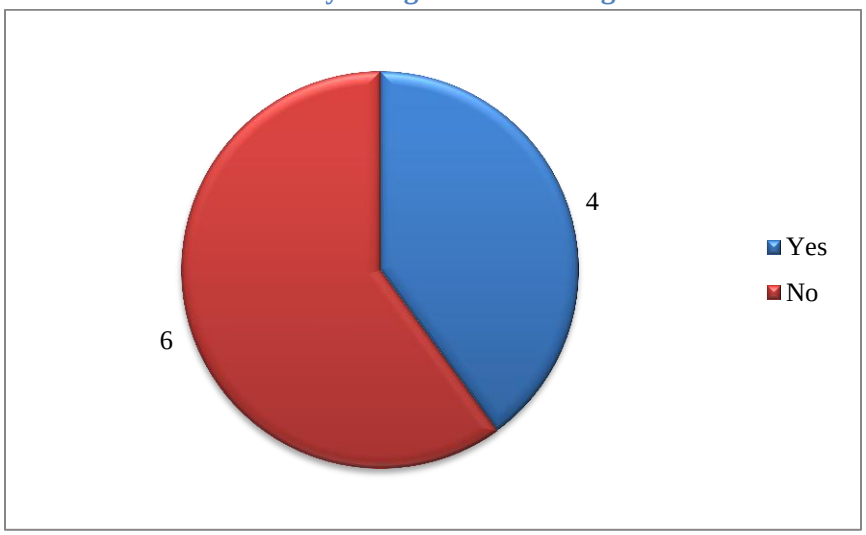
Graph 21. Nationality of Visitors in Storytelling



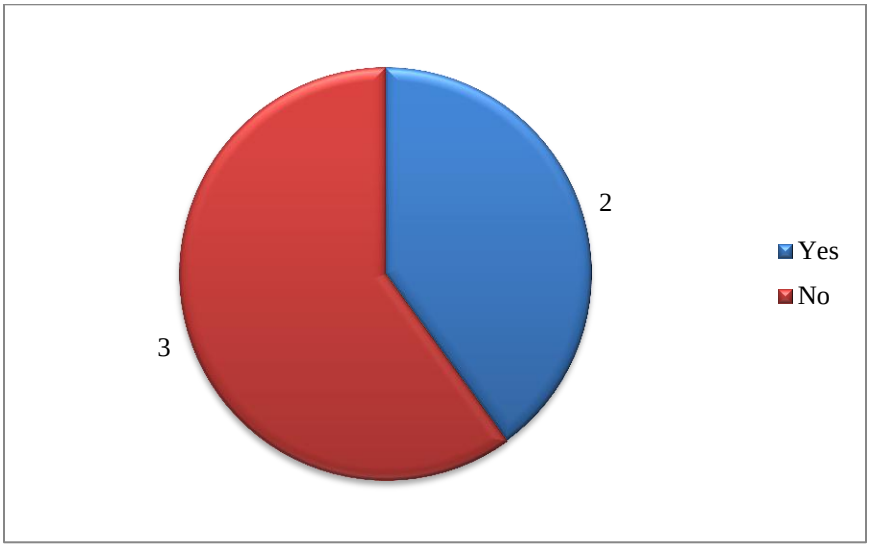
Graph 22. First Visit to LTM (Storytelling)



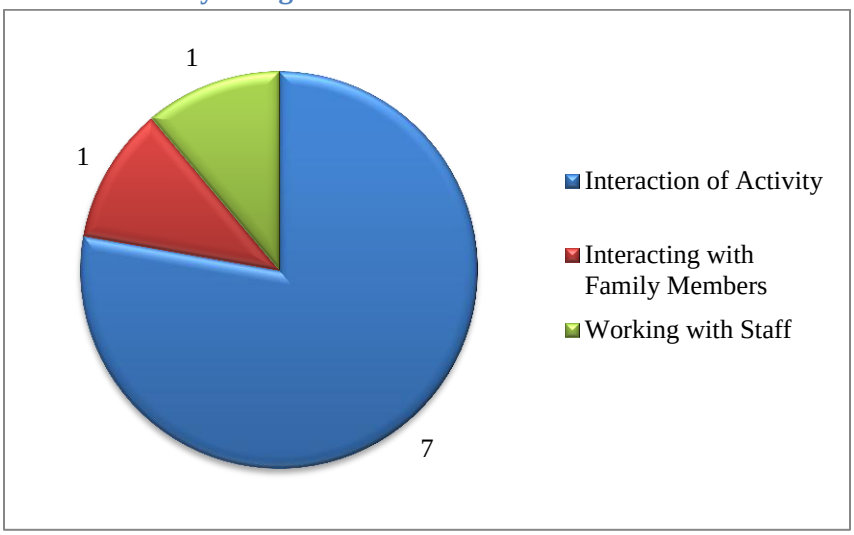
Graph 23. Did Visitors Know About Storytelling Before Coming to LTM



Graph 24. If Know Beforehand, was Storytelling the Reason They Came to LTM



Graph 25. Favorite Part of Storytelling



Graph 26. Illustration Workshop Survey Answers

	Family 1 (mom, 2 boys age 7, 8)	Family 2 (uncle, girl age 14)	Family 3 (boy age 7, girl age 10)
What is your nationality?	British	British	British
Is this your first visit to LTM?	No	No	Yes
Did you know about the activity before coming to LTM?	Yes	Yes	Yes
Was the illustration workshop the reason you came to LTM?	Yes	Yes	No
Did you enjoy the illustration workshop?	Yes, loved the art gallery and big paper	Yes, definitely	Yes, the kids loved it
Did you interact with the staff at this activity?	Yes	Yes	Yes
How was the quality of the activity and staff in charge?	Great quality	It was good	It was brilliant
What was your favorite part of the activity?	Seeing the posters then creating own drawing	Drawing, and different materials	Don't know
Additional comments?	Very fun, would do it again	No	Want more take-home materials from museum

Seven Characteristics for a Successful Exhibit

Interchange	Multi-sided	Multi-user	Accessible	Multi-outcome	Multi-modal	Readable	Relevant
Bus		**X**	**X**	**X**			**X**
Guess Who?	**X**	**X**	**X**				
Build a bus	**X**	**X**		**X**			**X**
Try me on	**X**	**X**	**X**				
Touch Objects		**X**	**X**	**X**		**X**	
Where do you live?		**X**	**X**				**X**
Best Way		**X**	**X**				**X**
How you get here?		**X**	**X**				**X**
All Aboard							
Train Play Set	**X**	**X**					**X**
Vehicles		**X**					**X**
Holiday Activities							
Storytelling	**X**	**X**	**X**	**X**		**X**	**X**
Make and Take	**X**	**X**	**X**	**X**	**X**	**X**	**X**
Illustration Workshop	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Additional Comments from Make and Take Surveys

Make and Take

- Suitable for her daughter, great for kids, lets the adults rest while kids are having fun, going a bit more
- It's really great for the kids
- Great to see something like this, great to get kids involved in public transportation
- Great intro to the stuff used every day and history brings us back to the types of buses we used
- Lots of fun and it was very enjoyable
- It's nice to have stuff for the kids to do
- Enjoyed LTM and the kids had fun
- The kids like having things they can touch and play with
- Very good day out
- Lovely addition to the actual visit to the museum, really enjoyed it
- Really good and informative museum, good for kids
- Really nice and relaxed

Additional Comments from Storytelling Survey

- Storytelling was good, museums don't always have something geared for young children
- Activities are great things for the kids
- Very good
- Great patience with the kids
- The staff highly interacted with the children, and all the children got involved

Additional Comments from Interchange Survey

- Fun, nice museum; thought it was free, kid too young for Interchange
- They come to the museum a lot and love it
- Loves the museum, but expand area for children because it gets crowded, and add more seating for parents
- Museum is wonderful
- Make things work that are supposed to do something
- Want more interactive areas, but liked the audio
- Have a few more exhibits
- Great place
- Would be better if there was more kids stuff

Additional Comments from All Aboard Survey

- Great place
- Loves the museum
- Come to the museum many times, and loves it

Appendix Q. Research Timeline