



**Impact Planning, Evaluation & Audience Research**

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**Formative Evaluation:  
*Places of Invention* Exhibition,  
Round 2**

*Prepared for the*  
**Lemelson Center for the Study of Invention and Innovation,  
National Museum of American History,  
Smithsonian Institution  
Washington, DC**

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# SUMMARY AND RECOMMENDATIONS

## INTRODUCTION

The Lemelson Center for the Study of Invention and Innovation at the Smithsonian's National Museum of American History contracted Randi Korn & Associates, Inc. (RK&A) to conduct a formative evaluation for *Places of Invention*, an exhibition funded by the National Science Foundation. This report presents findings from the second round of formative evaluation for the *Places of Invention* exhibition. The following summary and recommendations are the result of a thorough analysis of the data and is informed by discussions with Lemelson staff and exhibition designers from Roto after each day of testing. As is typical in formative evaluation, there are certain challenges inherent in exploring the objectives while prototypes are under development. When interpreting the findings, we have been careful to consider these challenges to produce a summary and recommendations that are salient.

## SUMMARY OF RESULTS

### MEDICAL ALLEY

Medical Alley functioned well in its prototype form. The interactive was engaging and mostly intuitive. Visitors enjoyed the patient files—saying that they were interesting reads and provided relevant information for completing the interactive. Visitors often used more than one file and interacted with their group members while working on the activity. However, a few visitors thought the exhibit was too easy because, when they removed the first patient file and replaced it with the next patient file, the correct answer was already lit up. Additionally, most visitors did not notice that there were two locations—the Medtronic garage and operating room—and did not grasp the concept that the development of the pacemaker involved the laborious process of working in the garage and then using it in the operating room. Likely, this issue may be remedied by further implementation since Roto has intentions to make the two locations distinct in the final exhibition. In terms of delivering the intended content, the prototype was fairly successful. The majority of visitors took away the idea that pacemakers were unique to individuals, so the current and pulse rate had to be adjusted based on the patient's demographics and health conditions. As with all the interactives, visitors were not reading the text panel about Medical Alley, so their ideas about what this exhibit says about place were cursory and ill-informed (e.g., visitors were making assumptions versus having a clear understanding of what the exhibit had to do with Medical Alley). Despite not reading, however, the patient files helped visitors grasp that the exhibit was about pacemakers of the past—and 1950s in particular.

### THE BRONX

The Bronx interactive exhibit tended to be highly appealing to some and not to others. In contrast to the Medical Alley exhibit, there were some visitors who stood back and observed another group member using the exhibit versus engaging with the exhibit himself or herself. Visitors had some difficulty figuring out how to use the interactive with many issues owing to the prototype format. For instance, visitors reported trouble hearing the scratch and tried adjusting various knobs to solve the issue; this will be resolved in the final exhibition since Roto intends to use an electronic simulation of a turntable that will be more robust than a physical record player. Notably though, some visitors were hesitant in engaging the interactive, to the point that some asked the evaluators if they were allowed to touch the record player since they had been conditioned to be gentle with records and record players;

likely, some apprehensions will be alleviated by replacing the record player with the turntable. Furthermore, findings reveal that the interactive worked best in the video format versus audio-only since visitors wanted to be able to *see* how to use their hand to scratch and, as evidenced by the observation data, needed to see the scratching movement in order to replicate it. Few visitors read the section text; however, visitors talked about the invention in terms of creativity evident in scratching. Additionally, visitors had cursory ideas about what the interactive implied about the Bronx.

## HUB BUILD YOUR OWN PLACE OF INVENTION

Hub Build Your Own Place of Invention proved to be the most problematic interactive, although the discussions around this interactive in daily debriefings and proposed modifications seemed fruitful. The greatest challenge was that visitors struggled to understand the purpose of this exhibit. Children in particular tended to build and make scenes without guidance. During the testing, guiding questions were added to the partition behind the exhibit, although since visitors rarely read them, they did not assist in directing visitors' activities. As a result, visitors often said the interactive was about stop-motion video technology and some even conjectured that it was part of the Hollywood section of the exhibition. Nevertheless, the interactive was very enjoyable for most visitors and the dwell time was respectable, such that it concerned visitors that this interactive would be crowded or require additional computers. In daily debriefings, we continually discussed whether the interactive in its current conceptualization could be modified in a way to promote the outcomes intended by the Lemelson Center, which is for visitors to think about the conditions needed for *their* hypothetical place of invention, such as what people or what resources you'd want accessible. While we were limited in what modifications could be made between days of testing to inform this decision, discussions suggested that Roto can change the exhibit to better support the intended outcomes. Explicit recommendations are below; they include integrating directives into the onscreen prompts (about the purpose of the activity) and including examples of stop-motion videos created by Lemelson staff (filtered to show prime examples).

## OVERALL EXPERIENCE

Unlike in the last round of formative evaluation when the prototypes more fully replicated entire sections of the exhibition, this round of evaluation focused on the interactives with little supplemental materials for context (RK&A, 2013). As such, it was difficult to gauge visitors' understanding of the entire exhibition. Furthermore, it seemed difficult for visitors to grasp the overall concept of the exhibition since they did so little reading during the testing. The idea of "place" emerged when asked what they thought the exhibition intended to show visitors although their ideas were understandably vague. Therefore, we present some of the same recommendations from the last round of evaluation, including further articulating the big idea and threading it through the exhibition.

## RECOMMENDATIONS

### MEDICAL ALLEY PACEMAKER INTERACTIVE

- ◆ Include strong visual clues demarcating the two areas and roles in the Pacemaker Interactive (e.g., Medtronic garage and operating room). As discussed in the daily debriefings, consider physically separating the areas, including objects indicative of the setting (e.g., tool sets in the garage), and generally creating a different vibe for each (e.g., cluttered garage versus sterile operating room).
- ◆ Use the names of the pacemaker inventors in the exhibit setting, such as by hanging a lab coat with Dr. C. Walton Lillehei's name on it.

- ◆ Consider showing an engineering notebook on the garage side of the table, with Earl Bakken's pacemaker circuit drawing(s) on it, to help underscore invention process message.
- ◆ Produce medical files like those in the testing since visitors responded well to the hints and personal information provided.
- ◆ Consider providing a chart showing different demographics' averages for cardiac pulse rate and current.

### THE BRONX SCRATCHING INTERACTIVE

- ◆ Use video instructions versus audio-only instructions since visitors needed visual cues to understand how to move their hand. Consider also adding hints about how to create a scratch successfully (e.g., press the turntable lightly).
- ◆ Consider providing more feedback on users' attempts to replicate various scratches and let them ascend to different levels of difficulty.
- ◆ Visually indicate progress, so that tracks are grayed-out after they've been tried.
- ◆ Limit time between activity steps (e.g., 3 seconds instead of 5 seconds).
- ◆ Use another phrase for "drop a beat," such as "Now experiment on your own to see what scratches you can create!"
- ◆ Consider how to make the inventors, DJs, and the Bronx more prominent through photographs or video montages during the freestyle activity or elsewhere.
- ◆ Consider the best way to more clearly state the objective of the interactive. A few groups felt that the creation of scratching seemed trivial when compared to the importance of the pacemaker.

### HUB BUILD YOUR OWN PLACE OF INVENTION INTERACTIVE

- ◆ Consider rephrasing the direction "Build Your Own Place of Invention" to "Build Your Place of Invention" since it may better connote that you are building the place with conditions ideal for *you* to invent versus simply being able to build something on your own.
- ◆ Include example stop-motion videos around the interactive to cue visitors that they are making a stop-motion film and to provide visual examples to clarify the meaning of build your own place of invention.
- ◆ Integrate some of the questions posed on the partition behind the prototype into the onscreen instructions for the exhibition.
- ◆ Consider providing visitors with specific invention scenarios as well as some sort of randomized prompt.
- ◆ Consider providing hints regarding the number of frames to record as well as to make small movements between frames if the example videos do not seem to alleviate this confusion.
- ◆ Consider the option of making a still photo of your Place of Invention that would be published as a postcard, which visitors could potentially email to themselves.

### OVERALL

- ◆ As recommended in the last round, consider how to introduce the exhibition so the idea of "place" is clearly articulated through text and design. For instance:
  - ❖ Consider defining "place" in the introduction or elsewhere to indicate the complex meaning of *Places of Invention* that NMAH intends.

- ❖ Consider reserving the word “place” to refer to the more complex idea of the exhibition and using the terms “time” and/or “location” as appropriate.
- ❖ Consider how to use maps strategically to emphasize geographic location as well as avoid maps when “place” is intended to represent a broader concept.
- ◆ Consider judicious use of bolding inventors’ names and/or 21<sup>st</sup> century skill words.

## REFERENCES

Randi Korn & Associates, Inc. (2013). *Formative evaluation: “Place of Invention” exhibition, round 2*. Washington, DC: Lemelson Center for the Study of Invention and Innovation, National Museum of American History, Smithsonian Institution.

# INTRODUCTION

The Lemelson Center for the Study of Invention and Innovation at the Smithsonian's National Museum of American History contracted Randi Korn & Associates, Inc. (RK&A) to conduct formative evaluation for *Places of Invention*, an exhibition funded by the National Science Foundation. This report presents data from the second round of evaluation. The Lemelson Center and the exhibition design firm Roto mocked up three interactives with some contextual information: the Pacemaker Interactive for the Medical Alley section, the Scratching Interactive for the Bronx section, and Build Your Own Place of Invention for the Hub section.

The objectives of the evaluation are to explore:

- ◆ How visitors use the prototypes;
- ◆ How visitors interpret the prototypes;
- ◆ Whether there are any barriers to visitors' use of the interactives;
- ◆ Whether visitors understand the relationships among people-place-invention and 21<sup>st</sup> century skills; and
- ◆ How visitors interpret what this exhibition, *Places of Invention*, is about.

## METHODOLOGY

The three prototypes created by the Lemelson Center and Roto were displayed in the 1 East Corridor. The space was stanchioned off to create a singular entrance into the prototype area. The introduction to the entire *Places of Invention* exhibition was displayed outside the space; it included images representing a two-dimensional and three-dimensional layout of the exhibition's six places and the Hub. The photographs on the right provide a general sense of the prototype's scale.



Figure 1. Outside the Prototyping Area

RK&A recruited walk-in adult visitors who were alone or in groups of adults and children to participate in the study. RK&A tried to recruit groups of no more than four individuals given the confined space of the testing area.

Upon agreement, RK&A escorted visitors to the entrance of the prototype area and introduced the exhibition to visitors by name (e.g., *Places of Invention*). RK&A asked visitors to read the introduction panel and asked them a few questions before trying the prototypes. Inside the testing area, RK&A informed visitors

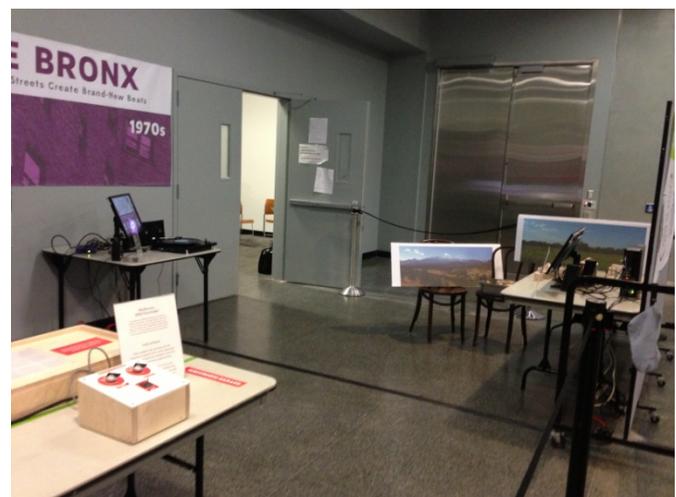


Figure 2. Inside the Prototyping Area

that they would experience just a part of the larger exhibition, and it was created for preliminary feedback (e.g., not finished). They also asked visitors to use all three exhibits as much or as little as they liked. While visitors experienced the prototype area, RK&A took open-ended, handwritten notes on visitors' behaviors and conversations. After visitors completed their experience, RK&A conducted an interview. Visitor groups were asked about two of the three prototypes. See Appendix A for the interview guide. Following the interview, RK&A recorded demographic information, including gender, age, and first-time/repeat visit to NMAH. As a token of appreciation for their participation, each visitor received a Lemelson Center pen.

## **DATA ANALYSIS AND REPORTING METHOD**

Observations and interviews produce descriptive data that are analyzed qualitatively, meaning that the evaluator studies the data for meaningful patterns and, as patterns and trends emerge, groups similar responses. Both observation and interview data are presented as narrative bullets within themed sections versus by methodology. Proportions presented in the report represent groups versus individuals (e.g., one-half of visitor groups versus individuals). Also, keep in mind that the sample size for the interactive-specific interviews is smaller than the overall sample since groups were not specifically asked about each interactive. Where possible, participants' verbatim language (edited for clarity) is included to exemplify trends.

### **SECTIONS OF THE REPORT:**

1. Overall Experiences
2. Medical Alley Pacemaker Interactive
3. The Bronx Scratching Interactive
4. Hub Build Your Own Place of Invention
5. Understanding of Exhibition Messages

# PRINCIPAL FINDINGS

## INTRODUCTION

The *Places of Invention (POI)* prototypes were tested during three weekdays in July. RK&A approached 89 groups of visitors at the National Museum of American History (NMAH), and 48 groups agreed to participate, for a participation rate of 54 percent. The 48 participating groups consisted of 133 visitors. Groups ranged in size from individuals to as many as five visitors; the median group size was three visitors. Two-thirds of groups consisted of adults and children.

Of individual respondents:

- ◆ More than one-half are male (67 participants), and nearly one-half are female (66 participants).
- ◆ More than one-half are adults (78 participants), and almost one-half are children (55 participants).
- ◆ Adult ranged in age from 18 to 80 years, and the median age of adults is 42 years.
- ◆ Children ranged in age from 6 to 17 years, and the median age of children is 11 years.
- ◆ Three-quarters are first-time visitors to NMAH, while one-quarter have visited NMAH previously.
- ◆ Most are United States residents (see Appendix B for Zip Codes of U.S. residents and countries of non-U.S. residents).

## OVERALL EXPERIENCES

In this section, we summarize visitors' general behaviors in the prototype area as well as their initial opinions of their experiences. This section is intentionally general (top-line summary) since the next few sections provide a detailed description of specific prototype components.

- ◆ Upon looking at the introductory panel to the exhibition, many visitor groups talked about place, but the majority shared vague ideas (e.g., "cities where invention happened), while a few said it may explain why invention happened in particular places (e.g., conditions including geography and people that allowed for invention). A few said the exhibition would be about invention in general, and a few others said it would be about technology.
- ◆ Visitors spent the greatest amount of time at Hub Build Your Own Place of Invention, with most visitors spending at least two minutes and some spending more than 10 minutes. Medical Alley had the second longest average dwell time at about three minutes. The Bronx had the lowest average dwell time at about two minutes.
- ◆ Most visitors used all three prototypes.<sup>1</sup>
- ◆ The majority of visitors did not read the section text panels. Relocation of the text panels did not improve reading.

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<sup>1</sup> On a few occasions, the prototype area was crowded, so the visitor group would have to wait to use the third exhibit. Therefore, RK&A interviewed these visitor groups after they had completed just two of three prototypes.

## MEDICAL ALLEY PACEMAKER INTERACTIVE

### PROTOTYPE DESCRIPTION

The Medical Alley Pacemaker Interactive explored the invention of the pacemaker by Dr. C. Walton Lillehei and engineer Earl Bakken. The prototype represented their collaboration by functioning as a two-person activity, with one individual adjusting the settings of an early pacemaker in the Medtronic garage side of the table and another person reviewing patient files and monitoring the pacemaker's effects on the operating room side of the table.

On the operating room side, visitors read 1950s themed patient files which described a patient's age, diagnosis, and treatment, as well as gave hints about the proper pacemaker settings. Visitors were supposed to place files on a light box which functioned as an operating table. On the Medtronic garage side of the table, visitors had to figure out the correct current and pulse rate settings for an individual patient by moving dials and flipping a test switch to view their results. The test switch activated an area of the light box in the operating room to provide feedback for the visitors such as "Well done Doctor," if the settings were correct, or "Heavens, Doctor," if the settings were incorrect.

Based on visitors' use of the activity, several changes to the prototype were made during the test period. For example, on the first day of testing, data collectors inquired what visitors had learned about amplitude and frequency. This question was modified for the second and third days of testing to ask what visitors learned about current and pulse rate—the labels associated with the pacemaker dials. In addition, on the first and second days of testing, the activity was set up so visitors at the operating room and Medtronic garage stood on opposite sides of the table, facing each other. To determine if this set up affected how visitors used the activity, the operating table and Medtronic garage were re-oriented on the third day of testing so that visitors stood next to each other on the same side of the table and faced the same direction while using the activity.

### FINDINGS

How visitors used the exhibit (from observations and interviews):

- ◆ On average visitors spent approximately three minutes at Medical Alley, the second longest dwell time among the three prototypes.
- ◆ About two-thirds of visitor groups described their behavior at the activity as figuring out and adjusting the setting of the pacemaker, with several saying they used trial and error to determine the correct settings.
- ◆ About one-third said they viewed more than two patient folders when using the activity; nearly one-third viewed two folders, and about one-quarter viewed only one folder.
- ◆ Nearly one-half were observed or reported reading the directional text placed on the table near the activity.
- ◆ Several were observed or reported reading the section text about Medical Alley.
- ◆ Several observed visitors oriented the folder on the light box incorrectly, thus giving them inaccurate feedback.

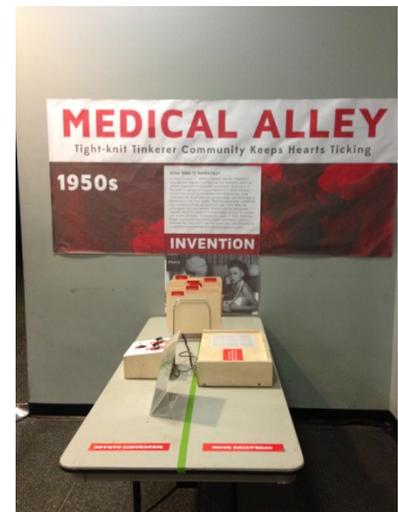


Figure 3. Medical Alley Pacemaker Interactive Day 2

- ◆ Several observed visitor groups either moved the pacemaker to the operating room side to manipulate the dials or reached across the table from the operating room side to the Medtronic garage side to manipulate the dials.
- ◆ Two interviewees, both children, used the activity in a way other than what was intended; they believed the purpose of the activity was to guess which area of the light box would light up based on moving the dials.

#### Most enjoyable aspects:

- ◆ More than one-half of visitor groups enjoyed the goal of the game: working to save a patient's life. One-third particularly liked the challenge of figuring out the correct settings on the pacemaker, while nearly one-quarter liked pretending to be a doctor.
- ◆ Nearly one-third liked the interactive nature of the activity, being able to turn dials and flip the test switch.
- ◆ Nearly one-third liked that the activity provided feedback such as "Good job, Doctor" or "Oh no, Doctor." As one man said, "You got results and knew if you were doing it right or wrong."
- ◆ Nearly one-quarter liked that the activity was generally educational.

#### Least enjoyable aspects:

- ◆ Slightly more than one-third of visitor groups could not find anything they didn't like about the activity.
- ◆ One-third wanted the exhibit to contain more information, such as directions for what to do at the activity and additional hints about how to adjust the settings on the pacemaker for individual patients. For example, one man said, "It wasn't explained the best; [the instructions] could have broken it down more than it did. He's nine and he couldn't understand the instructions."
- ◆ A few wanted the exhibit to provide more historical information and context about the pacemaker, with one woman saying, "There was a little bit of an explanation [on] how it was invented, but it wasn't enough. I would probably want to see the stories of real people who had the medical conditions . . . or maybe more about the inventor."

#### Confusing or hard to understand aspects:

- ◆ Nearly one-half of visitor groups said they could understand the activity.
- ◆ About one-third said they were confused as to what to do at the activity, with several saying they had to carefully read the patient file to determine which settings to use or that they did not know immediately to place the folder on the light box.
- ◆ One found it confusing that the light box remained lit after testing until the pacemaker dials were turned.

#### Intriguing aspects/piquing visitors' interest:

- ◆ One-quarter of visitor groups were interested in the pacemaker, including its technological evolution and the relationship between current and pulse rates. For example, one girl said, "I thought it was kind of interesting to see what the different dials did and how it would [have a] result in the patient."
- ◆ About one-quarter others said nothing about the activity piqued their interest.

- ◆ A few were intrigued by the interactive because of their prior interest in medicine, the interactive nature of the activity, or the challenge of figuring out the correct pacemaker settings.
- Awareness and opinion of using the two sides of the exhibit—Medtronic garage and operating room:<sup>2</sup>
- ◆ When tested on Day 1 and Day 2, when the two sides of the exhibit were on opposite sides of the table:
    - ❖ More than one-half of interviewees—nearly all of whom used the activity with others—used the two different sides of the activity, with several saying it was apparent that the activity was meant to be used by two people. For example, one boy said, “I guess it is designed for a person to be on other side . . . because otherwise, there would be no point to have the other part upside-down.”
    - ❖ Less than one-half used the activity from only one side of the table, some of whom used the activity individually and some of whom used it in a group; several placed the patient file on the operating table incorrectly so it was readable from the garage side and a few each reoriented the pacemaker to face them at the doctor’s side or turned the pacemaker dials from the doctor’s side without reorienting.
    - ❖ When probed further, several mentioned that they did not like the setup of the activity, that it was designed for two people to use, or that it required moving to different sides of the table.
  - ◆ When tested on Day 3, when the two sides of the exhibit were adjacent to each other on the same side of the table:
    - ❖ Nearly two-thirds of interviewees indicated that they were unaware that the two sides of the table.
    - ❖ A little more than one-third were aware that the two sides of the table.
    - ❖ Two visitor groups used the interactive as follows: one person selected a file and adjusted the pacemaker and then the next visitor selected a file and adjusted the pacemaker (e.g., never using the exhibit together).
  - ◆ Visitors’ awareness of the function of the two sides of the table (Medtronic garage versus operating room) did not differ greatly based on testing setup; some interviewees for each setup were unaware that there were two different sides to the activity.

#### Opinion of the patient cards:

- ◆ Many interviewees said they had enough information to use the activity, with about one-quarter saying that they used the patient’s personal characteristics, such as age, weight, and medical diagnosis to set the pacemaker.
- ◆ About one-quarter also mentioned using the doctor’s notes, found in red-colored script at the end of the patient’s file, as a way of determining the correct pacemaker settings. For example, one boy said, “I had to read closely the doctor’s notes because if I didn’t, I might make the heart too high or the pulse too low and the patient’s heart might go completely out of whack.”
- ◆ Several also liked the personal nature of the patient files and referred to patients they worked on by name during the interview, with baby Frank being mentioned most often.
- ◆ Alternatively, several others thought that the patient files had too much to read, especially if the activity was crowded.

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<sup>2</sup> On the first and second day of testing, the pacemaker and operating table were set up on opposite sides of the table, so that ideally one visitor was on each side, facing each other while using the activity (see image on previous page). On the third day, the activity was set up so that visitors could stand next to each other and face the same direction when using the activity.

Interpretation of the interactive’s message (what it is trying to show or tell them):

- ◆ One-third of interviewees described the activity’s message as being about “basic medical technology” and “the history of medicine.”
- ◆ About one-quarter said that pacemaker settings were unique for each individual, depending on factors like age, gender, weight, and fitness level.
- ◆ Nearly one-quarter others identified the theme as one of the following: pacemakers can save lives, about pacemakers and how they work, or that pacemakers can be used for patients with different symptoms.
- ◆ A few took away messages having to do with inventions, such as the challenges of inventing or that anyone can be an inventor.

What they learned about current and pulse rate:<sup>3</sup>

- ◆ About three-quarters of interviewees learned that current and pulse rate settings vary from person to person, with several mentioning characteristics like age, weight, gender, activity level, and health, and a few providing tips on low versus high current and pulse-rate levels.
- ◆ One-quarter said they learned nothing about current and pulse rates or were unclear about what they had learned

What the interactive represents about Medical Alley:<sup>4</sup>

- ◆ Slightly more than one-third said they did not know what the activity was intended to represent about the place where it was invented.
- ◆ Slightly more than one-third connected the activity to invention, with ideas ranging from the specific (e.g., the history of the pacemaker as an invention) to the general (e.g., that anyone can invent or that inventions can be made anywhere).
- ◆ Nearly one-quarter connected the activity with medical aspects, such as the history of medicine or learning about diagnoses and treatments.

## THE BRONX SCRATCHING INTERACTIVE

### PROTOTYPE DESCRIPTION

The Bronx Scratching Interactive was displayed on a table underneath the Bronx Invention text panel. The table featured a turntable (record player) and speakers, a touch-screen monitor, and printed instructions. The instructions gave visitors background information on scratching (“done by holding and moving a record under the needle while the record is playing.”) and invited them to “try [their] hand at scratching.” The touch-screen monitor offered five scratch tracks that visitors could listen to and try to copy on the



Figure 4. The Bronx Scratching Interactive Day 1

<sup>3</sup> On the first day of testing, the question asked about amplitude and frequency; however, nearly one-half of interviewees said they did not learn anything about amplitude or frequency. As a result, the question was changed on the second day to use the terms current and pulse rate in order to reflect the terms used on the Pacemaker Interactive. The findings above represent data from the second and third days of data collection.

<sup>4</sup> A specific question was added on the second day of testing to address this idea.

turntable. These scratch tracks got progressively more difficult. Each scratch track demonstrated the scratch three times, with time between each demonstration for visitors to try the scratch. At the end of each scratch track, visitors were invited to “drop a beat” or “experiment” on their own. Following the first day of testing, the prompt at the end of each scratch track was changed to “Now experiment on your own to see what scratches you can create!” The scratch tracks were available as audio-only tracks and video tracks. For the first day and a half of testing, visitors used the video tracks. For the remainder of the testing period, visitors used the audio-only tracks.

The prototype set-up remained similar across all three days of testing; however a few small changes were made. The photograph above shows the prototype on the first day of testing. On the second and third days of testing, the text panel was placed more directly above the Scratching Interactive. Additionally, between the first and second days of testing, additional background on the invention of scratching was added to the instructions for context.

## FINDINGS

How visitors used the exhibit (from observations and interviews):

- ◆ On average visitors spent approximately two minutes at the Bronx, the shortest dwell time among the three prototypes.
- ◆ Almost two-thirds of visitor groups were observed trying at least two tracks. At least one visitor group was observed trying as many as four of the five available tracks.
- ◆ More than one-half of visitor groups said that they were “trying to be a DJ” or “just learned how to scratch” at this interactive. A few of these groups also talked about changing the music and making different sounds. Almost one-half said that they were copying what they heard on the computer as they completed the interactive.
- ◆ Almost one-half were observed reading the instructional text at some point while using the Scratching Interactive.
- ◆ Slightly less than one-quarter were observed reading the text panel that explained the context of scratching and the Bronx. Changing the placement of the text panel between Day 1 and Day 2 did not appear to affect how many visitor groups read the text.
- ◆ More than one-third were observed moving the needle across the record to generate a scratching noise, rather than using their hand to create the sound. The majority of these instances occurred with visitor groups who experienced the audio-only files.
- ◆ Almost one-fifth pushed too hard on the record to make an audible scratch, or to complete the scratch successfully, often tilting the record up or dislodging it from the record player all together.
- ◆ Just over one-quarter were observed freestyling at some point while using the Scratching Interactive.
- ◆ A few interviewed groups were unsure about whether they could touch the record player.
- ◆ A few interviewed groups said that the interactive was difficult to complete because the music playing on the record player was too soft, making it hard to hear the scratch that was being made. For example, one woman said, “The problem was you could hear the base track, you couldn’t hear the scratching. . . . You were trying to interact, but you couldn’t really hear what you were doing because the scratching feed was so soft.”
- ◆ During the interview, two groups said that the objective of the interactive was not clear to them.

#### Most enjoyable aspects:

- ◆ Almost one-half of visitor groups talked about the experience of trying to be a DJ. Several said they never had the opportunity to scratch a record before, but had seen it on television and in movies. A few talked about the first-hand experience of scratching the record. In particular, a few adult respondents talked about the fact that scratching records was not something they could do at home, so there was a certain joy in doing that. For example, one woman said, “It was fun to actually be able to scratch because you didn’t want to do it to your own records growing up.”
- ◆ One-fifth said the most enjoyable aspect was the sounds that could be produced through scratching. For example, one boy said, “I thought it was interesting how you could get different textures of noises and different sounds out of one machine.”
- ◆ One-fifth said they enjoyed that they could touch the record player and try scratching.
- ◆ A few said they enjoyed the music. For example, one woman said, “The music. It is from my time, so I grew up with that kind of music.”

#### Least enjoyable aspects:

- ◆ One-fifth of visitor groups said that they found the interactive enjoyable.
- ◆ One-fifth said they did not like that it was difficult to hear the scratch pattern they were creating. These respondents wanted the sound of the scratching to be louder.
- ◆ Several said they wished there was more to do at the interactive. For example, one man said, “I think it needed more variety. It was kind of a one-hit wonder.”
- ◆ Several also said the instructions needed to be clearer. These respondents often talked about being unsure of how to start and how hard to touch the turntable when scratching.
- ◆ Several disliked that there was no feedback to let respondents know whether they were matching the scratch accurately.
- ◆ A few talked about issues tied specifically to the prototype that will not occur in the final exhibition, such as the music playing while they were trying to scratch.
- ◆ Two groups said they wanted more information about the Bronx. For example, one man said, “It could have had more background; it just said the Bronx. And I didn’t catch much more history. It could have had names or places.”
- ◆ One group who experienced the audio-only version of the interactive wanted “a demonstration of the different sounds and how to move the record.”
- ◆ One man did not like that there was only one turntable. When they tested the prototype, all five members of the group were observed trying to scratch the record at one time.

#### Confusing or hard to understand aspects:

- ◆ More than one-third of visitors groups said they understood everything.
- ◆ Almost one-quarter talked about aspects of the prototype that will not appear in the final exhibition, such as the need to replace the needle on the record, or uncertainty about the iPod dock’s purpose.
- ◆ Almost one-fifth said they were confused about where to scratch the record. All of these visitor groups experienced the interactive with audio-only instructions.

- ◆ A few said they were confused about whether they should touch the turntable and the touch screen.
- ◆ A few said the long intervals between scratch examples were confusing to them. For example, one man said, “It took a long time for the screen, to wait for the next track, so I think you lost interest. . . . It would be better if you would be able to hit the button again to try again rather than have to wait to hear it again.”

#### Opinion of the difficulty of scratching

- ◆ One-half felt that the interactive was easy to complete, although a few of these groups qualified their assessment by saying that the concept was easy to understand, but it was difficult to successfully copy the scratch in the demonstration. Several said that the interactive was difficult, with most of these respondents saying that it was difficult to know where to touch the record to successfully match the scratch.

#### Intriguing aspects/piquing visitors’ interest:

- ◆ More than one-half said being able to actually scratch the record piqued their interest. A few of these groups said that record scratching was something they had wanted to try before. For example, one boy said, “I always thought DJs were cool and stuff, and [to] have an opportunity to try and by a DJ, it would be fun.” Two groups also talked about the different sounds that scratching the record could create. For example, one boy said, “I thought it was interesting to see how many different sounds you could make with just a record.”
- ◆ A few groups said the music or the musical topic piqued their interest. For example, one man said, “It was a good record.” Another man said, “We both have an interest in music, a natural curiosity to play around with anything musical.”
- ◆ A few said the interactivity piqued their interest.
- ◆ Two groups said the record player/turntable piqued their interest. For example, one girl said, “It was just something I had never seen before.” Her mother added, “You had never seen a record player.”

#### Opinion of the audio and video instructions:<sup>5</sup>

- ◆ Of those interviewees who experienced the video instructions:
  - ❖ One-half of visitor groups thought the clips were easy to copy and the instructions were helpful. For example, one boy said, “It was easy to understand. Not, like, you have to do this and that and press down this much.” Another woman said, “I thought it was good because instead of saying ‘Move your hand left, right, left, right,’ it showed you what you were supposed to do. You had a live example.”
  - ❖ A few suggested offering on-screen, written instructions as well as the video instructions (e.g., “Maybe that should be stated in words at the top or bottom of the screen, ‘Watch her hand motion and repeat her pattern.’”).
  - ❖ Two said that the video instructions were unnecessary. For example, one boy said, “I didn’t need to see a video of a guy moving his hand.”
- ◆ Of those interviewees who experienced the audio-only instructions:

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<sup>5</sup> On the first day and half of the second day of testing, the interactive was tested with the video instructions. After that, it was tested with the audio instructions.

- ❖ Almost one-half of talked about how difficult it was to copy the clips. (By comparison, none of the visitor groups who had the video instructions talked about the difficulty of copying the clips).
- ❖ Less than one-third said that the instructions were helpful or long enough. For example, one boy said, “[The length] was good. [It] gave you enough time to try it.”
- ❖ None specifically requested video instructions, but one man said, “Was there video trying to show you how to do it?”
- ◆ Of all interviewees:
  - ❖ A few groups suggested providing feedback to tell visitors if they are completing the scratch correctly or incorrectly.
  - ❖ One group suggested indicating which tracks have already been selected by a visitor group so that they move through the sequence in order (e.g., “Maybe it should be grayed out when you have completed it so you don’t lose your place in these things.”);

#### Understanding of the “drop the beat” prompt<sup>6</sup>

- ◆ More than one-half believed that “drop the beat” was an invitation to try scratching on their own, but they were unsure of the specific meaning. For example, one boy said, “I think I have heard it before, but I don’t have an extremely clear idea of what it means. I think it means try it out for yourself, but I wasn’t entirely sure about that.”
- ◆ One-quarter understood the meaning of “drop the beat.” For example, one man said, “It meant you could freestyle the beat.”
- ◆ One group was unclear on the meaning and was not able to guess what the phrase meant.

#### Interpretation of the interactive’s message (what it is trying to show or tell them):

- ◆ Almost one-half of visitor groups said the Museum was trying to show or tell them how new ideas are created. Several of these groups specifically mentioned that scratching was created using technology or music that already existed, but using it in a new way. For example, one woman said, “It layered concepts on top of each other. It took existing music, layered it with the scratching and invented a new sound.” A few other groups mentioned that scratching allowed people to create new sounds without the use of other technology like synthesizers. For example, one boy said, “How to create different affects and different sounds without something like a synthesizer that is programmed with thousands of different noises.”
- ◆ More than one-third said the interactive was trying to show or tell them about the evolution of music and music history. Some of these groups specifically spoke about the history of scratching. For example, one man said, “I thought its purpose was just seeing where music started from and seeing how far it has come [in] this age.”
- ◆ Almost one-quarter said the interactive showed or told them about what it was like in the Bronx in the 1970s. For example, one woman said, “I think they were trying to show me how stuff would work in and what you would do in the Bronx, NY. . . . It kind of feels like you are there.” Overall these people spoke in a general way and did not offer specific examples from the wall text.
- ◆ A few said the interactive showed or told them about how to scratch a record.

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<sup>6</sup> A specific question was added on the second day of testing to address this question. The “drop the beat” prompt was removed later that day.

What the interactive represents about the Bronx:<sup>7</sup>

- ◆ More than one-third of visitor groups did not draw a connection between the interactive and the representation of the Bronx.
- ◆ Less than one-third talked about the Bronx as the place where scratching originated, with a few of these groups specifically talking about the music that was created on the streets. For example, one woman said, “There were street kids who may[be] didn’t go to colleges, but they had musical experience, and they changed the music industry with just this simple stuff. And their innovations went around the world.”
- ◆ One-fifth offered idiosyncratic responses that often were not tied to the idea of place of invention. For example, one woman said, “Just their love for music and [an] expression of their creativity, maybe.”
- ◆ A few talked about changes in music, although these responses were generally not tied to the idea of place. For example, one boy said, “There were a lot of musicians and there were songs and they wanted to make a remix out of it.” Another girl said, “They loved music and they wanted to [make] different kinds.” This girl’s mother added, “They took risks, experimented. They were probably told not to scratch the record, either.”

## HUB BUILD YOUR OWN PLACE OF INVENTION

### PROTOTYPE DESCRIPTION

Build Your Own Place of Invention was displayed on a folding table. A computer monitor prompted visitors to enter their name to start. The next screen instructed visitors: “To begin building your own Place of Invention, use the buildings and people pieces in the bin. Hit ‘RECORD A FRAME’ at anytime to capture a portion of your video. Hit ‘PLAY YOUR MOVIE’ to see your Place of Invention playback.” There were various blocks available for visitors to use including some labeled “museum,” “university,” “bank,” and “tavern” as well as unlabeled building blocks. Additionally, there were some wooden people, including some labeled “entrepreneur,” “professor,” and “kid” as well as unlabeled people. There were also five different backdrops from which visitors could choose.

After the first day of testing, questions were posted up on the wall partition behind the computer. Questions included, “Who would be on your invention team? A scientist? An artist? A mechanic?” and “Where do you feel creative? A coffee shop? A museum? A garage?” Additionally, halfway through the second day of testing, the prompt to enter an invention name was removed.



Figure 5. Build Your Own Place of Invention Day 1



Figure 6. Build Your Own Place of Invention Day 2

<sup>7</sup> A specific question was added on the second day of testing to address this idea.

After the second day of testing, the name of the exhibit “Build your own place of invention” and three of the questions from the previous day were printed larger and on colored paper.

## FINDINGS

How visitors used the exhibit (from observations and interviews):

- ◆ Visitors spent between two minutes to upwards of ten minutes at the Hub, the longest dwell time among the three prototypes.
- ◆ Of the visitors who approached it as a group, one person generally took the lead manipulating the blocks and sometimes a second person designated himself or herself to capture the frames.
- ◆ Visitors used a mixture of blocks and people with labels and those without labels.
- ◆ About one-half of visitors captured just one frame, or at least did so initially (some realized that they were supposed to capture more than one frame upon playing their movie; several of these visitors added additional frames to their movie and played it again).
- ◆ A few visitors selected play movie before capturing any frames.
- ◆ Few visitors looked at the questions posted on Day 2 and Day 3.
- ◆ During the first day of testing when visitors were prompted to enter an invention name, most did not think about the invention when placing blocks and making their movie.



Figure 7. Build Your Own Place of Invention Day 3

Most enjoyable aspects:

- ◆ More than one-half enjoyed manipulating the blocks. Many described it as “building” or “constructing.”
- ◆ About one-third enjoyed making a video, with some specifically referring to it as a stop-motion video. The majority of these interviewees said they enjoyed playing their movie or seeing the “end product.”
- ◆ A few said they did not like the exhibit and did not name anything that they liked most.

Least enjoyable aspects:

- ◆ One-third talked about their confusion as to what to do at the exhibit. The majority of these talked about their confusion around the purpose or objective of the exhibit. Some talked about their confusion about the function of making a movie; for instance, they described taking a picture versus creating multiple frames (or simply did not capture enough frames to make it feel like a movie). They also said they did not know to make small changes to the scene in between frames to make the stop-motion movie.
- ◆ A few talked about the wooden blocks and people. The majority wanted greater variety of shaped blocks, people, and labels. One thought that wooden blocks were too simple, and one did not like that the blocks were labeled.
- ◆ A few did not like that the exhibit took time to complete, suggesting that this would lead to a crowded experience in the final exhibition.

- ◆ A few said they liked everything.
- ◆ A few responses were miscellaneous.

#### Confusing or hard to understand aspects:

- ◆ Nearly one-half said they said they did not understand the purpose of the exhibit, saying they didn't know what kind of film they were supposed to make.
- ◆ Several were confused by the instructions for making a stop-motion video. The majority of these interviewees didn't understand that they are supposed to capture multiple frames and make small changes between frames.
- ◆ Several said that there was not anything confusing about the exhibit.
- ◆ Initially a few were unsure as to where the camera was focused

#### Intriguing aspects/piquing visitors' interest:

- ◆ More than one-half of visitors did not name anything that intrigued them or piqued their interest.
- ◆ A few people were intrigued by stop-motion video and wanted to know more.
- ◆ Two were intrigued by things related to places of invention, such as how industries end up in certain places and about how the people in the community contribute to places of inventions.
- ◆ Other responses were miscellaneous.

#### Interpretation of the interactive's message (what it is trying to show or tell them):

- ◆ Nearly one-third said it was about places of invention, such as where inventions start or all the people it takes to go from an idea to invention.
- ◆ Several talked about building a city. A few of these interviewees said they were building their dream city although they did not articulate a connection to place of invention.
- ◆ Several talked about making stop-motion pictures.
- ◆ A few said the exhibit was supposed to be fun and hands-on—not naming a message outside this.
- ◆ Other responses were miscellaneous.

#### How this exhibit relates to the others:

- ◆ More than one-half were not sure how the exhibit related to the others (Medical Alley pacemaker and the Bronx scratching).
- ◆ Several talked about how the exhibit was interactive as were the other exhibits.
- ◆ Several connected the interactive to the exhibition's theme. The responses varied but included one visitor saying it shows that people worked together to invent and another saying you have to persevere to invent.

## UNDERSTANDING OF EXHIBITION MESSAGES

Interpretation of exhibition message after having experienced the three prototypes:

- ◆ As when asked in the beginning, many visitor groups talked about place, but the majority provided simplistic examples, such as inventing scratching in the Bronx. A few said they thought about what one need to have a place of invention, often referring to their experiences with the HUB Build Your Own Place of Invention interactive.
- ◆ Several visitor groups described messages they took away from each of the three exhibits, such as different people needing pacemakers with different balances of current and pulse rate, versus a singular message that they took away from the exhibits collectively.
- ◆ A few responses were miscellaneous.

How the interactives helped them feel inventive:

- ◆ About one-third said the Hub Build Your Own Place of Invention exhibition made them feel inventive. Visitor groups talked about building and using the blocks as well as making a stop-motion film.
- ◆ About one-third said that none of the exhibits made them feel inventive.
- ◆ Almost one-quarter said the Bronx turntable made them feel inventive, often describing scratching as being “creative.” Notably, no visitors talked about how the turntable was invented.
- ◆ Almost one-quarter said Medical Alley, referring to figuring out what they needed to do to save each patient.

# APPENDICES

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## APPENDIX A: OBSERVATION AND INTERVIEW GUIDE<sup>8</sup>

REMOVED FOR PROPRIETARY PURPOSES

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<sup>8</sup> Small modifications were made to the interview guide after the first day of testing. This guide is the final version.

## APPENDIX B: RESIDENCE

**TABLE A**  
**US RESIDENTS' ZIP CODE OF RESIDENCE**

ZIP CODE	<i>n</i>	ZIP CODE	<i>n</i>	ZIP CODE	<i>n</i>
72015	6	66610	3	20912	1
07963	5	70570	3	21146	1
30004	5	75007	3	21673	1
38841	4	78660	3	22207	1
46815	4	95129	2	22310	1
71303	4	95391	2	23230	1
76712	4	02052	2	37215	1
97045	4	13033	2	37920	1
01040	3	20120	2	37923	1
08691	3	20147	2	38863	1
10918	3	21113	2	52804	1
20125	3	37073	2	76354	1
20158	3	58801	2	85338	1
29051	3	62864	2	88310	1
32221	3	83716	2	92677	1
34761	3	85340	2	94110	1

**TABLE B**  
**US RESIDENTS' STATE OF RESIDENCE**

STATE	<i>n</i>	STATE	<i>n</i>	STATE	<i>n</i>
Texas	11	Maryland	5	Virginia	3
Virginia	10	Mississippi	5	Idaho	2
California	8	New York	5	Illinois	2
Florida	8	Tennessee	5	North Dakota	2
New Jersey	8	Indiana	4	Iowa	1
Louisiana	7	Oregon	4	New Mexico	1
Arkansas	6	Arizona	3		
Georgia	5	Kansas	3		
Massachusetts	5	South Carolina	3		

**TABLE C****NON-US RESIDENTS' COUNTRY**

<b>COUNTRY</b>	<b><i>n</i></b>
Singapore	4
India	3
Germany	2
Hong Kong	2
Ireland	2