Exhibit Evaluation Report:

Qualcomm Tricorder XPRIZE Exhibit

XPRIZE

QUALCOMM FOUNDATION

ideum

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EXECUTIVE SUMMARY

In 2018, as a result of the successful Qualcomm Tricorder XPRIZE, the XPRIZE Foundation contracted with Ideum to create an exhibit to be placed in science centers that would highlight advances in medical diagnostic technologies. The exhibit was to be as innovative as the technology developed for the Qualcomm Tricorder XPRIZE. The result was an eye-catching interactive 65" multitouch table consisting of three distinct activities that encourage investigation, social interaction and learning. One activity allows users to use a fingertip scanner to measure their own pulse, skin temperature, and skin conductance; another encourages visitors to design a diagnostic "tricorder" device to use in a described health scenario; and at the third, two users take on the role of doctors to analyze the symptoms of a simulated patient. The exhibit has been placed in five US science centers. In 2019, a team of evaluators visited three of those sites—the Tech Interactive in San Jose, CA; Pacific Science Center in Seattle, WA; and Liberty Science Center in Jersey City, NJ—to evaluate the exhibit *in situ* through structured observation and visitor interviews. The majority of those surveyed or observed were youths aged approximately 8-13, with over 70% of the sample 13 and under. Data suggests that most visitors found the experience interesting and compelling, with high percentages of users showing observable evidence of positive engagement and/or providing positive comments. Many visitors were particularly drawn to the exhibit's interactive and social aspects. Only minor differences in visitor behavior and responses were found between the three venues.

INTRODUCTION

In February 2018, XPRIZE and Ideum collaborated to create an interactive exhibit designed to highlight key developments in medical diagnostic technologies.

The exhibit was designed to further the goals of the Qualcomm Tricorder XPRIZE (QTXP), a competition resulting in the development of a handheld medical diagnostic tool for use by people lacking easy access to doctors or hospitals.[1] XPRIZE's mission of enticing world citizens to take action on major challenges has spurned seventeen incentivized competitions in health, oceans, literacy, space, learning, energy, environment, transportation, safety, and robotics.

This new exhibit was designed to meet several key goals, including:

- sparking investigation of careers in science, technology, and the health sciences;
- prompting experimentation with critical thinking and hypothesis testing, especially as these cognitive skills relate to health and biology;
- facilitating social interaction and discussion to deepen engagement, reflection, and learning; and
- introducing the public to the XPRIZE model of harnessing the power of private citizens to solve world problems.

To create the exhibit, XPRIZE worked with Ideum, a company using emerging technologies to design installations that inspire the public to engage in self-guided experimentation and investigation. After several months of design, development, and testing, including a daylong evaluation session with museum visitors at Explora, a hands-on science center in Albuquerque, NM, the exhibit was installed in five prominent US science centers: Liberty Science Center in New Jersey, Pacific Science Center in Washington state, the Oregon Museum of Science and Industry, the Tech Interactive (formerly the Tech Museum of Innovation) in California, and the Reuben H. Fleet Science Center in California.

The exhibit was designed to run on a custom 65" multitouch table. Three separate but related activities on the touch table focus on different ways of exploring medical technology:

- *Scan Yourself*, a single-person activity at which visitors use one of three fingertip sensors mounted on a panel at the edge of the touch table to measure their heart rate, skin temperature, and skin conductance.
- *Build a Medical Scanner*, a single-person activity at which visitors are first presented with a medical scenario—a set of health risks associated with, for example, a journey through a tropical jungle or an assignment to a long space voyage—and then use touch and gesture to design a diagnostic device to assess patients in that situation.
- *Diagnosis*, a two-person activity in which users work together as doctors to diagnose an ill patient by asking the patient questions and selecting appropriate laboratory tests to perform.

In addition to these three primary activities, there were four buttons on the touch table (two on each side of the table at the bottom edges of the Scan Yourself and Build a Medical Scanner modules) that led to Timeline and About sections. The Timeline provided information about technological advances in medical diagnostic information across time (e.g., the invention of the stethoscope); the About section provided information on the development of the exhibit, including the fact that it was based on the Qualcomm Tricorder XPRIZE competition.

Rather than visitors toggling between the three primary activities, the exhibit locates each activity in a persistent zone on the touch table, so that all three are always available and individual visitors or small groups can use them in whatever order they desire. The proximity of the experiences and the fact that they share an overall design strategy was intended to motivate visitors to move from one activity to another as they observe other visitors exploring other modules. The design was also intended to encourage discussion of the experiences people were having at the exhibit.

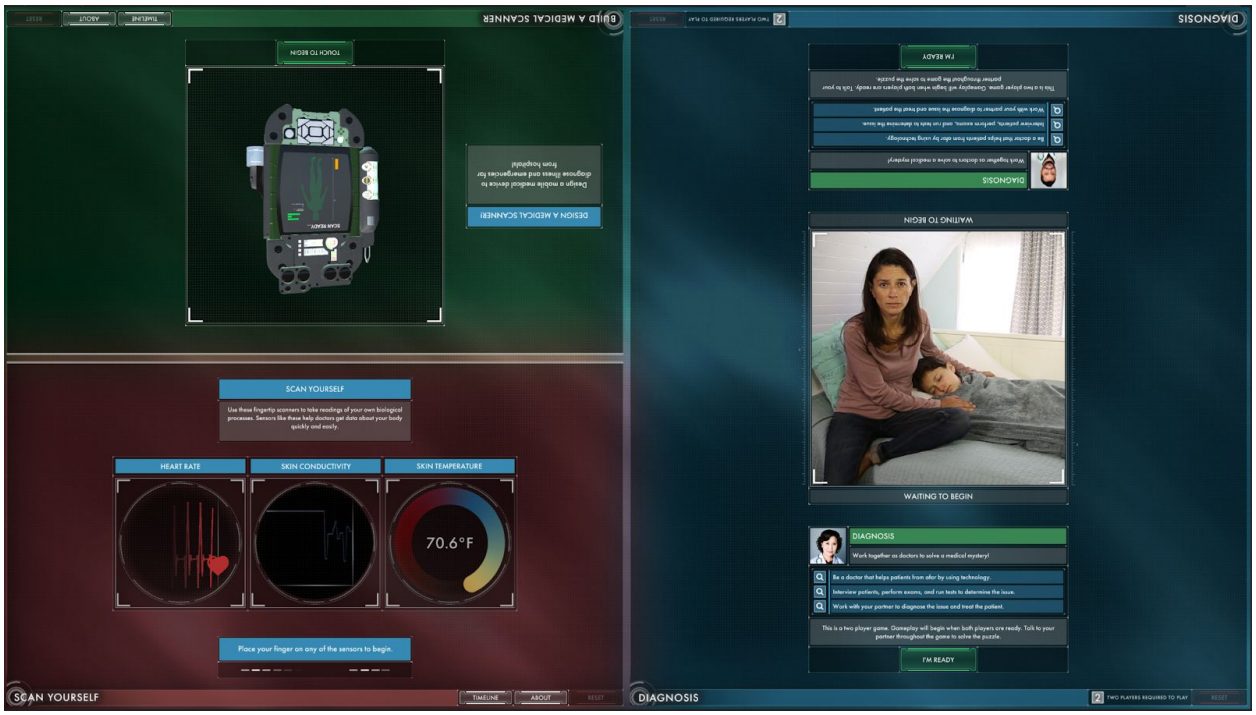

Figure 1: Layout of the exhibit. Clockwise from upper left: Build A Medical Scanner, Diagnosis, Scan Yourself.

Figure 2: Fingertip sensor panel for Scan Yourself module. The panel extends to the left of the module.

METHODS

Evaluation Team

The evaluation team was comprised of three museum professionals with experience designing museum exhibits, including interactive exhibits for science centers, and assessing visitor experience and behavior. The team met several times before evaluations began to develop protocols and instruments and review observational techniques and coding procedures. All three members of the team participated in each of the data collection approaches described below, which ran concurrently at each of the three evaluation venues. Our primary evaluation goals were to study how visitors used each activity, how they moved between activities, how they interacted with other people at the experience, and how they responded cognitively and affectively to the exhibit. We were also interested in the possibility that the exhibit would be used differently and/or prompt different responses at the three museum venues.

Procedures

We employed three main data collection approaches during this evaluation project:[2]

(1) Structured Visitor Observation and Timing

In this approach, evaluators selected a semi-random subset of users to maximize sample representativeness and minimize experimenter bias. Evaluators selected every Nth person who stopped at the exhibit. (See

Appendix A for the instrument used for this phase.) This data-collection method was designed to assess observable indicators of engagement and social learning, assess confusion about the exhibit's user interface; and measure the total time visitors spent at the exhibit, multiple activity use, and repeated activity use.

(2) Visitor Interviews

For this method of data collection, evaluators selected every Nth person who had interacted with the exhibit as they began to leave the immediate area. Again, this procedure was adopted to maximize sample representativeness and minimize experimenter bias. Permission was requested from staff or chaperones before approaching guests who appeared to be minors. (See Appendix B for the instrument used for this phase.) This method was designed to assess visitors' conceptual understanding of the exhibit, engagement with exhibit content, and evaluative and emotional responses to the experience; assess user interface confusion; and gather additional comments.

(3) Data Analytics

The exhibits were designed to automatically gather information about user behavior, including how many times each interactive element was used. We were able to use these data to objectively assess user behavior at each of the three exhibit modules, including the extent to which each module was completed and the number of shared correct diagnoses visitors achieved.

Site Information

The Tech Interactive, San Jose CA

- Evaluation dates: Friday-Saturday, February 29-30, 2019
- Visitorship: 450,000 annually with an additional 150,000 reached through Tech Academies outreach program. *(Museum website)*
- Mission: To inspire the innovator in everyone. *(Museum website)*
- Context: The exhibit was placed in an open area and could be approached from several directions. Overall framing and adjacent exhibits emphasized health and disease in the developing world and medicine in rural areas.
- Interpretive signage was provided in English only:

Empowering personal healthcare
Explore three interactive activities
Next generation diagnosis tools (with exhibit diagram)
1 Scan
2 Design
3 Diagnose

Figure 3: Exhibit at The Tech Interactive.

Liberty Science Center, Jersey City NJ

- Evaluation dates: Friday-Saturday, March 5-6, 2019
- Visitorship: 750,000 annual, plus tens of thousands from off-site and on-line programs. *(Museum website.)*
- Mission: To inspire the next generation of scientists and engineers and excite learners of all ages about the power, promise, and pure fun of science and technology. *(Museum website)*
- Context: The exhibit was placed against a freestanding wall in a semi-enclosed structure with approach mainly from one direction. Overall framing and adjacent exhibits emphasized mechanisms of disease transmission.
- Interpretive signage was available in English only:

  Clinic of the Future
  Before you can help a patient, you have to figure out what illness they have. See how technology will make diagnoses faster, cheaper, and available almost anywhere, even in places far from doctors.

Figure 4: Exhibit at Liberty Science Center.

Pacific Science Center, Seattle WA

- Evaluation dates: Friday-Saturday, May 17-18, 2019

- Visitorship: 1.1 million people, including outreach. *(Museum website)*
- Mission: Pacific Science Center ignites curiosity in every child and fuels a passion for discovery, experimentation, and critical thinking in all of us. We bring science to life. *(Museum website)*
- Context: The exhibit was placed against a wall in an open area with approach available from several directions. Overall framing emphasized space sciences and diagnosis/treatment of astronauts in space.
- Interpretive signage was available in English and Spanish:

How will we get medical care to future astronauts?

Medicine in deep space
Imagine you're part of a deep space mission. How would you diagnose an illness or assess an injury? Could you stop a bleeding cut in zero gravity? What if you needed medicine, but it was literally millions of miles away?

Deep space medical solutions must be light, durable, and simple enough to use without extensive training.

Medicine on Earth
Such medical inventions also benefit us on earth, from expanding medical access in remote communities to empowering people to diagnose and treat more conditions at home.

Try it!
Use the touch table to monitor your vital signs, learn about scanning technologies, design handheld diagnostic devices, and take on the role of space doctor as you diagnose a patient from afar.

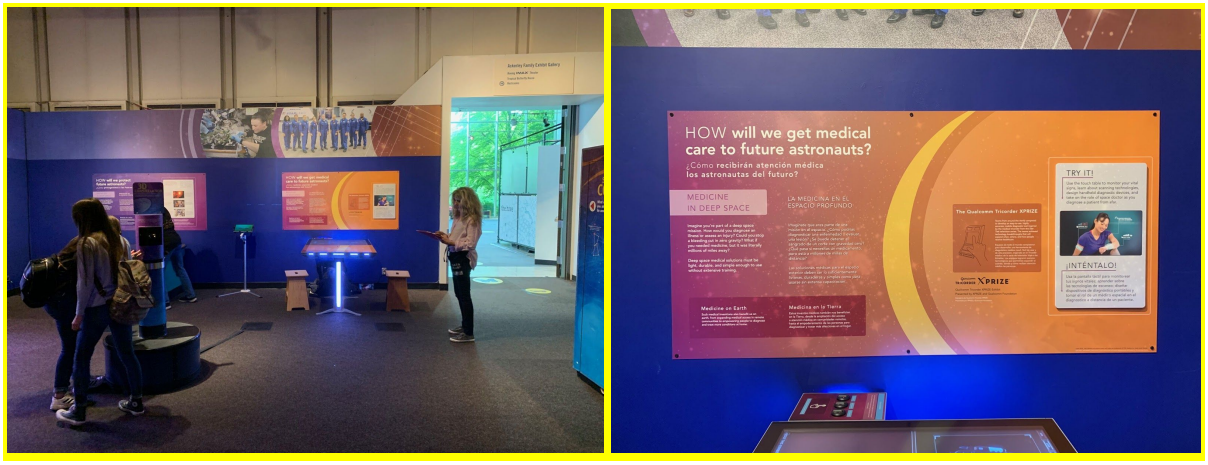

Figure 5: Exhibit at Pacific Science Center.

RESULTS

Structured Visitor Observation

Demographic information:

During the structured observation phase, the team observed a total of 88 visitors using the exhibit (N=33 Liberty, (*LSC)*; 20 Pacific, (*PSC)*; 35 Tech Interactive, (*TI*). The vast majority of these visitors were young, with 43% being under 10 (as estimated by observers) and 34% being 10-13; the remaining 23% of observed visitors were 14-55. An approximately equal percentage of males and females were observed. These percentages were comparable across all three venues.

Holding time and touch behavior:

We assessed the total dwell time at the exhibit across modules used; that is, we measured the time spent by visitors *starting when they first engaged with the experience and ending when they left the table*, disregarding the specific activities they used during their visit. Observed visitors spent an overall average of 190 seconds (3 minutes, 10 seconds) engaged at the touch table. The highest average holding time (4 minutes, 48 seconds) was found at PSC; the lowest (2 minutes, 25 seconds) was found at LSC. The truncated age ranges of our observed sample suggest caution in interpreting holding times by age, but the key youth demographics observed showed an average holding time of 2 minutes, 36 seconds (ages below 10) and 3 minutes, 16 seconds (ages 10-13). Nearly all observed visitors touched the

display screen multiple times during their use of the exhibit (TI 33/35 = 94%; LSC 32/33 = 97%; PSC 20/20 = 100%). (In interpreting holding times, it is important to reiterate that this experience actually comprised several related but discrete experiences, a design which is likely to increase holding times relative to other single-experience exhibits in science museums.)

Use of multiple modules:

In comparison with many interactive exhibits presented in museums and science centers, one of the unusual features of this exhibit is that three related but distinct experiences are presented at the same time; that is, Build a Medical Scanner, Scan Yourself, and Diagnosis are always open and available without the need to switch or toggle between them. This design strategy allowed the development team to offer visitors a persistent range of ways to explore the same core concepts.

Given this, a key measure of engagement is the extent to which visitors used multiple modules during their visit. After experimenting with one activity, what percentage of visitors went on to use a second or third experience? We found that a substantial percentage of observed visitors (39%) used more than one module at the exhibit. This percentage was not markedly different across the three venues.

Evidence of positive engagement:

The evaluation team assessed indicators of both positive engagement (e.g., smiling, laughing, positive utterances) and confusion or frustration (e.g., frowning, repeatedly tapping inactive areas of the display, negative utterances) at each module. Observers discussed what would constitute visible evidence of these conditions before beginning the evaluation process and agreed to use a conservative approach to these assessments. Visitor behavior at the exhibit was coded as one of three categories of evidence of either positive engagement or confusion: None, Some, or Extensive.

Across the three venues, 89.6% of visitors showed either Some or Extensive evidence of positive engagement, with 40% showing Extensive evidence:

Some/Extensive Evidence of Positive Engagement by Venue	
TI	82%
PSC	95%
LSC	93%

We also assessed engagement across exhibit activities:

Some/Extensive Evidence of Positive Engagement by Activity	
Diagnosis	96%
Scan Yourself	92%
Build a Medical Scanner	79%

Evidence of confusion:

Across the three venues, 71% of the visitors we observed showed no visible evidence of confusion or frustration at the exhibit. 29% of visitors showed either Some or Extensive visible evidence of confusion or frustration at the exhibit, with only 8% of visitors showing Extensive evidence. As with the observations of positive engagement noted above, this pattern held generally for each of the three venues:

No Visible Evidence of Confusion/Frustration by Venue	
TI	68%
PSC	65%
LSC	78%

The degree of observed evidence of confusion/frustration ranged across activities:

Some/Extensive Evidence of Confusion/Frustration by Activity	
Diagnosis	31%
Scan Yourself	22%
Build a Medical Scanner	38%

Visible social interaction:

Observers also assessed the extent to which visitors engaged in social interaction while using the exhibit, and, where possible, noted whether those interactions focused on the exhibit *interface* (e.g., asking for help or helping others use the exhibit by, for example, showing where to touch on the display or coaching others in how to make selections) or on the *content*

displayed at the exhibit (e.g., discussing health and disease, verbally analyzing a patient's symptoms). (We did not differentiate between social interactions with friends, family members, staff, chaperones, or others.)

Across the three venues, 54% of visitors engaged in either Some or Extensive social interaction about the exhibit interface. This pattern was nearly identical at all three venues:

Some/Extensive Social Interaction About Interface by Venue	
TI	57%
PSC	55%
LSC	50%

A similar pattern appeared when assessing evidence of social interaction about exhibit content, with 51% of visitors across venues discussing the content with others. Again, this pattern held for each of the venues:

Some/Extensive Social Interaction About Content by Venue	
TI	57%
PSC	47%
LSC	47%

As with the other measures reported above, we also assessed social interaction for each of the three exhibit activities:

Some/Extensive Social Interaction About Interface by Activity	
Diagnosis	73%
Scan Yourself	59%

Build a Medical Scanner	25%

Some/Extensive Social Interaction About Content by Activity

Diagnosis	69%
Scan Yourself	57%
Build a Medical Scanner	22%

Visitor Interviews

Demographic information:

The evaluation team conducted a total of 46 interviews at the three venues (N=16 LSC, 15 PSC, 15 TI). 61% of the total sample were female, but our semi-random sampling procedure led to a dissimilarity in gender balance across venues, with 75% of the LSC sample and 73% of the PSC sample being female while 33% of the TI sample was female. The mean age of the sample was 31 (range 10-50; 34 LSC, 26 PSC, 33 TI).

Exhibit recall and description:

Visitors were asked to name or otherwise describe the exhibit experiences they used. Across venues, 59% of those interviewed visitors reporting using Diagnosis, 61% reported using Scan Yourself, and 35% reported using Build a Medical Scanner. These percentages were substantially the same for each individual venue, though these sample sizes are small enough such that observed differences here may be unreliable.

Visitors were also asked to characterize the *nature* of the exhibit—what did they think the experience was about? Interviewees were free to answer in any way they liked, and interviewers subsequently coded their responses into one or more predetermined categories. Across venues, 43% of visitors described the exhibit as being about Health and Disease; 24% about Doctors and Patients; 21% about Medical Technology; and 7% about Innovation. 30% of interviewees gave answers categorized as Other. (A number of these responses included statements focusing on the body, such as "...the state of my body", "... your body", and "...learning about your body".)

Given the fact that the exhibit was contextualized somewhat differently at the three venues, we were especially interested in learning whether visitors at different venues described the exhibit differently. However, the general pattern noted above was found at each venue, with the largest percentages of visitors, 47% at both PSC and TI and 38% at LSC, describing the exhibit as being about Health and Disease. (Note again that these within-venue sample sizes are small, so any differences noted may be unreliable.)

Evaluative responses:

Across venues, 85% of visitors reported liking their experience at the exhibit, and this finding was approximately the same at each venue. Visitor explanations for their responses varied widely. A number mentioned either the Diagnosis or Scan Yourself modules:

"Symptoms are interesting, and trying to get the right answers."
"I liked pretending to be a doctor."
"Thought it was cool to have a chance to try to diagnose a patient with my son."
"Really liked Diagnosis. Treat a real patient."
"Really fun because patient's life was at stake."
"It was exciting to find out the illness."
"It was interesting to see the difference between my readings and my friends'."
"Fun to see difference between my son's readings and my own."
"Very cool to see my personal info."
"Cool that you can actually test yourself."

Other visitor comments focused on the interactive and social aspects of the experience:

"Interactive, learn by doing, hands-on."
"People could work together."
"Interactive, social, teams."
"It was fun to do in a group and compare."
"Loved it! Collaborate and get to do something new."
"Two-person interaction was the best part."
"My whole family was using it, which makes me happy."

Some visitors also provided comments about aspects of the exhibit they found confusing or frustrating. The majority of these focused on the exhibit interface:

"Association of buttons with screens isn't clear."
"It was hard to navigate the questions."
"Scanner didn't work for me."
"Screen took too long to respond."
"It was confusing. Not sure what buttons to push."
"There was too much text."

A few negative comments focused on the fact that the Diagnosis activity constrained visitors' choices or options:

"It was constraining. I wanted to guess right away."
"Why couldn't I diagnose earlier? We knew what it was early!"

Although the clear majority of respondents found the activity engaging and informative, one visitor we interviewed, a medical doctor, felt that the Diagnosis activity oversimplified the diagnostic process:

"Not precise in connecting symptoms to diagnosis. I didn't think it was scientific."

Data Analytics

The exhibit was designed to automatically record several types of data at each activity, such as the number of times modules were touched each day

and the percent of times that the Diagnosis and Build a Medical Scanner were completed. Given that these data were collected over a period of months rather than days (TI: October 26, 2018 – March 9, 2019; PSC: October 30, 2018 – May 9, 2019; LSC: October 10, 2018 – July 1, 2019), they present a much broader picture of exhibit use across activities and venues. However, certain features of the recording process complicate analysis of these numbers. For example, although we can make some assumptions about the behavior of a specific individual from the time stamps associated with screen touches, it is not possible to draw conclusions about which data are associated with individual visitors with 100% confidence.

Diagnosis:

We recorded the absolute number of times that the home screen of the Diagnosis activity was initially touched at each venue (TI 6,695; PSC 8,778; LSC 16,715) and then calculated the average number of initiations per day. For this calculation, we omitted data indicating that the module was *only initiated* with no further screen interaction:

Average Number & Range of Diagnosis Initiations per Day by Venue	
TI	65.6 (0-97)
PSC	56.2 (0-88)
LSC	82.8 (0-155)

We were also able to calculate the percentage of times that users who began the Diagnosis activity (a) continued until they *completed* the activity by reaching a diagnosis, and (b) *agreed* on that diagnosis:

Percentage of Diagnosis Initiations Completed

TI	49%
PSC	41%
LSC	28%

Percentage of Diagnosis Initiations Leading to Agreement

TI	84%
PSC	88%
LSC	85%

Scan Yourself:

Scan Yourself contained three fingertip sensors—an infrared pulse sensor at right, a galvanic skin response (GSR) sensor measuring skin conductance at center, and a skin temperature sensor at left. (See Figure 6 below.) When visitors place their finger into the custom rounded sensor ring, an onscreen readout displays the result—an image of a beating heart with a pulse rate, a graph showing skin conductivity in real time, or a skin temperature value.

Figure 6: Touch sensor panel for Scan Yourself activity.

We recorded how each of the biometric sensors at the exhibit were used to calculate average daily usage at each venue:

Average Daily Scanner Uses & Ranges by Venue

	GSR	Pulse	Temp
TI	20.7 (0-113)	13.5 (0-70)	7.7 (0-76)
PSC	5.9 (0-37)	8.9 (0-69)	8.5 (0-69)
LSC	6.3 (0-33)	10.9 (0-55)	9.5 (0-112)

Build a Medical Scanner:

As with Diagnosis, we recorded the number of times that this activity was initiated, the average number of initiations per day, and the percentage of times that initiation led to a completed scanner:

Average Number & Range of Build A Scanner Initiations per Day by Venue

TI	54.5 (0-174)
PSC	53.8 (0-169)
LSC	77.4 (0-208)

Percentage of Build A Scanner Initiations Completed

TI	43%
PSC	38%
LSC	35%

Timeline and About Pages:

We also recorded the number of times that visitors touched the display to see the exhibit's About and Timeline sections:

Average Number & Range of Timeline Visits per Day by Venue

TI	19.9 (0-83)
PSC	20.4 (0-79)
LSC	40.8 (0-180)

Average Number & Range of About Visits per Day by Venue

TI	13.7 (0-67)
PSC	14.0 (0-45)
LSC	29.9 (0-131)

DISCUSSION

Our evaluation data suggest that most of the visitors we observed and interviewed found the exhibit interesting and engaging. Nearly all of those observed touched the display multiple times, and a majority used more than one of the three exhibit activities. Across the science centers, nearly 90% of visitors showed at least some behavioral evidence of positive engagement, while less than a third, 29%, showed behaviors suggestive of confusion or frustration.

The evaluative responses we gathered during visitor interviews showed a similar pattern, with 85% of visitors interviewed reporting that they liked the experience. Many visitors also seemed to grasp at least some of the core ideas behind the exhibit, with the highest percentages of those interviewed describing the exhibit as being about health, disease, doctors, patients, medical devices, and the ability to learn about what's happening inside one's own body.

Our results for holding time are generally consistent with these conclusions. Holding time (or dwell time) is a notoriously noisy construct because of the tremendous variety of factors that can affect it. For example, people can leave an exhibit for many reasons—they have explored it fully, they are bored or frustrated, the area is crowded or noisy, their friends or group members want to move on, etc. In addition, museums almost always offer multiple temptations to leave one exhibit in the form of other

attractive exhibits. Exhibits themselves vary widely in terms of the sheer amount of options for exploration they offer. For these and related reasons, there really is no reliable estimate of "average exhibit holding time" for science center exhibits to compare to data found at a specific exhibit. That said, our evaluation team's overall impression was that this exhibit's holding time—an overall average of over 3 minutes—was indicative of moderately strong to strong visitor engagement; the fact that younger visitors, who are likely to have shorter attention spans, spent an average of over 2 minutes at the exhibit, is notable.

In our view, this is likely due to several key factors, including the unusually broad range of interactivity presented in the experience—3 separate but related activities, each offering a unique set of options and outcomes—and the fact that the exhibit was designed specifically to foster and support social interaction. In fact, we found that one of the aspects of the exhibit described most often as a positive element was its social dimension. Note that while the Diagnosis activity was explicitly a two-person experience, numerous social interactions were also observed at the other two activities, and many of those involved discussions about the core concepts at the heart of the exhibit. (This was particularly true of Scan Yourself.)

A second notable positive aspect of the experience cited by multiple visitors was the fact that it allowed visitors to learn something new *about themselves*, a finding almost certainly reflective of experiences with Scan

Yourself. On the other hand, negative comments about the exhibit tended to reflect frustration with the exhibit interface rather than the exhibit's core concepts.

We did find some evidence of differential approach to the three exhibit activities. Visitors using Diagnosis and Scan Yourself showed higher levels of both engagement and social interaction than we found at Build a Medical Scanner. (Again, recall that Diagnosis explicitly prompted visitors to seek out a partner, while the other two could be navigated by solo visitors.) We note that Build a Medical Scanner required visitors to first digest a hypothetical scenario and then to pull virtual "components" together to create a medical device specifically suited for that scenario. It is possible that this activity required more cognitive effort to complete than the other two. For example, the connection between the scenario and the scanner might not be obvious; the linkage between the menu of scanner components--a blood tester, a neurological instrument, etc.—and the scenario could be unclear; and/or the scanner-building interface, which required visitors to pull components into a build window, could be confusing. The possibility that this activity is more difficult to use is consistent with our observations of visitor behavior, which showed more evidence of visible positive engagement for Diagnosis and Scan Yourself and more evidence of visible frustration for Build a Medical Scanner.

Although the exhibit was framed somewhat differently at the three science centers we visited— at TI, it was situated in a gallery devoted to medicine

in developing nations; at PSC, it was part of a focus on medicine and health in space; and at LSC, surrounding exhibits centered on vectors of disease transmission—this did not appear to lead to markedly different use patterns. Overall, we found similar evidence of positive engagement, confusion, and social interaction across the three venues. The only notable difference we found between venues was a pattern of considerably higher exhibit use at LSC. However, this pattern held for only two of three exhibit activities, with Scan Yourself not showing this pattern. It is possible that because of the exhibit placement at LSC, with the scanner panel between the touch table and a nearby wall, the sensors were more difficult to see at this venue than at the other two. Note also that evidence indicates that visitors to science centers are not likely to read signage, or notice context, when presented with an appealing interactive opportunity such as presented in this touch table.

Perhaps relatedly, we found limited evidence of exploration of the exhibit's About and Timeline sections. In addition to the fact that these sections offered less interactivity and instead provided static contextual information, it's important to note that we intentionally designed the exhibit to focus visitors on the interactive activities and made the About and Timeline options relatively unobtrusive.[3]

In conclusion, with this exhibit, XPRIZE and Ideum attempted to create an experience that met a range of challenges—most fundamentally, presenting a wide range of dynamic content, much of it conceptually complex, in

multiple interactive formats, on a single large touch table in a way that captured and held visitor interest and supported self-directed exploration and social interaction. In addition to the results described here, all of the science centers involved in the project have provided positive reviews in response to queries about how their visitors and staff view the experience. Taken together, these findings strongly suggest that this exhibit is largely effective at prompting reflection on, investigation of, and social interaction about the project's core concepts, including the core idea that emerging medical technologies can provide new ways to learn about health, disease, and the human body.

NOTES

1 The Qualcomm Tricorder XPRIZE was a $10 million global competition to incentivize the development of innovative technologies capable of accurately diagnosing a set of 13 medical conditions independent of a healthcare professional or facility, ability to continuously measure five vital signs, and have a positive consumer experience. Final Frontier Medical Devices, a small team led by engineer-turned emergency room doctor, Basil Harris, and his brother George (also an engineer) won the top prize of $2.6 million. Runner-up Dynamical Biomarkers Group was awarded $1 million.

2 For a range of reasons, every method of studying human behavior and social interaction has limitations. For example, people tend to adjust their actions when they are aware they are being watched; they may answer questions in ways that please the researcher or present their own behavior in the best light; and they may not be fully aware of their own motivations. Therefore, using multiple methods of data collection is widely viewed as an industry "best practice" in these contexts.

3 We made no attempt in this series of evaluations to assess the degree to which visitors came away with information about the kinds of processes or organizations, including XPRIZE, that facilitate or support the kinds of technical innovations described in the exhibit. Indeed, we consciously avoided branding the exhibit with highly visible logos or information about the project's sponsors. During these studies, we conducted a parallel evaluation process focused on assessing visitor awareness of the role organizations like XPRIZE play in fostering innovation. In that study, visitors leaving the exhibit area were asked if they'd like to answer a few questions about the nature of innovation presented on a digital tablet. The results of that study are described in the report Qualcomm Tricorder XPRIZE Exhibit 2018-2019 Impact Report.

APPENDICES

Appendix A: Observation/Timing Sheet

Appendix B: Visitor Interview Sheet

OBSERVATION/TIMING SHEET

Random selection of observation targets to minimize experimenter bias: Once session begins, observers will select every Nth person who uses the exhibit. N determined by observer; if busy, N might be every 3rd or 4th visitor; if not busy, N might be every 2nd visitor. One sheet per visitor.

Begin time (visitor stops at exhibit, looks at screen):

Initial exhibit:	**Diagnosis**	**Tricorder**	**Scanner**
Screen touches:			Y N
Multiple screen touches:			Y N
Evidence of positive engagement: *(smiling, laughing)*			None Some Extensive
Evidence of confusion or frustration: *(negative affect, button bashing w/o engagement)*			None Some Extensive
Social interaction re interface: *(helping others, asking for help)*			None Some Extensive
Social interaction re content:			None Some Extensive

Next exhibit:	**Diagnosis**	**Tricorder**	**Scanner**
Screen touches:			Y N
Multiple screen touches:			Y N
Evidence of positive engagement: *(smiling, laughing)*			None Some Extensive
Evidence of confusion or frustration: *(negative affect, button bashing w/o engagement)*			None Some Extensive
Social interaction re interface: *(helping others, asking for help)*			None Some Extensive
Social interaction re content:			None Some Extensive

Next exhibit:	**Diagnosis**	**Tricorder**	**Scanner**
Screen touches:			Y N
Multiple screen touches:			Y N
Evidence of positive engagement: *(smiling, laughing)*			None Some Extensive
Evidence of confusion or frustration: *(negative affect, button bashing w/o engagement)*			None Some Extensive
Social interaction re interface: *(helping others, asking for help)*			None Some Extensive
Social interaction re content:			None Some Extensive

End time (visitor leaves table):

Demographic:

Age: -10 10-13 14-17 18-25 26-35 36-45 46-55 56+ Gender: M F

VISITOR INTERVIEW SHEET

Random selection of interview targets to minimize experimenter bias: interviewers will select every Nth person who uses the exhibit. N determined by observer; if busy, N might be every 3rd or 4th visitor; if not busy, N might be every 2nd visitor. Approach as visitor is clearly finished and begins to move away from the exhibit. Obtain permission from staff, supervising adults before approaching children.

Age: Gender:

Hello! I'm NAME. We are working with the museum. Can I ask you just a few questions about this exhibit?

First, which parts of the exhibit did you use? (circle all that apply)
Diagnosis
Tricorder
Scanner
Don't know/Don't remember
Other:

Can you tell me what you think the exhibit is about? (circle all that apply)
Medical technology
Health and disease
Doctors and patients
Science
Innovation
Other:

Did you like the exhibit?
(YES OR AMBIGUOUS) What did you most like about it?

(NO) Can you say why not?

Was there anything you *didn't* like about it?

Was there anything about it that was confusing or hard?

What would make it more fun or interesting?

Is there anything else you'd like to say or ask about the exhibit?