Bouncing Ball

Post-Redesign Evaluation

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THIS IS A POST-REDESIGN EVALUATION REPORT

After an exhibit has been renovated, redesigned, or refurbished in preparation for the Exploratorium's move from the Palace of Fine Arts to Pier 15, an interview and observation study is conducted. The purpose of the study is to identify any major issues that would require immediate attention prior to the move. This collection of redesign evaluations will serve as a baseline of information for the Exploratorium's new exhibit set at Pier 15.

Post-redesign studies like this one **are conducted quickly,** which may mean:

- small sample sizes
- expedited analyses
- brief reports

Bouncing Ball
Post-Redesign Evaluation

Study Goals

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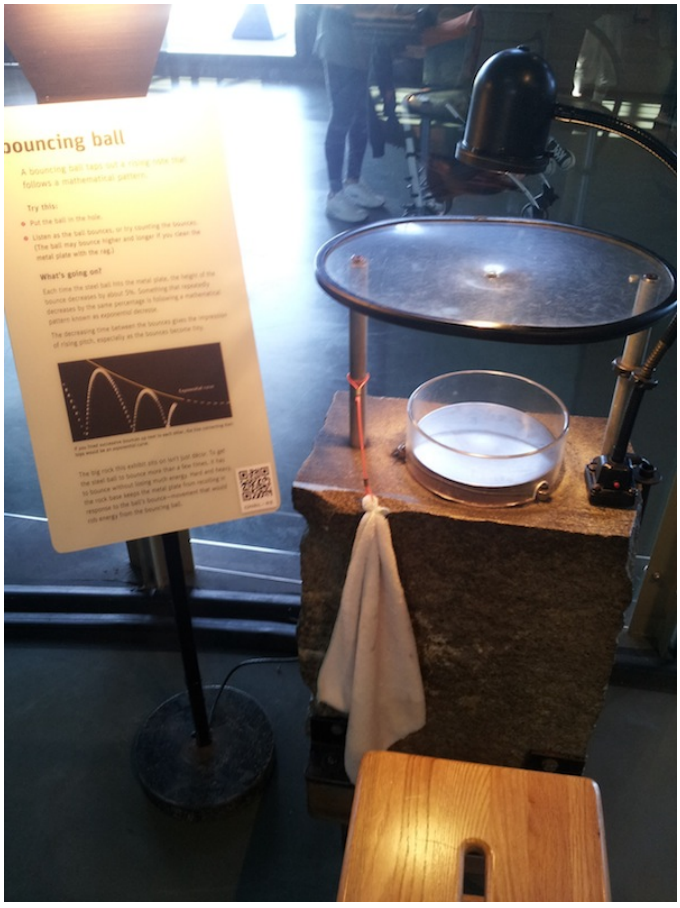
General goals:

- To confirm that visitors are able to access and use the exhibit
- To confirm that visitors can build a basic understanding of the exhibit's content
- To uncover visitors' frustrations and confusions
- To understand whether visitors move on from an exhibit for intrinsic or extrinsic reasons

Exhibit Description

BOUNCING BALL demonstrates the exponential nature of the frequency of bouncing. The visitor pushes down a plunger and picks up a steel ball bearing on a magnet. Upon release, the plunger rises and the ball drops on a steel plate. The sound of the bouncing ball is amplified and heard on a set of speakers. Since the ball bounces to a height, which is a certain portion of its last bounce, the frequency of bounce goes up exponentially.

A remarkable aspect of this exhibit is that the frequency of bounce can be as high as several hundred hertz, providing the ball and plate are clean.



Methods

Uncued observations and interviews were conducted. A researcher randomly selected visitors who crossed an imaginary line on the floor that stopped facing the exhibit with two feet planted and either looked at or touched the exhibit for approximately 15 or more seconds.

Uncued visitors do not know they are part of the study until after they finish using the exhibit so their behavior can be considered representative of normal use patterns. This means that some of the visitors in this study may have used the exhibit only briefly.

Visitors were approached after they left the exhibit and asked if they would be willing to participate in a 7-question interview about their experience at the exhibit.

Demographics

Gender	Count (N=12)
M	3
F	9

English as a Second Language?	Count (N=12)
N	11
Y	1

Estimated Age	Count (N=12)
8-12	4
13-17	0
18-29	2
30s	3
40s	3
50s	0
60+	0

Visitor Group Composition	Count (N=12)
Adults-only	5
Adults with children	6
Adults w/ teens	1
Adults w/ teens and children	0

Findings

Holding Time

This is the time the visitor spent using or otherwise engaged with this exhibit. The amount of time a visitor spends at an exhibit is influenced by many factors and can indicate level of engagement or interest, but not as a measure on its own.

Time at exhibit	mm:ss (N=12)
Mean	1:04
Median	0:54
Minimum	0:21
Maximum	3:16

Visitor Behaviors

Visitors were observed as they used various parts of the exhibit.

Drops ball through hole?	Count (N=12)
One time	6
2 or more times	6

Uses Rag?	Count (N=12)
Yes	5
No	7

Lets ball bounce until it stops?	Count (N=12)
Yes	11
No	1

Leans in to listen?	Count (N=12)
Yes	5
No	7

Counts bounces out loud?	Count (N=12)
Yes	0
No	5
Unsure	7

Visitor Interest

Visitors were asked about their interest in the exhibit and why they rated from "not interesting" to "very interesting" (1 – 7).

Interest Level	Count (N=12)
High Interest (6-7)	2
Moderate Interest (4-5)	8
Low Interest (1-3)	2

Visitor responses:

H	Because it was fun, like it would jump.
H	Interesting how the ball bounces
M	Interesting because there's a math concept behind it.
M	I'm an engineer and a musician; I like it because of the sound.
M	I counted how many bounces, did not know it would bounce that high.
M	Never seen something like that before.
M	Because it's cool how science is working.
M	It was over quickly.
M	(Looks at the accompanying adult) [Remember, there are no right or wrong answers here, I'm really interested in YOUR opinion]. (Looks at adult, uncomfortable.)
M	(Doesn't say anything.)
L	Never thought about it before. [Can you tell me more?] Decreasing height would be a mathematical presentation.
L	It (pauses) it's just a bouncing ball, no flashing lights, and cooler if the bouncing ball would make a tune.

Visitor Frustration or Confusion

Visitors were asked to tell us if there was anything confusing or frustrating, what the source of the frustration was, and whether or not it made them want to leave the exhibit and move on to another one.

Source of visitor frustration or confusion*	Count (N=15)	# that wanted to move on
How to begin using	1	0
Ball bounced out	1	0
Didn't understand what rag is for	1	0
Nothing Frustrating or Confusing	12	--

*Totals may add up to more than N = 12 because visitors gave more than one response.

Visitor Understanding

Visitors were asked what they think the exhibit was about with the goal to determine whether or not they have a basic understanding of the concepts presented and to identify possible areas of misunderstanding. We acknowledge that this study has a small sample size and that these findings illustrate trends and may not be representative.

It appears that visitors DO have a basic understanding of concepts presented.	X
It appears that visitors DO NOT have a basic understanding of concepts presented.	

Visitor responses:

- About mathematical concept behind any phenomenon, things follow certain pattern.
- Decreasing the height of the ball fits the mathematical curve. [Can you say a little more about that] Surface that it is hitting is so solid, energy is just slightly diminished.
- How balls bounce.
- Newton's law, gives you auditory, that pitch toward the end.
- Curvature that the ball is making with each bounce.
- Math pattern. [Anything else?] No.
- I think about the decrease in the height of the bouncing object and the relationship to the sound. [Anything else?] Maybe transfer between different types of energy.
- Shows the percentage of the decrease, the sound.
- I don't know.
- How the ball bounces, as it bounces it (the bounce) gets smaller and smaller.
- The difference in pitch.

Visitor Reasoning for Leaving the Exhibit

The goal of this question is to explore how open or closed-ended the exhibit seems to be for the visitor. Visitors tend to leave exhibits for intrinsic reasons, such as feeling bored, or finished with the experience, or for extrinsic reasons, like having to go to lunch or being distracted by another exhibit. Leaving for intrinsic reasons could suggest a more close-ended exhibit experience.

Reasons for moving on to the next exhibit	Count (N=12)
Intrinsic	8
Extrinsic	2
Unclear / Uncodable	2

Visitor responses:

Intrinsic	I was done with it.
Intrinsic	Done with it.
Intrinsic	I tried it and I've seen it now.
Intrinsic	Done.
Intrinsic	After done it, read it, done with it.
Intrinsic	I was done with it.
Intrinsic	Done with it.
Intrinsic	I've seen what it does.
Extrinsic	Kids.
Extrinsic	Wanted to see something else.
Unclear	I was ready.
Unclear	Family.

Conclusions

Based on this small sample, we conclude that the redesigned exhibit does not require immediate remediation. This evaluation did not identify sufficient impediments to visitor use, engagement or basic understanding.

APPENDIX: Graphic Panel

5925_L1_BouncingBall_MainLbl (11" x 20") .5" rounded corners | Embedded: 1/16 polycarb + 1/16 ABS

bouncing ball

A bouncing ball taps out a rising note that follows a mathematical pattern.

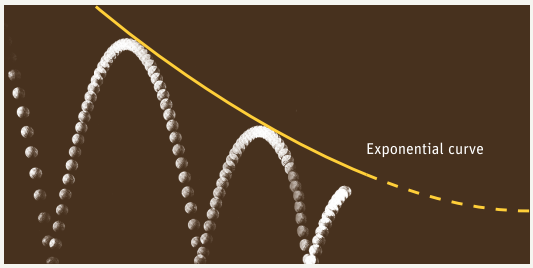
Try this:

- Put the ball in the hole.
- Listen as the ball bounces, or try counting the bounces. (The ball may bounce higher and longer if you clean the metal plate with the rag.)

What's going on?

Each time the steel ball hits the metal plate, the height of the bounce decreases by about 5%. Something that repeatedly decreases by the same percentage is following a mathematical pattern known as *exponential decrease*.

The decreasing time between the bounces gives the impression of rising pitch, especially as the bounces become tiny.



If you lined successive bounces up next to each other, the line connecting their tops would be an *exponential curve*.

The big rock this exhibit sits on isn't just décor. To get the steel ball to bounce more than a few times, it has to bounce without losing much energy. Hard and heavy, the rock base keeps the metal plate from recoiling in response to the ball's bounce—movement that would rob energy from the bouncing ball.

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