

Listen: Making Sense of Sound
An exhibition at the Exploratorium
Summative Evaluation

Prepared by Minda Borun, Museum Solutions
Based on data collected by
Exploratorium Evaluation Staff

with the generous support of



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Introduction

The *Listen* exhibition at The Exploratorium, which was funded by the National Science Foundation and opened in October 2006, deals with the production and physical characteristics of sound, the reception of sound in the ear and its perception in the brain, and the human capacity to interpret and act on the information transmitted by sounds. Summative evaluation of *Listen* consists of two parts: tracking and timing and exit interviews. Instruments for the studies were developed by Minda Borun. Data were collected by Exploratorium staff members Mary Kidwell, Emily Pinkowitz, Heather Posner, and Deborah Siegel, and were tabulated by Mary Kidwell. The summative evaluation is designed to assess the impact of the exhibit on museum visitors and to determine to what extent it is achieving the goals of the exhibit developers.

Executive Summary

Tracking and Timing

Visitors spent an average of 17 minutes in the *Listen* exhibit. This is comparable to the average amount of time people spend in recent exhibits at The Franklin Institute. The exhibits at the Franklin are 5-6000 square feet, which is roughly comparable to the *Listen* exhibit at 6580 square feet. In a study of 110 exhibitions, Serrell found that the average time spent in an exhibition (regardless of size) was less than 20 minutes. The Sweep Rate Index (square feet / average time) for *Listen* is 387 which is lower (better) than the 110 exhibit average of 432.

In terms of “attracting power, Out-quiet Yourself was the most popular component of the *Listen* exhibit, attracting 46% of the visitors and earning a composite score (see p. 8) that is 60% higher than the next most popular exhibit. The next most popular stations were Play Alone, Play Together, Sonic Storytelling, and What’s Wrong with This Car? These stations had an average holding time of two to four minutes.

Other significant times were spent at: Hearing Health Risks, Soundscapes, Keeping the Beat, Sounds of Conflict, and Hole Saw Rhythms. Pitch Slider, which had an average holding time of just under one minute, attracted more than 40% of the visitors.

Exit Interviews

Expectations and Satisfaction

The largest group of people (39%) did not have expectations about the exhibit before they saw it. Of those who said the exhibit was not what they expected (27%) half of them (13.7%) said it was *better* than they expected.

“I didn't think there were that many aspects of sound.”

Comments of those who said the exhibit wasn't what they expected are given on page 15 below.

The exhibit components which people found particularly interesting or cited as favorites are: *Out-quiet Yourself, Echo Tube, Keeping the Beat, and Play Alone, Play Together.*

“It was interesting to see how much noise we make.” (at Out-quiet Yourself)

“When you clap it goes “ping.” I never knew that before.” (at Echo Tube)

“It's very interactive; the kids loved it.” (at Play alone, Play together)

About one quarter of the visitors did report having difficulty with an exhibit citing in particular *Listening While Talking* and *What's Wrong with this Car* (see Table 15).

Learning Science

People said that they learned about a lot of different facets of sound and listening in the exhibit including: resonance, the path of sound waves, echoes, frequency and volume, hearing loss, octaves, listening with and without sight, and being quiet. The fact that visitors reported enthusiastically that they had learned about so many aspects of sound and listening indicates that the Listen exhibit did successfully achieve its goals in terms of communication of content.

“I didn't know sound could travel though the ball like that.”

“Like how the echo travels up and comes back to you.”

“I learned what things resonate.”

“It was interesting to see the longer tube caught the lower frequencies of sound.”

“How the variations in frequency relate to pitch.”

Two thirds of the people noticed exhibits that deal with the role of the ears.

“How your ears help with the direction of sound. “

“As you got closer to them, they sounded different.”

“How your ear interacts with the different frequencies—[they] affect different parts of the ear.”

Nearly half of the sample remembered seeing exhibits dealing with the role of the brain in listening.

“I fooled my husband. I told him to hit me and he hit the other direction because I was standing on the other side.”

“It has to do with visualizing, when you hear sound, you have to visualize a picture.”

“Perception is a combination of brain and listening.”

Three quarters of the visitors were aware of exhibit stations that deal with the transmission of sound. They spoke of focus, waves, echoes, frequency, pitch, and resonance.

On the other hand, only twenty percent of the respondents said that they found out something about the effects of sound on the health of their ears. People with hearing problems were particularly aware of these exhibits.

“I’m going to turn down the TV and listen to the radio as low as possible.”

“It is important to wear earplugs if you will be in an environment that’s loud. Also it’s important not to turn up the volume too loud because you can damage your ears.”

Exhibition Techniques:

Respondents did not seem to feel strongly about the representation of people in the exhibit. Only one third of them said that they remembered seeing people. It may be that visitors are so used to video images of people that this did not register as a departure from standard science museum practice. The blind man in the BART station made the biggest impression.

“I wasn’t able to hear stuff he could because I can see.”

On the other hand, over one quarter of respondents did say the people made the exhibit better.

“It really pulled together different ways of listening, not everybody hears the same way.”

“Makes it more personal”

“It enhanced the experience very much so. In terms of the lady auto mechanic, we already had seen the car but went back to it and had a deeper appreciation of it.”

“Kids can’t visualize things, if they hear a story or an anecdote; it makes it easier to understand.”

Two thirds of the respondents thought headphones improved their experience.

“I don’t usually read instructions, so I liked it.”

“It helped to understand some of the experiments.”

Other people preferred printed explanations:

“[Hearphones are a] good idea for children especially who can't read well enough to get the gist. I am quicker at reading than listening.”

People did seem to feel that there was too much printed text in the exhibit.

“We found it to be too much. It's boring to read a lot.”

But the level of the text seems appropriate.

“All the instructions were easy. I liked that.”

Also, in terms of the density of the exhibit, most people said it is “about right”.

“It doesn't seem too cluttered. I liked the little sectioned off rooms, the audios and visual displays.”

Aspects of devices that people seemed to especially enjoy were those that were a bit challenging (e.g. *Out-quiet*) or surprising (e.g. *Echo*) allowed for open-ended play (e.g. *Keep the Beat*) or explained how things work.

Impact

About half of the people said they thought the exhibit changed the way they listen to sound.

“Just taught me to open my ears. More to listen to my surroundings so much noise/sound even though you think you're so quiet.”

“Thinking of common noises as beautiful sounds--sense of sound [is] heightened.”

“I heard different things in there than usual. I'm more of a visual person, so just listening for different things was interesting.”

“If [we] didn't have sound you would determine the world so differently.”

“It makes you really think about what listening means.”

“We watched the video on listening and they had the various short films about the jobs people had and the points they made we could use in our everyday life.”

“[The exhibit] just taught me to open my ears. More to listen to my surroundings, so much noise/sound even though you think you're so quiet.”

People who reflected on their own listening offered some interesting insights.

"I don't do enough of it. We take listening for granted."

"It allowed me to see how sounds play a role in life."

People also had some interesting reflections on listening skills:

"I had to be more aware of where sound is coming from. It improved my overall hearing because usually we have our eyes."

"Trying to listen to different channels that your ears can pick up."

"It heightened my awareness to how powerful listening can be--to be more aware of it when you close your eyes."

The exhibition received a lot of attention from musicians who associated the experiences to their music:

"I do play piano and guitar so I think about why and how sound comes. When you're tuning - you listen to it."

"I'm trying to make my own instruments so I want to remember to steal this (Sound Sculpture)."

"I have a specific interest in music. [I'm] interested in everything to do with music."

"I learned that an octave is 2 times or double the frequency. That was interesting because I play the piano."

"I'm a musician - my wife saw this exhibit yesterday with my kids and said "You have to go see this exhibit especially the pitch slider."

Finally, the *Listen* exhibit stimulated rich personal associations.

"I walk a labyrinth ...trying to be as quiet as possible. I never thought when I try to walk quietly how much noise there is still."

"I work with swords while we're blindfolded. We fight by hearing the swords move through the air - so it helped me with [sword] fighting."

"[The exhibit] reminded me of picking up sound from far away— trying to figure out what it is."

"In the MOMA in NY years ago they had a soundproof room with wood and you leaned with your elbows on the wood. Sound waves were conducted through the wood and you felt the sound and melody in your bone structure."

"Something I already do. I do quiet meditation. I do pay attention to sound. [The exhibit] reinforced this--helped me to identify sounds around me."

"When I was a little kid I wanted to live here at the Exploratorium."

Conclusions

The *Listen* exhibit is a rich, varied, multi-sensory and interactive experience. There is something for people of all ages to do and discover. The explanatory text is clear and understandable and most people were comfortable with the content, although they did say there could be less of it. The exhibit deals with sound creation, transmission and perception; with the role of the ears and brain in listening, and with the ways we use listening skills. People said that they had learned about many different aspects of sound and listening in the exhibit. While most people did not try to articulate how the exhibit helped them to develop listening skills, those who did make it clear that such skill development is facilitated by the Listen exhibit.

The experience was full of stimuli that triggered personal associations and memories which enhanced the exhibition's impact. In terms of communicating information on all aspects of sound, the exhibit certainly reached its goals. In terms of providing a compelling, engaging, enjoyable experience, the goals were exceeded.

Part I—Tracking and Timing

A tracking and timing study of visitors to the *Listen* exhibit took place from February 10 to March 4, 2007. Subjects age 10 and above were randomly selected and were tracked from station to station in the exhibit and the time spent at each component was recorded. A random sample of 89 visitors to the exhibit was tracked and timed. A minimum time of two minutes in the exhibit was needed in order to be counted. Tracking and timing gives a measure of the relative attracting (tracking) and holding power (timing) of each exhibit station. After a subject completed a visit to the *Listen* exhibit, a “sweep” count was made. This involves making a rapid count of the number of people at each exhibit station. Sweeps give another measure of the relative attracting power of the various stations.

Results

Visitors spent an average of 17 minutes in the Listen exhibit. This is comparable to the average amount of time people spend in recent exhibits at The Franklin Institute. The exhibits at the Franklin are 5-6000 square feet, which is roughly comparable to the Listen exhibit at 6580 square feet. See Table 2 for exhibit comparisons.

In her study of 110 exhibitions, Beverly Serrell found that the average time spent in an exhibition (regardless of size) ranged from 1 to 45 minutes and in 82% of the exhibitions, the average was under 20 minutes. (Serrell, Beverly. (1998), *Paying Attention: Visitors and Museum Exhibitions*, American Association of Museums, Wash. DC, p.19).

Serrell also defines a Sweep Rate Index (SRI) which is how quickly people go through the exhibit. This is the total square footage (6580) divided by the average amount of time people spend in the exhibit (17 minutes). *Listen* has an SRI of 387, which is lower (better) than the 110 exhibit average of 432. The lower the number, the slower the pace, the more time available for learning. (ibid, p. 24).

Table 1: Time Spent in the *Listen* exhibit

Mean time (minutes)	17
Range (minutes)	2-54
Median (minutes)	15

Table 2: Comparison to Time Spent in Franklin Institute Exhibits

Exhibit	Average Time
<i>Listen</i>	17 minutes
Air Show	14 minutes
The Sports Challenge	19 minutes
Trains	18 minutes
Space Command	17 minutes
The Giant Heart	15 minutes
Average of All TFI Exhibits	17 minutes

Table 3: Demographics of Tracking Sample

	Number	Percent
Adult Males	35	39
Adult Females	33	37
Boys (age 10-20)	12	14
Girls (aged 10-20)	9	10
Total	89	100

- *In terms of “attracting power,” Out-quiet Yourself was the most popular component of the Listen exhibit, attracting 46% of the visitors and earning a score that is 60% higher than the next most popular exhibit. The next most popular stations were Play Alone, Play Together, Sonic Storytelling, and What’s Wrong With This Car? These stations had an average holding time of two to four minutes.*
- *Other significant times were spent at: Hearing Health Risks, Soundscapes, Keeping the Beat, Sounds of Conflict, and Hole Saw Rhythms. Pitch Slider, which had an average holding time of just under one minute, attracted more than 40% of the visitors.*

Visitor comments in the Exit Interview section shed light on what people found particularly compelling about these devices.

Table 4: Tracking and Timing

Exhibit Station	Time at Display (Seconds)		% of Visitors ¹ (N=89)
	Mean	Range	
Out-quiet Yourself	206	3-867	46
Play Alone, Play Together	194	17-399	30
Sonic Storytelling	224	4-1,138	21
What’s Wrong With This Car?	110	5-750	42
Hearing Health Risks	219	9-547	12
Pitch Slider	57	3-150	42
Soundscapes	123	10-405	19
Keeping the Beat	107	2-359	18
See a Sound Wave	91	3-280	19
Sounds of Conflict	152	8-535	11
Hole Saw Rhythms	105	14-407	16
Delayed Speech	74	4-285	21
Listening Guide Theater	217	4-1,025	7
Jukebox	141	5-773	10
Catch the Sound Wave	35	3-104	39
What You Say, How You Say It	67	3-170	20
Find The Groove	72	3-240	17
Ear Tricks	44	12-120	27
Mysterious Melodies	114	28-260	10
Oscyllinderscope	41	3-150	27
Sound Spectrogram	84	5-223	12
Listening Sticks	55	6-161	18

			Questionnaire 1
Eavesdropping	80	23-162	12
Listening While Talking	43	5-130	22
Focused Conversation	42	7-132	22
Ear To The Ground	65	3-447	15
Sound Memories	61	5-199	15
Find The Sonic Focus	43	4-248	20
Sound Sculpture	37	4-89	21
Theremin	54	7-160	15
Shape The Soundscape	58	10-224	13
Echo Tube	42	11-102	18
Auditory Illusions	90	5-251	8
Resonators	24	3-116	28
Tone Memory	60	4-143	11
Electric Ear	99	6-259	6
Acoustic Navigation	62	5-171	9
No Peek Pong	53	2-150	10
Art Piece With Triangle, Pins	18	3-51	29
Find The Highest Note	57	26-95	8
Sound Puzzles	97	35-180	4
Listen Through	38	12-84	11
Find That Sound	60	17-128	7
Sound Bite	56	6-151	6
Intro Label at Stairs	16	3-52	11
Entry Label at Traits	13	4-28	9
Auditory Transduction	14	8-24	3

¹ Percent here is the percent of people in the tracking sample who stopped at this exhibit.

Note that in the Tracking and Timing table (Table 4), average time at an exhibit is based on the days the exhibit was on the floor during the tracking study. In other words, an exhibit is not penalized for being down on some of these occasions. This is not the case with the sweeps table (Table 5). Obviously, visitors could not be counted at an exhibit, if the exhibit was not on the floor or was not functioning.

Only four exhibits were down for a significant portion of the study: Electric Ear was down for 6 observations, Sound Bite for 17, Listening Sticks for 29, and Jukebox for 47. This fact only makes a big difference in calculation or ranking for Jukebox and Listening Sticks. For these two exhibits, it's probably best to look only at Table 4 (Tracking and Timing). The implications for exhibit maintenance are beyond the scope of this study.

Sweeps

A total of 88 sweeps was completed during the tracking and timing study. As mentioned above, sweeps give us another way of determining the relative appeal of different exhibit components. As can be seen from Table 5, the results are similar to the tracking and timing measures. A sweep gives a view of the exhibit at a moment in time. The observer “sweeps” through the exhibit rapidly counting the people at each display. The goal is not to count any person more than once. A sweep counts the number of people clustered around a component at the moment of the sweep, not just the individual “at the controls”. The advantage of doing sweeps is that it expands the sample size, giving input from many more visitors.

Table 5: SWEEPS (N=6,037)

Exhibit Station	Number	Percent of N	Mean Time (from Table 4)	Score²
Out-quiet Yourself	929	15.39	206	3170
Play Alone, Play Together	348	5.76	194	1117
What’s Wrong With This Car?	254	4.21	110	463
Hearing Health Risks	240	3.98	219	872
Keeping The Beat	232	3.84	107	411
Sonic Storytelling	215	3.56	224	797
Pitch Slider	187	3.10	57	177
Echo Tube	185	3.06	42	129
Listening Guide Theater	156	2.58	217	560
Soundscapes	153	2.53	123	311
Ear Tricks	148	2.45	44	108
What You Say, How You Say It	145	2.40	67	161
Acoustic Navigation	137	2.27	62	141
Delayed Speech	134	2.22	74	164
Auditory Illusions	129	2.14	90	193
Catch The Sound Wave	121	2.00	35	70
See A Sound Wave	117	1.94	91	177
No Peek Pong	114	1.89	53	100
Hole Saw Rhythms	111	1.84	105	193

SWEEPS continued

Exhibit Station	Number	Percent of N	Mean Time (from Table 4)	Score ²
Listening Sticks	104	1.72	55	95
Mysterious Melodies	101	1.67	114	190
Find That Sound	100	1.66	60	100
Jukebox	97	1.61	141	227
Eavesdropping	92	1.52	80	122
Oscylinderscope	91	1.51	41	62
Find The Groove	90	1.49	72	107
Sounds of Conflict	86	1.42	152	216
Listening While Talking	85	1.41	43	61
Ear To The Ground	83	1.37	65	89
Sound Spectrogram	82	1.36	84	114
Sound Sculpture	77	1.28	37	47
Listen Through	76	1.26	38	48
Sound Puzzles	75	1.24	97	120
Shape The Soundscape	74	1.23	58	71
Sound Memories	73	1.21	61	74
Focused Conversation	63	1.04	42	44
Sound Bite	60	0.99	56	55
Auditory Transduction	58	0.96	14	13
Art Piece With Triangle, Pins	55	0.91	18	16
Tone Memory	55	0.91	60	55
Find The Highest Note	54	0.89	57	51
Theremin	53	0.88	54	48
Find The Sonic Focus	52	0.86	43	37
Electric Ear	49	0.81	99	80
Resonators	48	0.80	24	19
Entry Label at Stairs	26	0.43	16	7
Entry Label at Traits	23	0.38	13	5

*Asterisk indicates exhibits that were down or off the floor for a significant portion of the sweeps.

² *Score* is the average time at a display (from Table 4) multiplied by the percentage, from the sweeps table (Table 5) of visitors who stop at that display. *Score* gives us another way of comparing the impact of different exhibit stations. It combines the average time at a display (from the individual tracking and timing) and the number of people who stop at the display (from the sweeps data).

Note that the number of people at *Out-quiet* is so high because the people who were standing in line were counted as “at the exhibit” for the sweeps.

Part II—Exit Interview¹

This portion of the summative evaluation is based on data collected using two questionnaires: 51 interviews were conducted on weekends between February 10 and 25, 2007 using Questionnaire 1 and 55 interviews were conducted on weekends between February 17 and 25, 2007 using Questionnaire 2. Subjects age 10 and above were selected through random sampling with half being interviewed at each of the two entrance/exits to the exhibit: the Stairs and at the entrance to the adjacent *Traits of Life* exhibit. Results of the two instruments are presented in sequence by question below. Two separate instruments were used because one would have been too long. Questions were distributed between the two so that both contained some simple observations as well as some open-ended personal reflections. The first questionnaire focuses somewhat more on exhibit characteristics. The second instrument asks about what was learned. But, some questions were moved from one to the other in an attempt to balance the amount of time it took to answer the questions.

Questionnaire 1

Table 6: Location of Interviews

	Number	Percent
Stairs	25	49
Traits	26	51
Totals	51	100

1. In what city do you live?

- *Most respondents are from California, outside of San Francisco.*

Table 7: Residence

	Number	Percent
San Francisco	11	22
Other California	35	69
Other state*	4	8
Other country	1	2
Totals	51	100

* One each from Michigan, Oregon, Texas, West Virginia

2. Age and Gender

- *The sample is evenly distributed by gender with the majority of people in the 30-49 year age group.*

¹ *Some percents do not add up to 100 due to rounding.
When more than one person gave the same answer the number is in ().*

Table 8: Age and Gender

	Total		Males		Females	
10 - 14	6	12%	3	6%	3	6%
15 - 19	1	2%	1	2%		
20 - 29	8	16%	2	4%	6	12%
30 - 39	12	24%	7	14%	5	10%
40 - 49	19	37%	12	24%	7	14%
50 - 59	3	6%	1	2%	2	4%
60+	2	4%			2	4%
Totals	51	101%	26	51%	25	49%

3. How many people are in your group today?

- *The largest grouping of people came in groups of two.*
- *No singletons (one person) were recorded.*

Table 9: Group Size

	Number	Percent
Two	19	37
Three	9	18
Four	9	18
Five	3	6
Six	2	4
More than six	9	18
Totals	51	100

4. With whom did you come to this museum? (Please check only one)

- *Most people were in family groups.*

Table 10: Group Type

	Number	Percent
Family	37	73
Friends	11	22
Organized group*	3	6
Totals	51	100

*One each: Police Activities League, College of the Redwoods, A Dad's Group

5. What would you say this area is about? (multiple answers accepted)

- *The largest group of respondents said the exhibit is about sound.*

Sound (34)

Listening (13)

Hearing (11)

Perceptions of sound (7)

Different sounds (5)

How the brain processes sound (4)

Sound wavelengths (3)

Frequency (3)

Your senses (3)

Music (2)

How sound travels (2)

It's a sound boot – electrical (2)

Sound vibrations (2)

Learning about the different components of sound, things that affect sound, the energy that makes it not just noise (2)

Resonance (1)

Dynamics of sound (1)

Echoes (1)

The physics of and the science of sound (1)

Sound systems, sound mechanisms (1)

Developing different types of Listening capacities (1)

Experimenting with sound and rhythm (1)

6. Have you seen this area before today?

If yes, including today, how many times have you seen it?

- *Most people were first time visitors to the exhibit.*

Table 11: Repeat Visits

	Number	Percent
Yes*	8	16
No	43	84
Totals	51	100
*Number of Times Before		
One /Two	5	63
Four /Five	2	25
Ten	1	13

7. Did you see what you thought you would in this area?

- *The largest group of people (39%) did not have expectations about the exhibit before they saw it. Of those who said the exhibit was not what they expected (27%), half (7/14) said it was **better** than they expected.*

Table 12: Saw What Expected

	Number	Percent
Yes	17	33
No expectations	20	39
No	14	27
Totals	51	99

If you **didn't** see what you thought you would, what was different? (multiple answers accepted)

Better than expected (7)

I haven't been here since it's been re-done; a lot of this is new.

I went up to watch the dissection then there was all this sound stuff.

There weren't as many noise-making devices as there were listening devices.

I didn't think there were that many aspects of sound.

There was a lot of different stuff, I learned a lot.

I'm a musician - my wife saw this exhibit yesterday with my kids and said "You have to go see this exhibit especially the pitch slider (#32)." I was expecting to see more instruments. Not disappointed just different expectations.

8. Was there anything in the area that you found especially interesting?

Table 13: Something especially Interesting

	Number	Percent
Yes	44	86
No	7	14
Totals	51	100

Can you say a little bit more about that??

- The exhibit components which people found particularly interesting are: *Out-quiet Yourself*, *the Echo Tube*, and *Keeping the Beat*.
- Aspects of devices that people seemed to especially enjoy were those that were a bit challenging (e.g. *Out-quiet*) or surprising (e.g. *Echo*) or allowed for open-ended play (e.g. *Keep the Beat*) or explained how things work (e.g. *See a Wave*, *Car*, *Oscyllindescope*). There is something to appeal to many different kinds of learners.

Exhibit	N	Comments
Everything	2	It was all really cool.
Out-quiet yourself	10	Fun to try to beat yourself. Hands-on and interactive more than other ones. It was interesting for the kids and hard to do. I never tried walking on rocks before. It was interesting to see how much noise we make. I like it because it's very challenging and not boring. It was different. I liked the activity and the feedback at the end. I liked seeing how silent you could go.
Echo tube	6	It's cool. I never heard my echo that distinct before. When you clap it goes "ping." I never knew that before. Fun. Being able to say anything you want and having it come back.
Keeping the beat	5	It gets really specific in the sound. She (child) loved it. The electric drum kit was new--especially the choice of music.
Catch the sound waves	4	The tones are like colors, sounds out there; they vibrate and make different tones. Sounds like a pipe organ over there.
Ear tricks	4	I'd like to walk around the whole place with them [head phones] on.
See a sound wave	4	It was very educational how sound is made. Cool It let you do little things with the water. The way the frequency and the volume affects the physical materials. It helped showing my daughter what sound waves looked like.
Oscyllindescope	4	You see how guitar strings move but you never experience it in different ways We always tell our son about how vibrations in the air make the sounds. It was neat for him to actually see the vibrations on the string.
What's wrong with this car?	3	Because we use a car every day and I never know what's inside. I like trying to figure things out.
Focused conversation	3	I wasn't aware you could talk through a balloon like that. It was interesting. The balloon was fascinating.
Play alone, Play together	3	
Soundscapes	2	It was a group activity
Sonic story telling	2	Fun. It's interactive.
What you say, How you say it	2	Neat concept. Also, it is away from the noise of the museum and you are able to

		concentrate.
Tone memory	2	I'm into music so it was interesting to me to see how close I could get.
Pitcher slide	2	Kids loved the slide.
Mysterious melodies	2	
Resonators	1	
Listening through	1	
Auditory illusions	1	Easy to understand, easy directions, did not take a long time and it worked.
Eavesdropping	1	Makes you aware of sounds.
Sound spectrogram	1	(No comment)
Listening sticks	1	“
Delayed speech	1	“
Find the highest note	1	“
Health risks	1	“
No Peek Pong	1	“
Find that sound	1	“
Acoustic navigation	1	“
Jukebox	1	“
Listening guide theater	1	“
Sound memories	1	“
		The things my son liked, they're what I liked too.

9. Were there any stations that were too hard or that you couldn't get to work?

- *About one quarter of the visitors reported having difficulty with an exhibit including: Listening While Talking and What's Wrong with this Car.*

Table 15: Too Hard or Not Working

	Number	Percent
Yes	12	24
No	39	76
Totals	51	100

If “yes”, which ones?

Exhibit	N	Comments
Listening while talking	3	I didn't hear it when I started talking. We couldn't get it to work. I couldn't get the joke thing to work.
What's wrong with this car?	2	We couldn't tell what the car was doing.
Resonators	1	For child
Eavesdropping	1	For child
Listening sticks	1	
Focused conversation	1	Maybe we were just standing in the wrong spot.
Acoustic Navigation	1	Really hard to focus
Jukebox	1	
Oscyllindescope	1	Tried to focus on that but he couldn't hear.
		There are a few that you lose patience with. Some were too crowded and we didn't want to take the time to wait. A couple were broken but that was indicated. It was just busy. I didn't understand some of it. Never been here before so everything is foreign.

10. Did you find out anything new about sound in this area?

- *People cited a lot of different facets of sound and listening that they learned about in the exhibit including: resonance, the path of sound waves, echoes, frequency and volume, hearing loss, octaves, listening with and without sight, and being quiet.*

Exhibit	N	Comments
Focused conversation	3	Sound goes through balloons. I learned what things resonate. I didn't realize you could bend sound waves, then bend them back and focus sound that way.
Echo tube	2	Just when you clap you hands it goes "ping." If you make a word, the echo comes back. If you make different noises, it changes the further down the tube it gets.
What's wrong with this car?	1	Frequency and volume and how it works.
Hearing health risks	1	My hearing isn't what it used to be. He (son) could hear much higher than me.
Tone memory	1	I learned that an octave is 2 times or double the frequency. That was interesting because I play the piano.
Ear tricks	1	The animal ones sound different
Acoustic navigation	1	Stuff is different when you're looking and listening versus closing your eyes and listening. You got to see how other people hear.
Out-quiet yourself	1	It's hard to walk on rocks quiet
Listen through	1	The different way things resonate.
Mysterious melodies	1	Sound is still recognizable in different octaves.
Keeping the beat	1	(No comment)

New understandings that were not about a specific exhibit:

Yes, I learned something but can't say what. (3)
 No learning for adults but for children (3)
 I learned ways to make different sounds and how sound waves work.
 Wave frequency, sound waves
 The definition of rhythm, because I'm not a musical person
 That I'm losing my hearing. Says normal range is between 20-30 megahertz and mine isn't.
 Thinking more about hearing. I'm into smelling. Smell provokes memory. But sound is good

Comments from people who said they did not learn anything new:

Sound can be fun
 It's fascinating how many different ways you can have an experiment.
 It made me more aware of it. Maybe for music purposes, the thing on the end (#3 Catch the Sound Waves) there are different notes, someone could make music out of it, like effortless tones. Each one is a note; you could record it on to a digital thing, and make a song.
 Reminded me more of things I had forgotten.
 The wave aspects, to see visually in different ways, was cool. (#38 See Sound Wave)

- *Note that these are visitors' self-reports. We do not have direct measures of learning in the Listen exhibit. For the latter, we would have had to administer pre/post tests of learning, which would be extremely difficult and most inappropriate in the free-choice, informal environment of the science museum. However, the fact that visitors reported enthusiastically that they had learned about so many aspects of sound and listening indicates that the Listen exhibit did successfully achieve its goals in terms of communication of content.*

11. In this area, there are examples of people who use listening in their daily lives. Do you remember any of these people?

- *Only one third of the respondents remembered the people in the exhibit. The blind man in the BART station made the biggest impression.*

Table 18: Notice the People

	Number	Percent
Yes	17	33
No	34	67
Totals	51	100

If yes, can you tell me about one of these people?

Exhibit	N	Comments
Acoustic navigation	7	We actually sat down on one, the blind man walking through the subway stations. I wasn't able to hear stuff he could because I can see. The blind man on the BART. (2) That was cool. The gentleman who takes you on a tour of the BART. The blind people. (2)
Listening Guide Theater	3	I remember the blind guy. The auto mechanic, the wildlife tracker, the guy with the cochlear implant. We were watching the female auto mechanic...very interesting.
Sound memories	3	One girl was talking about how her dad was snoring and she thought it was a bear. The girl with pink hair talking about camping. How it was dark so she didn't know what sounds were and had to listen. The couple in the photo booth. On his wedding day the man sang a song.
Sonic story telling	1	(No comment)
Ear to the ground	1	(No comment)

Do you remember any others?

Guy talking about Niagara Falls (#36 Sound Memories)

The blind guy (#33 Listening Guide Theatre)

The fellow who had drumsticks (#43 Ear to the Ground)

12. What do you think about having those people included in this area?

- *Over one quarter of the respondents did say the people made the exhibit better. However, most people did not answer this question.*

Table 20: Role of People

Did they make things:	Number	Percent
Better	15	29
No difference	2	4
Worse		
No answer	34	67
Totals	51	100

Can you say a little more about that?

It was interesting. (2)

Actual people, you could see how they hear and stuff. (2)

Fun introduction to what you'll be finding out

It really pulled together different ways of listening, not everybody hears the same way.

Makes it more personal

I'll pay more attention to listening. Won't turn music up so loud

I have a specific interest in music. [I'm] interested in everything to do with music.

Educational

It enhanced the experience very much so. In terms of the lady auto mechanic (#33 Listening Guide Theater), we already had seen the car (#6 What's Wrong) but went back to it and had a deeper appreciation of it.

Cause you got to find out some stories about some people. I only listened to the bear one. It was really funny how she was in her sleeping bag and she thought it was a bear. (#36 Sound Memories)

Kids can't visualize things, if they hear a story or an anecdote; it makes it easier to understand.

Having a visual aid is helpful. With him (son) I can't spend enough time before he's off to the next thing. But visual aids are helpful in that regard.

She (child) seemed bored by the presentation so we only stayed about 45 seconds (#28 Acoustic Navigation).

13. Did you see anything in this area that dealt with the role of your ears in listening?

- *Two thirds of the subjects noticed exhibits that deal with the role of the ears.*

Table 21: Noticed Role of ears

	Number	Percent
Yes	34	67
No	17	33
Totals	51	100

If yes, what?

Exhibit	N	Comments
Everything	3	
Ear tricks	9	The deer ones there was no difference. The reverse one tricks your brain into hearing sounds coming from different directions. How they [deer] hear different by how their ears are shaped. How your ears help with the direction of sound. I fooled my husband. I told him to hit me and he hit the other direction because I was standing on the other side.
Catch the sound waves	6	As you got closer to them, they sounded different. Capturing all that ambient sound. Interesting the way it separates out the sound. Held my attention.
Hearing health risks	4	It showed how parts of your cells would react. How your ear interacts with the different frequencies--affects different parts of the ear.
Resonators	2	I'm not sure if they're specifically having to do with ears, but they were really interesting. Not actually anything about the structure of the ear though.
What you say, how you say it	2	Sounds can be perceived in different ways depending on your location. You hear different things in different places.
Audio transduction Movie	2	The parts of the ear and how it works. I know a little bit about that but I haven't seen it for a while. What parts of the ear hear what sounds, was interesting. How your ear moves when sound comes.
Acoustic navigation	2	The audio tour with the blind man was a very detailed example of that.
Shape the soundscape	1	(No comment)
Listening while talking	1	"
Focused conversation	1	"
Electric ear	1	Signals to your brain
Find the highest note	1	Range of sounds
Find that sound	1	(No comment)

14. Did you see anything in this area that dealt with how your brain interprets (makes sense of) sound?

- *Nearly half of the sample remembered something dealing with the role of the brain in listening.*

Table 23: Noticed Role of Brain

	Number	Percent
Yes	24	47
No	27	53
Totals	51	100

If yes, what?

Table 24: Exhibits Showing Role of Brain in Listening

ID #	Exhibit	N	Comments
6	What's wrong with this car?	2	You had to think.
26	No peek pong	2	It has to do with visualizing, when you hear sound, you have to visualize a picture.
27	Find that sound	2	You have to determine where it's coming from. Hear sounds from different directions
17	Delayed speech	1	
19	Auditory transduction	1	Couldn't hear without the little hairs. Needs those to tell nerves about sound
20	Find the highest note	1	(No comment)
24	Sound bite	1	(No comment)
30	Out quiet yourself	1	(No comment)
32	Slide pitch slider	1	(No comment)
33	Listening Guide theater	1	The video about the cochlear implants
34	Mysterious melodies	1	You adjusted the notes into octaves and your brain still recognized it.
	Other	2	Perception is a combination of brain and listening. All of them, now I understand the reason we listen to sound, I never think about the mechanism.

Again, it is very difficult to try to find out how much learning occurred in an exhibit. We generally rely on visitors' self-reports. Since visitors will focus on those parts of an exhibition that catch their eye or attract them in some way, and do not make an exhaustive survey of the interactives, it's hard to know what percentage of the audience actually learned a particular kind of information. That's why the tracking, timing and sweeps studies are important. They tell us how many people stopped at, or had an opportunity to learn particular concepts.

15. Around this area there were white cones that played audio instructions for some exhibits...did you ever listen to one of those cones?

- *About half of the people said they listened to the headphones.*

Table 25: Use Headphones

	Number	Percent
Yes	24	47
No	27	53
Totals	51	100

How did it affect your experience? Did it make it:

- *Of the people who used them, two thirds of the respondents thought headphones improved their experience.*

Table 26: Value of Headphones

Did they make	Number	Percent
Better	16	67
No difference	8	33
Worse		
Totals	24	100

Can you say a little more about that?

It helped to understand some of the experiments. (7)

Sets up an introduction so you know what's going on. (4)

Thought that it was cool you had listening cones.

A brief moment to sit and listen

I listened to it at Ear Tricks (25). I don't think it was clear what they were for. I'd already played with the headphones at Ear Tricks, so the instructions on the white cone were moot for me.

A few were a little too loud. The one on Mysterious Melodies (#34) was too loud.

I listened to about half, then stopped. I could figure it out.

Some people may find them helpful, but the directions were clear.

I listened to what people think about music. It showed how some people think one sound is music, and some think another sound is music (#31 Jukebox).

I picked up the one for the tubes one (#3 Catch the Sound Wave). I always like explanations. It's nice to experience something without being told what it is, to come up with your own ideas, and THEN you can listen to it.

I usually read the descriptions.

I don't usually read instructions, so I liked it.

I assumed it was for people who couldn't...or people who won't read. I listened for 3 seconds. Good idea for children especially who can't read well enough to get the gist. I am quicker at reading than listening.

- *In an unpublished study conducted by this researcher, of the relative effectiveness of print, audio, and video for explanatory information, both audio and video attracted significantly more attention and higher dwell times than printed labels. However, it bears mentioning that qualitative data in the form of respondent comments showed that each of the three media had its strong proponents. What emerged was a picture of variation in learning styles.*

QUESTIONNAIRE 2

Table 27: Location of Interviews-Questionnaire 2

	Number	Percent
Stairs	28	51
Traits	27	49
Totals	55	100

1. In what city do you live?

- *Again over half of the sample was from California outside of San Francisco.*

Table 28: Residence--Questionnaire 2

	Number	Percent
San Francisco	10	18
Other California	32	58
Other state*	9	16
Other country**	4	7
Totals	55	100

* Three from Nevada one each from Kansas, Massachusetts, Missouri, Oregon, Texas, Virginia

** One each from England, Italy, France, Venezuela

2. Age and Gender

- *The largest group of people was in the 20-49 year old age group.*

Table 29: Age and Gender—Questionnaire 2

	Total		Males		Females	
	Number	Percent	Number	Percent	Number	Percent
10 - 14	2	4%	1	2%	1	2%
15 - 19	3	5%			3	6%
20 - 29	11	20%	3	6%	8	15%
30 - 39	17	31%	12	22%	5	9%
40 - 49	12	22%	5	9%	7	13%
50 - 59	5	9%	3	6%	2	4%
60+	5	9%	4	7%	1	2%
Totals	55	100%	28	51%	27	49%

3. How many people are in your group today?

- *People tended to come in groups of two or three.*

Table 30: Group Size—Questionnaire 2

	Number	Percent
Two	13	24
Three	14	26
Four	10	18
Five	8	15
Six		
More than six	10	18
Totals	55	100

4. With whom did you come to this museum? (Please check only one)

- *Three quarters of respondents came in family groups.*

Table 31: Group Composition—Questionnaire 2

	Number	Percent
Family	43	78
Friends	9	16
Organized group*	2	4
Other**	1	2
Totals	55	100

*One each: Boy Scouts, University

** Nanny

5. What do you think about the amount of written information in this area; was it:

- *People did seem to feel that there was too much printed text in the exhibit.*

Table 32: Amount of Text

	Number	Percent
Too much	46	84
Too little	4	7
About right	3	6
No answer	2	4
Totals	55	100

Comments

Could not read it because of kids (3)

Need more information (2)

Not enough information on the controls for all the exhibits.

It would be nice if there were more information somewhere for people who are students. Maybe a bibliography or web site addresses.

It was a lot, but not too much.

Not as much as the rest [of the museum].

There is a lot.

It was above the six year old level, so our kids didn't get it. Maybe next year it will be better.

We found it to be too much. It's boring to read a lot.

For little guys there's too much. Some exhibits don't seem age appropriate for kids.

The above comments are voluntary and all comments are listed. Thus, they have not been selected to reinforce the quantitative data. Rather, they show the range of opinions visitors chose to express. The quantitative data in Table 32 above do indicate that visitors felt their was too much text.

By science museum standards, the text in *Listen* was fairly limited. It may be that people felt that the density of interactives and the complexity of the experiences was such that they didn't want to take the time to read the text.

6. What do you think about the appearance of the area; is it:

- *In terms of the density of the exhibit, most people said it is "about right".*

Table 33: Density of Components

	Number	Percent
Too sparse	2	4
Too cluttered	5	9
About right	47	85
No answer	1	2
Totals	55	100

Can you say a little more about that? (multiple answers accepted)

Cluttered:

Maybe a little cluttered, but where are you going to put more? After all, that's why you come back more than once.

Need a few more exhibits. People are piling up at exhibits. Need to spread them out.

Too close to each other. Get in people's way.

A bit cluttered in parts. Not enough room for kids to move through.

There was a look of "many," rather than focus. Even a painted circle around an activity would have been good.

Not cluttered:

It wasn't cluttered. I liked all the sound stuff.

I remember it looking cluttered, it feels less now.

It doesn't seem too cluttered. I liked the little sectioned off rooms, the audios and visual displays.

Other comments:

It was too dark. (3)

It was kind of hard to follow. It didn't have a logical pattern to go around—the kids were running all over the place (2)

It's attractive. (2)

It was fine. (2)

The focus was on sound, so there weren't that many visuals. (2)

All they had was headphones, and you couldn't tell what going on until you went up and read it.

This is the best children's museum I've been in. I love that it is interactive. When they are little, they can just do stuff, and later they can read. It is a museum that will grow with them.

All the instructions were easy. I liked that.

It was fun over all.

I liked the walls.

It looks different from the rest of the Exploratorium. It is a stand alone experience, and has more elaborate things—the xylophones (#37), the radio sound effects (#7)

It's good. Nice because you can touch the stuff.

It was hard to get to some of the exhibits and experience them because you had to go one at a time. You had to wait to get the headphones. This differed from exhibits downstairs where a bunch of people could gather around. There, though one person might be directly interacting with the exhibit, observers could see the effect.

- *People did acknowledge that it is more difficult to create group experiences with an exhibition about listening. The comments here are to some extent indicative of a problem encountered with success i.e. crowding!*

7. Which exhibit station(s) in this area did you like best? (multiple answers accepted)

- *Favorite exhibits were: Play Alone Play together, Out-quiet Yourself, and Keeping the Beat.*
- *This is similar to the exhibits listed as interesting in Questionnaire 1 (i.e. Out-quiet Yourself, the Echo Tube, and Keeping the Beat).*

Exhibit	N	Comments
Everything	5	
Play alone, Play together	10	It's very interactive; the kids loved it. It was more for the kids. Cool
Out-quiet yourself	9	I get to do it. When it's really interactive like that it's fun.
Keeping the beat	6	The kids liked them.
What you say How you say it	4	
Focused conversation	4	
Echo tube	4	
Sonic story telling	3	The kids loved making the movie.
See a sound wave	3	It really illustrates something very well.
Catch the sound waves	2	
Shape the soundscape	2	Maybe there could be more written instructions about that.
What's wrong with this car?	2	The kids liked that one. My 3-year-old son loves cars. This was the first time he could actually touch the engine without it being too hot. He stayed there a long time.
Listening sticks	2	Fun
Delayed speech	2	(No comment)
Ear tricks	2	Kids could put those on and walk around.
No Peek Pong	2	It was fun.
Jukebox	2	Really cool
Pitcher slide	2	It makes noise. It was fun.
Soundscapes	1	(No comment)
Resonators	1	“
Listening through	1	“
Sounds of conflict	1	“
Listening guide theater	1	“
Mysterious melodies	1	“
Theremin	1	I like the sound, I like creating a sound like that.
Find the sonic focus	1	(No comment)
Hole saw	1	I just liked it.

8. Did you see any exhibits that dealt with how sound is transmitted?

- *Three quarters of the visitors were aware of exhibit stations that dealt with the transmission of sound. They spoke of focus, waves, echoes, frequency, pitch, and resonance.*

Table 35: Noticed Exhibits on Sound Transmission

	Number	Percent
Yes	41	75
No	14	25
Totals	55	100

If yes, what do you remember about this?

Exhibit	N	Comments
All exhibits	2	Almost all dealt with it on some level; but they're all coming at it from a different perspective, I liked it.
Focused conversation	8	That was pretty interesting We had fun with that. It (sound) went better through the center (of the balloon). Little kids can figure out you can talk through a balloon - here on a grander scale
See a sound wave	8	Had a lot of fun with it.
Echo tube	7	Like how the echo travels up and comes back to you.
Catch the sound waves	4	It was interesting to see the longer tube caught the lower frequencies of sound. The tubes over there were cool, where you could hear different frequencies.
Pitcher slide	3	How the variations in frequency relate to pitch.
Listening through	2	
Oscyllindescope	2	
What you say, How you say it	1	
Listening while talking	1	
Eavesdropping	1	
Electric ear	1	
Audio transduction	1	
Fine the highest note	1	
Sound bite	1	
Ear tricks	1	
Out-quiet yourself	1	
Find the sonic focus	1	
Other comments		The ones about sound waves. It would be good to have something with better explanation of how sound waves travel through the air and how it is transmitted Sound comes from vibration. We watched a thing on the Magic School Bus about that.

9. Did you find out anything in this area about the effects of sound on the health of your ears?

- *Only twenty percent of the respondents noticed and were able to comment upon exhibits about the health effects of sound. People with hearing problems were particularly aware of this issue.*

Table 37: Learned Something New

	Number	Percent
Yes	11	20
No	44	80
Totals	55	100

If yes, what did you learn?

Exhibit	N	Comments
Everything		
Hearing health risks	3	It is important to wear earplugs if you will be in an environment that's loud. Also it's important not to turn up the volume too loud because you can damage your ears. I couldn't hear the high-end frequencies, I couldn't even hear 14,000 cycles. The iPod-- how long you're supposed to listen to it for.
Shape the soundscape	1	
What you say How you say it	1	Where you put helmets on and move faster and slower and there is sound on your ears
Electric ear	1	Where it shows the different implants in your ears.
Other comments		If too loud would affect [my hearing]. I have a sensitive ear so if it's too loud I can't listen to it. I have some concerns about that, although I hear really well right now. My hearing is not good.

10. Do you think the exhibit stations in this area may have changed the way you listen to sounds?

- *About half of the people said they thought the exhibit changed the way they listen to sounds.*
 - *“Just taught me to open my ears. More to listen to my surroundings so much noise/sound even though you think you're so quiet.”*

Table: 39: Changed Listening

	Number	Percent
Yes	30	55
No	24	44
No answer	1	2
Totals	55	100

If yes, can you say a bit more about that? (multiple answers accepted)

Exhibit	N	Comments
Ear tricks	5	Your perception can trick you. It was different because you had an animal perspective or a backwards perspective. That's funny
Listening guide theater	4	When he was in the rain - how certain things affect how you hear - how you hear when a car comes. Made me think about how much I don't hear. We watched the video on listening and they had the various short films about the jobs people had and the points they made we could use in our everyday life
Catch the sound waves	2	(No comment)
No Peek Pong	2	You can know from where the sound arrived without seeing
Mysterious melodies	2	I didn't realize how much change there was in octaves, variations on sounds that are familiar.
Play alone, Play together	2	Never played with a xylophone before.
Soundscapes	1	
Sounds of conflict	1	Made me think "oh that's what I am doing."
Sound sculpture	1	I'm trying to make my own instruments so I want to remember to steal this.
Find that sound	1	
Acoustic navigation	1	It gave me some insight into what it's like to not be able to see
Out-quiet yourself	1	Just taught me to open my ears-- to listen to my surroundings so much noise/sound even though you think you're so quiet
Oscyllindescope	1	See the effect of the strings moving, the tension, change in pitch, change in volume.
Keeping the beat	1	(No comment)
Ear to the ground	1	(No comment)
Hole saw rhythms	1	Hearing weird objects making different sounds.

Other comments:

Just being more attentive to sounds (6)

It makes you really think about what listening means.

Noticing that acoustics have a lot to do with sound. My classroom has bad acoustics. The kids sound louder than they really are.

Not for me, but as kids they are like "that's how it works."

For him (her child), yes. Experiences like these, learning to pay attention. These are what we call adventure days - experience something new.

I work with swords while we're blindfolded. We fight by hearing the swords move through the air - so it helped me with fighting (form of samurai sword fighting).

Maybe/perhaps (5)

Maybe next year when they're older.

11. Did you find out anything about your own listening that seemed new to you?

- *People who reflected on their own listening offered some interesting insights.*
 - *"I don't do enough of it. We take listening for granted."*

Table 41: Listening Insights

	Number	Percent
Yes	16	29
No	39	71
Totals	55	100

If yes, can you say a little bit more about that?

Exhibit	N	Comments
Auditory illusions	2	Like the perception, if you close your eyes it sounds different when there is a visual. Like the da-da ba-ba, or bouncing ball. Where the balls seem to either hit or pass through each other. Interesting to see that my interpretation changed with the sound.
Focused conversation	1	I didn't know sound could travel though the ball like that.
Hearing Health risks		The station that said people can hear varying degrees of low sounds. I was surprised to find I have different abilities than the person using the station before me.
Ear tricks	1	I was surprised by the headgear where you hear from the other side. I realized how bi-modal, or how oriented we are to hearing right and left sounds
Echo tube	1	I wish it was longer or spiraled like a tuba.
Play alone, Play together	1	I don't tend to listen to individual tones. Xylophone really made that happen, especially when 2 kids and 2 music students were in there. I followed suggestions to hit one at a time... difference between metal and wood and even the two woods.
Other comments		I'm going to turn down the TV and listen to the radio as low as possible. I'm losing my hearing. (2) I don't do enough of it. We take listening for granted. (2) The frequency loss How high I could listen to sounds on the frequency meter. That was cool.

**12. Was there anything in this area that allowed you to develop some sort of listening skill?
Or maybe to get better at something you already do?**

- *People also had some interesting reflections on listening skills:*
 - *“I had to be more aware of where sound is coming from. It improved my overall hearing because usually we have our eyes.”*
 - *“Trying to listen to different channels that your ears can pick up.”*

Table 43: Develop New Skills

	Number	Percent
Yes	21	38
No	33	60
No answer	1	2
Totals	55	100

If yes, could you say a bit more about that? (multiple answers accepted)

Exhibit	N	Comments
No Peek Pong	3	Identify where sounds were coming from. I had to be more aware of where sound is coming from. It improved my overall hearing because usually we have our eyes. Try to equalize the sound across ears, so balance phone between ears
Out-quiet yourself	2	I appreciated the instructions, how to really think about what you're doing and be aware of what you're doing in nature.
Listening guide theater	2	The whole idea when you're blind or deaf - focus in on certain sounds - guides your whole life.
Catch the sound waves	1	When you hear the low ones, differentiating between some of them when you listen.
Listening while talking	1	(No comment)
Electric ear	1	Trying to listen to different channels that your ears can pick up.
Auditory transduction	1	Made me think of the question all musicians ask, "What is music?"
Find that sound	1	Identifying where sounds were coming from.
Mysterious melodies	1	Normally I think of myself as pretty good at hearing music, but I had trouble with that one.
See a sound wave	1	Interesting to see sound you can't hear.
Find the sonic focus	1	Move to sides and hear so differently from standing in the center.
Keeping the beat	1	For the kids, the ability to select when to hit a drum and the different sounds that come through it.
Find the groove	1	I didn't realize how many rhythms make up a backbeat, the actual rhythm you hear in a song. It takes it to a different level. It gives me more respect for people who mix music too.

General comments:

Sitting down and taking your time to really listen. All the ones with headphones - I looked at a lot of them. Putting on the headphones helped me slow down and really listen.

Something I already do. I do quiet meditation. I do pay attention to sound. [The exhibit] reinforced this. Helped me to identify sounds around me.

Since they're all about listening, you tune up, and become more aware.

The stuff that deals with music because I play instruments.

Slowing down and having to pay attention.

Patience and trying to work everything out and just focus.

I do play piano and guitar so I think about why and how sound comes. When you're tuning - you listen to it.

It heightened my awareness to how powerful listening can be. To be more aware of it when you close your eyes.

- *While most people did not try to articulate how the exhibit helped them to develop listening skills, those who did make it clear that such skill development is facilitated by the Listen exhibit.*

13. Did this area remind you of anything in your life outside the museum?

- *The exhibition stimulated many rich personal associations.*

Table 45: Stimulated Associations

	Number	Percent
Yes	39	71
No	16	29
Totals	55	100

If yes, what did it remind you of?

Exhibit	N	Comments
What's wrong with this car?	2	It just required better listening. Car problems, looking at the car.
Delayed speech	2	I heard different things in there than usual. I'm more of a visual person, so just listening for different things was interesting. I used to set up audiovisual equipment.
Acoustic navigation	2	Just listening, paying attention to what's around you. Taking BART in Civic Center.
Out-quiet yourself	2	I walk a labyrinth ... trying to be as quiet as possible. I never thought when I try to walk quietly how much noise there is still. I thought about how trackers use this.
Electric ear	1	[It] reminded me of picking up sound from far away— trying to figure out what it is.
Listening guide theater	1	We started listening to the deaf person. If [we] didn't have sound you would determine the world so differently.
Mysterious melodies	1	Reminded him of son's toys at home.
See a sound wave	1	I touched many things. The light and the water.
Echo Tube	2	Sound and echoing relates to life well. Natural stuff like in a cave.

General comments about the whole exhibition:

Sound memories:

Just listening ... becoming more aware of your environment; how sound travels....

If there's a conversation and I'm eavesdropping I shift what I listen to.

How sound is around us; all over the place.

In the MOMA in NY years ago they had a soundproof room with wood and you leaned with your elbows on the wood. Sound waves were conducted through the wood and you felt the sound and melody in your bone structure.

It allowed me to see how sounds play a role in life.

The glasses with the water where you make them sing.

Seashells

Music:

Playing music when I was a kid (2)

I volunteer at the symphony. Michael Tilson Thomas is very interested in contemporary composers. Contemporary composers are concerned with found instruments and different sounds. I am also interested in Non-European music. It's a completely different way of listening.

A symphony

I was a musical theater major. I took voice class and speech class--how you hear different things.

Instruments--because I like music

The music stuff

When I'm just hearing things in general or playing my instruments

Because I am a teacher (I teach in the "Keeping Score" program with the San Francisco symphony) we teach how to make sound and where sound comes from. [This] reminds me a lot of school.

It reminds me of being a musician, I play guitar and piano. How you listen to each other and to our playing

Childhood:

When I was a little kid I wanted to live here at the Exploratorium.

When I was little and lived in the country.

Everything. I haven't come to this area for a long time. It let me remember a lot of stuff from my childhood.

It reminded me of childhood. I got to play with a lot of things and watch how it developed.

It was enjoyable.

Reminds me of sitting in lecture halls in college; finding a place so you can hear and see things.

Other:

The aquarium

It brings an educational experience to all of us.

It was fun.

With three small children, I crave quiet time, silence. [The exhibit] made me realize I appreciate listening, but also silence and soothing sounds.

She (wife) can't hear very well. Dad was somewhat deaf too. What it would be like for them if I couldn't hear.

Keeps me aware of taking care of my ears.

Conclusions

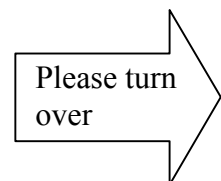
The *Listen* exhibit provides a rich, varied, multi-sensory and interactive experience. There is something for people of all ages to do and discover. The explanatory text is clear and understandable and most people were comfortable with the content, although they did say there could be less of it. The exhibit deals with sound creation, transmission and perception; with the role of the ears and brain in listening, and with the ways we use listening skills.

People said that they had learned about many different aspects of sound and listening in the exhibit. The fact that visitors reported enthusiastically that they had learned about so many specific topics indicates that the *Listen* exhibit did successfully achieve its goals in terms of communication of content. While most people did not try to articulate how the exhibit helped them to develop listening skills, those who did make it clear that such skill development is facilitated by the *Listen* exhibit. Finally, the *Listen* experience was full of stimuli that triggered personal associations and memories which enhanced the impact of the exhibit.

**Listen
Summative Evaluation
Questionnaire 1**

Please help us to find out what visitors think about this area.

1. In what city do you live? City _____ State _____ Country _____
2. Your Age: Children 10-14 15-19
Adults 20-29 30-39 40-49 50-59 60-69 70+
- 2.5. Your Gender: Male Female
3. How many people are in your group today?
 1 2 3 4 5 6 or more
4. With whom did you come to this museum? *(Please check only one)*
 Alone Organized group (which) _____
 Friends Other (what?) _____
 Family
5. What would you say this area is about? *(wave hands to indicate the area)*
(If one word answer, say, "Could you tell me more?")
6. Have you seen this area before today? Yes No
If "yes," including today, how many times have you seen it? _____
7. Did you see what you thought you would in this area? Yes No No Expectations
If you didn't see what you thought you would, what was different?
8. Was there anything in this area that you found especially interesting? Yes No
Can you say a little bit more about that?
9. Were there any stations that were too hard or that you couldn't get to work? Yes No
If "yes", which ones?



10. Did you find out anything new about sound in this area?

11. In this area, there are examples of people who use listening in their daily lives. Do you remember any of these people? (video/audio) Yes No (If no, skip Jump to 13)

If yes, can you tell me about one of these people?

Do you remember any others?

12. What do you think about having those people included in this area?

Did they make things:

Better _____ Worse _____ No Difference _____

Can you say a little more about that?

13. Did you see anything in this area that dealt with the role of your ears in listening?

Yes No

If yes, what?

14. Did you see anything in this area that dealt how your brain interprets (makes sense of) sound?

Yes No

If yes, what?

15. Around this area there were white cones that played audio instructions for some exhibits...did you ever listen to one of those cones? Yes No (If "no," then skip to end)

How did it affect your experience? Did it make it:

Better _____ Worse _____ No Difference _____

Can you say a little more about that?

THANK YOU VERY MUCH FOR YOUR HELP

**Listen
Summative Evaluation
Questionnaire 2**

Please help us to find out what visitors think about this area.

1. In what city do you live? City _____ State _____ Country _____

2. Your Age: Children 10-14 15-19
Adults 20-29 30-39 40-49 50-59 60-69 70+

2.5. Your Gender: Male Female

3. How many people are in your group today?
 1 2 3 4 5 6 or more

4. With whom did you come to this museum? *(Please check only one)*
 Alone Organized group (which) _____
 Friends Other (what?) _____
 Family

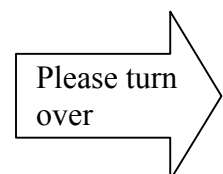
5. What do you think about the amount of written information in this area; was it:
Too much _____ Too Little _____ About Right _____

6. What do you think about the appearance of the area; is it:
Too empty _____ Too cluttered _____ About Right _____

Can you say a little more about that? (repeat back their answer)

7. Which exhibit station(s) in this area did you like best?

8. Did you see any exhibits that dealt with how sound is transmitted? (How it travels to you?)
 Yes No
If yes, what do you remember about this?



9. Did you find out anything in this area about the effects of sound on the health of your ears?

Yes No

If yes, what did you learn?

10. Do you think the exhibit stations in this area may have changed the way you listen to sounds?

Yes No

If yes, can you say a bit more about that?

11. Did you find out anything about your own listening that seemed new to you?

Yes No

If yes, can you say a little bit more about that?

12. Was there anything in this area that allowed you to develop some sort of listening skill? Or maybe to get better at something you already do?

Yes No

If yes, could you say a bit more about that? (be sure they name both the experience and the skill-- or probe)

13. Did this area remind you of anything in your life outside the museum? (What did it bring up for you?)

Yes No

If yes, what did it remind you of?

THANK YOU VERY MUCH FOR YOUR HELP