The Effect of Live Interpretation with Theater on Attitudes and Learning of Children in the Mythbusters Exhibit

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Abstract *Mythbusters: The Explosive Exhibition* is a traveling exhibit based on the popular television show. When housed at the Museum of Science and Industry, Chicago, it included a traditional, interactive free flow exhibition space followed by a live facilitated show. This paper describes results from an experimental study about the effects of the Live Show on the learning of and attitudes towards science. A pre-test was given to 333 children entering the exhibit. A post-test was given to 80 children after they walked through the free-flow portion of the exhibit and to 191 children after they watched the Live Show. Thirty-two children were interviewed in lieu of taking the post-test. Findings show additional knowledge and attitude gains by the children who watched the Live Show. However, no gains in either group were found on items related to recognizing terminology related to the scientific process.

Introduction and Theoretical Framework

Science museums have long recognized the importance of interactive experiences,[1] but have also had to balance that need with the economic and logistical challenges of supporting large populations of visitors who move at their own pace.[2] This study looks at the effects of integrating an interactive, live show into a more traditional exhibit space and its effect on the learning and affective goals of the exhibit.

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Live interpretation, real-time interaction between staff and guests,[3] and use of theater in museums, dates back to the 1930s.[4] Live interpretation can increase learning and support a deeper and more emotional connection to the exhibit.[5] Guests in particular enjoy more salient museum experiences when they involve story and play.[6] But museum audiences change day-to-day and even show-to-show, so flexibility in content and delivery is important.[7] For example, a visiting school group has a different social dynamic than a family group. Like many formal educational settings, the character of particular groups can change remarkably based on the presence or absence of a few key personality types. Improvisational technique, such as changing the timing, discussion points, and sequence of events of a presentation, provides the flexibility needed to adapt an experience to the audience. These techniques have been shown to be effective in teaching science to the public,[8] especially in museums.[9]

Mythbusters: The Explosive Exhibition is a traveling exhibit based on a popular television show. The show is based on the concept of a crew of Hollywood-based engineers and scientists who take urban legends and test them using the scientific method. For example, in one episode they tested whether running or walking in the rain will keep a person drier. During its run at MSI, the exhibit had two main sections. The first was a free flow

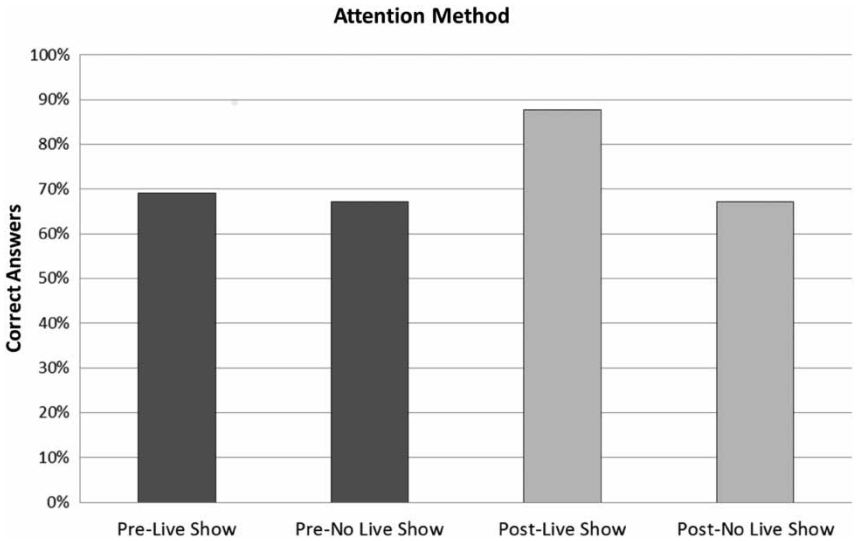

Figure 1 Responses to the "What is the fastest way to get someone's attention?" test item. The increase in the post-test score is statistically significant.

exhibit space with artifacts and interactive recreations of many of the show's experiments. The second section contained a stage and hosted a 10–12 minute interactive demonstration (hereafter: "Live Show"). The Live Show itself consisted of two facilitators on a small, rectangular stage that extended into the audience to create a more intimate environment. Facilitators were trained to use inquiry-based learning strategies and positive reinforcement engagement strategies along with improvisational technique. A paintball gun was set up at one end of the stage and a gong at the other. The facilitators introduced the audience to the concept of response time and the differences in human response time due to two types of warning cues: light and sound. Throughout the show, many guests were called upon to participate from the audience. Facilitators invited three members of the audience on stage during the show to participate in an activity using a hand buzzer to test response time associated with a visual or aural cue. Then they selected an audience member to attempt to dodge a paintball while being provided different levels of warning time.

The Live Show differed from strict live facilitation due to its narrative framework. It followed a traditional two-act structure. First, it started with an attention grabbing event (firing of paintballs at a loud gong — the beginning). That was followed by an introduction and build up to a semi-climax (an audience competition with hand buzzers — the middle). Then there was an increase in tension leading to a finale (an audience member successfully dodges a paintball — the end). However, it is not a scripted show with memorized dialogue. While an outline was developed for training purposes, facilitators were specifically requested to insert personally relevant and appropriate humor, interact with the audience conversationally, and banter back and forth with one another to bring the show to life. Two members of the research team observed three shows and counted the number and type of interactions between facilitators and guests. They found an average of 22 general interactions where a facilitator asked the audience to react (verbally respond, clap, etc.) and nine targeted interactions where a specific member of the audience was asked to respond or do something in front of the rest of the audience.

The Study

This study consisted of a one-page pre-/post-test and short post-session interviews with children visiting with families. The pre-test was given before they walked into the exhibit. Members of the control group took the post-test as

they were leaving the free flow portion of the exhibit and before they participated in the Live Show. Members of the treatment group took the post-test after participating in the Live Show. Some children participated in short, semi-structured, interviews in lieu of the post-test.

Test questions were aligned with the intended learning goals of the Live Show — to engage guests in an investigation using the scientific method and to increase guest knowledge of some of the factors that influence reaction time. The test had four sections. The first included a simple multiple choice question: "What is the fastest way to get someone's attention?" In addition to being introduced in the Live Show, a portion of the exhibit space was also devoted to this topic. The second section was designed to measure change in knowledge of the scientific process. This item consisted of three words (ex: "Experiment") above a randomly distributed collection of six word balloons. Three of the balloons included definitions (ex: "a test with results") and three included examples of those definitions ("Compare freezing times and decide if your prediction was right"). To answer, the guest drew a line from each word to one definition and one example that best describes it. The third section of the test included a ranking item where the child ranked how hard it would be to dodge paintballs shot from three different distances. The last section included three Likert scale items to measure change in attitude and engagement of the children ("Science is fun," "I like participating in science," "I prefer to learn about science in a group"). The levels of agreement they could choose from were communicated through a series of five emotion laden face drawings (similar to the pain scale used in medicine).

We conducted interviews to elicit more in-depth responses to our core questions. The interview protocol was designed to last around 10–12 minutes. The semi-structured guide included optional follow-up questions and "think-aloud" style questions. Children sat at a small table on the museum floor with the interviewer on one side and the child on the other.

Analysis and Results

A total of 333 guests took the pre-test. Of those 333 guests, 271 took the post-test as a part of either the control group or the treatment group. Eighty children took the post-test before they participated in the Live Show (labeled as "Control" in the figures) and 191 children took the post-test after they participated in the Live Show. In lieu of taking the post-test, we interviewed 32 additional children. Thirty guests did not participate in a post-test or

interview. The average age of all participants was 11 years and they self-reported as 63 percent male and 37 percent female. On each item of the test, we did not find a statistically significant difference between the pre-test and control-group. We found no significant relationship between any of these results and gender or age.

We analyzed each of the four sections of the test separately. Responses from the first item, about the fastest way to get someone's attention, was categorized as either correct or incorrect. We found a statistically significant increase in correct answers, from 69 percent on the pre-test to 88 percent on the post-test (Figure 1), meaning that those who watched the Live Show did better than those who only walked through the free flow exhibit space.[10]

The second section of the test was coded according to whether a correct or incorrect link was drawn between the word balloons and the phrase or word that is associated with them. We found no significant difference on any of the six pairs of items between the pre- or post-test (Figure 2).

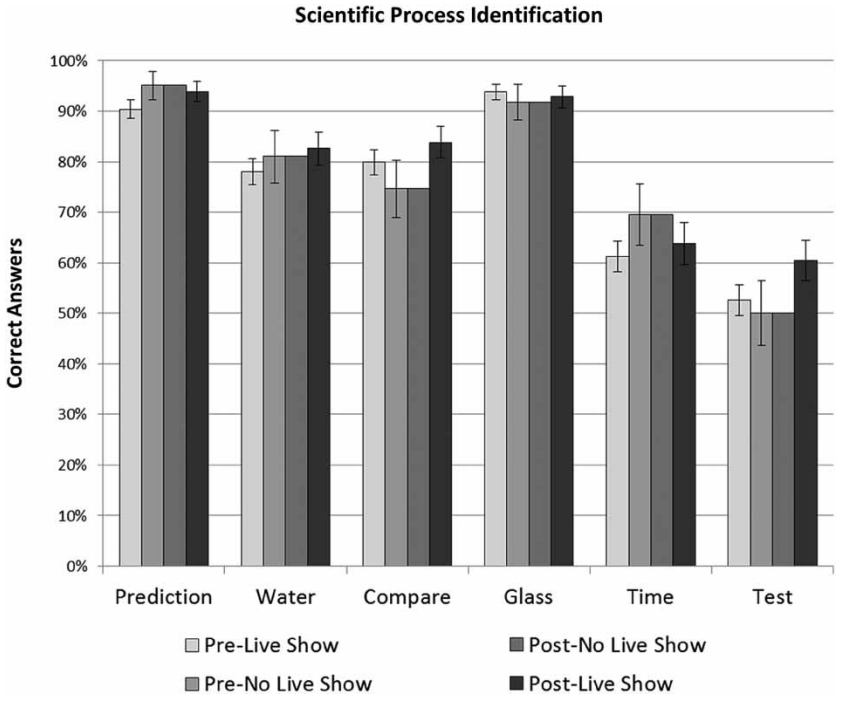

Figure 2 Number of correctly drawn links between word balloons relating to the scientific method.

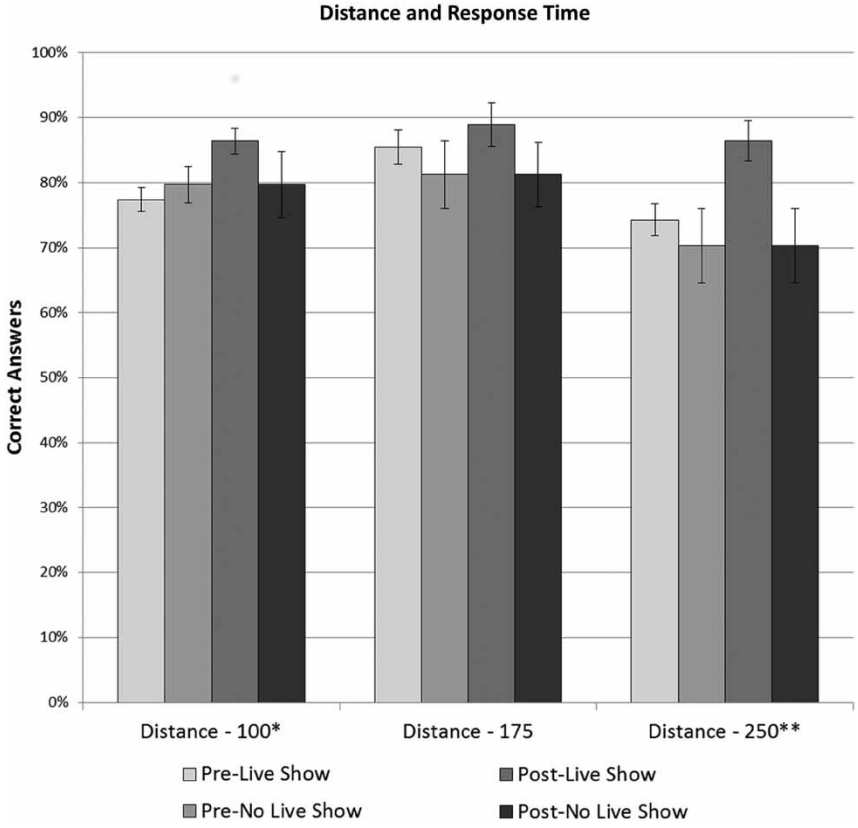

Figure 3 Responses to children being asked about relative difficulty of dodging a paintball from various distances.

The third section of the test was coded according to whether each of the three distances were placed in the correct ranking order. We found a significant increase in correct responses on the shortest and longest distances, between the pre- and post-tests (Figure 3).[11]

The fourth section of the test involved the Likert items about attitudes towards science learning, which were scored on a 1–5 ascending scale. We found significant increases in positive attitudes for all three items between the pre- and post-test (Figure 4).[12]

Interviews

We analyzed the interviews to look more deeply into two results from the survey responses. First, we looked for explanations as to why the Live Show

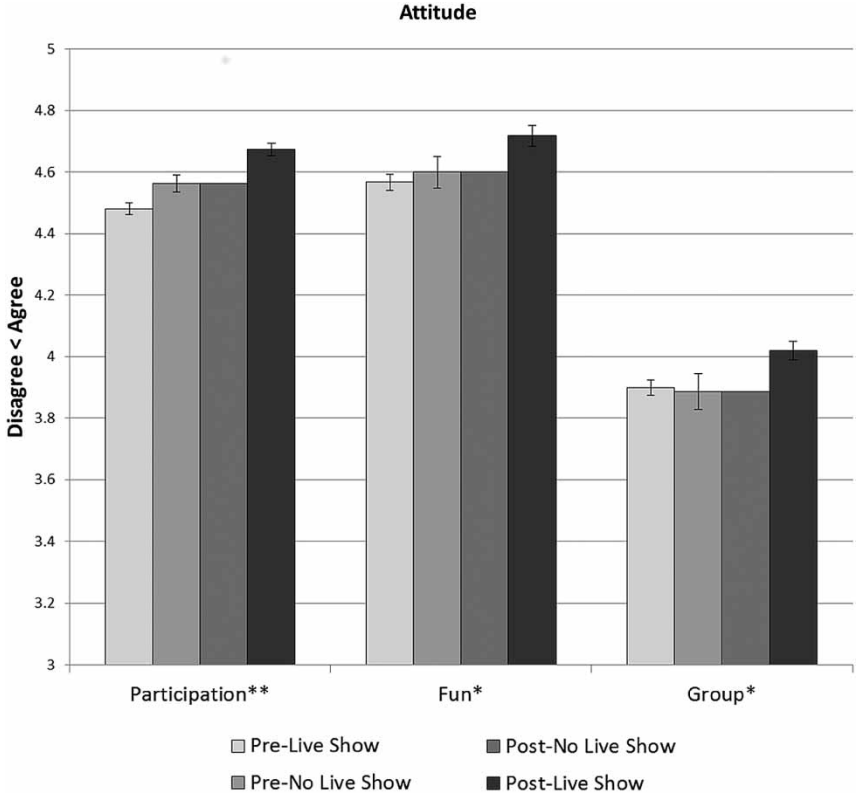

Figure 4 Mean differences between groups on the attitude items.

had no impact on children's ability to identify some elements of the scientific process. Second, we looked for deeper understanding behind children's definitions of and attitudes towards participating in science, which had the highest increase among items on the attitude section of the survey.

In the survey data, children were asked to link a scientific term with phrases that describe and illustrate the term. The phrase "a test with results" had the lowest scores of all the phrases. A closer inspection of the data revealed guests were evenly divided over whether it should be linked to "experiment" or "conclusion." Of the 32 interviews, 25 were asked to "think aloud" while answering that section of the survey. Of those 25, 19 chose "experiment," six chose "conclusion," and none of the children chose "hypothesis." Some children debated these choices as they answered the question. Four children either said that they had a difficult time choosing between the two or debated with

themselves out loud as they answered the question. For example, one child (C) engaged in the following dialogue with the interviewer (I):

C:	Alright … um a test with results sounds like the whole thing, so the actual experiment but it also has a conclusion. Um and I would put it underneath … I'm debating conclusion or experiment.
I:	Why are you debating between those two, what makes you think it could be either?
C:	Um, experiment because … it kind of sums, or whenever someone says experiment you think you go through the whole scientific process. But whenever someone says conclusion, it's the wrap up of the experiment as well. Um …
I:	Okay, so what about this in here, what about the words in here makes it confusing?
C:	Um the test is the experiment but with results is the conclusion.
I:	Okay, so which one would you choose?
C:	I would put it under conclusion.
I:	Okay. Can you have an experiment without results?
C:	You can.

Overall, we feel the phrase "A test with results" was not clear enough to distinguish between "experiment" and "conclusion" for many children. This may be one reason why the section of the test about the scientific process did not detect a change between the pre- and post-tests.

The biggest change in the attitude section was "I like participating in science." First, we asked children if they participated in the Live Show. Of the 30 respondents who answered, 22 said "no," four said "yes," and four gave responses that could not be clearly categorized. Next, the child was asked about whether he or she participated in one of four possible audience activities we identified in the show: (1) dodge the paint ball on stage, (2) hit a buzzer on stage, (3) hit an imaginary buzzer while in the audience, and (4) raise her hand to verbally answer questions from her seat. Twenty of the 22 guests who initially replied "no" later indicated that they indeed did participate in one of those four options. Further discussion with the children revealed that this discrepancy is likely because most of the children did not consider actions taken while in the audience as "participation." For example:

I:	How did you feel about participating in the show?

C: Oh. (Pause) What do you mean, "participating," because I wasn't, like, up there on stage, but —

When asked, 19 of 30 guests said that they usually participate in shows like the Mythbusters Live Show. Also, five of the seven respondents who said that they did not normally participate in shows like that did in fact later report that they participated (according to the definition established above) in the Live Show. These participants were asked why they decided to participate in the Mythbusters show when they usually would not. The reasons given can be summarized as (1) a comfort with the content being addressed, (2) the desire to learn something new, (3) because not many others were participating, (4) because it was a smaller crowd, and (5) because it was fast paced and engaged the respondent. The quotations below demonstrate each of these reasons.

Guest one:

I: Do you usually participate in something like this?

C: Uhh, I usually am very like, shy to participate in stuff, so …

I: So why do you think you wanted to do it this time and not like normal?

C: … something new …

I: You wanted to do what?

C: I wanted to learn something new

Guest two:

C: Um, I felt it was, I felt that I was, like usually when I do those live shows, I don't really want to participate. I'm like no, but now since, I know like what they would be asking about and I know about that stuff, I just said why not.

Guest three:

C: … I feel like no one else is like … not that may people raise their hands for questions. And the people that did already had gotten like had answered a question.

Guest four:

I: Why do you think you did this time and not usually?

C: Smaller crowd.

I: Okay. So that made a big difference?

C: Yes.

Guest five:

C: Um, I think I liked this more, this show was quite fast, quite re— entertaining, and you got to participate in it, and it was fun overall, so that was good.

I: Okay, what do you mean by "fast"?

C: Like, it didn't drag on, like, and they didn't, like, keep expla—, over explaining everything so, it was very interesting which was good, but it wasn't too long. So it wasn't too short, but it wasn't too long.

Overall, the interviews showed that there was ambiguity in the wording for the scientific process section of the test and that guests thought of the audience role as being passive, regardless of the level of activity involved. But those who did participate had their own individualized reasons for doing so.

Discussion and Conclusion

This study was focused on measuring the impact of the Live Show on children's learning and attitudes related to its educational goals. Using an experimental design, we isolated the Live Show experience from that of the rest of the exhibit experience. Results show that the Live Show had a modest but positive impact on science learning in the form of basic knowledge building but not in the form of awareness of the scientific process. The show also had a positive impact on the attitudes of children who watched it.

Regarding knowledge gains, children who participated in the Live Show displayed increased ability to recognize that auditory cues were more effective than visual cues in attracting attention. And they were also better able to associate distance with response time for dodging a paint ball. Regarding the scientific process, there was no change in the children's ability to identify and define three elements of the scientific process that were discussed in the Live Show. This lack of change could be due to a ceiling effect in the data (the audience already scored highly on these items in the pre-test). Also, our interviews illustrated problems with our wording.

There was an across-the-board increase in positive attitudes towards science by those who participated in the Live Show. We saw increases both in agreement that science is fun and in preferences to learn about science in a group setting. But the largest impact was in attitudes towards *participating* in science. Respondents' attitudes were likely influenced by seeing other audience

members have fun on stage at multiple times during the experience. This points to the importance of involving the audience in interactions beyond traditional audience crowd work. Some of the children reported an initial reluctance to participate at this level, yet they overcame the reluctance for a wide variety of reasons. Interviews suggest that guests think of participation as becoming engaged outside of their role in the audience. Live, improvisational-inspired facilitation can help blur that line and inspire normally passive science learners to become more engaged in the learning process. Often, museums try to minimize live facilitation because of its cost.[13] However, our results show it can have a positive impact on the learning and affective goals of an exhibition. Live facilitation offers unique contributions absent from non-staffed exhibits, such as the ability to draw participation out of passive learners — as seen here by guests who did not consider themselves as typically active participants until they were asked to describe their experience. Finally, none of these findings are unique to science museums. Our biggest results — regarding attitude change and knowledge gain — can be applied to non-science-based institutions as well.

The Live Show at the end of the Mythbusters exhibit was a relatively unique aspect of the overall exhibit experience. These results show that it improved learning and attitudes greater than that achieved by just going through the free flow portion of the exhibit alone. Others have found that structured and collaborative museum experiences increased learning of inquiry skills compared to unstructured and isolated experiences.[14] An effective museum experience can combine the strength of both techniques for a positive, across-the-board learning experience.

Notes

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10. A paired-sample t-test, $t(145) = -4.37$, $p \leq .001$.
11. A paired-sample t-test, $t(147) = -2.52$, $p < .01$ and $t(148) = -3.09$, $p < .01$, respectively.
12. Paired-sample t-tests: "I like participating in science" $t(173) = -4.30$, $p < .01$, "Science is fun", $t(179) = -2.20$, $p < .05$, and "I prefer to learn about science in a group", $t(173) = -2.04$, $p < .05$. The effect sizes were .30, .22, and .12, respectively.
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