Cultivating Confidence: The impact of a single science museum visit on young adults

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What will I get from this article?

For people creating museum content and programs: Learn what features of the museum experience young adults reported as supporting their self-efficacy in science.

For people securing support and funding: Learn about the measurable positive impacts of a single science museum visit on young adults.

For museum and learning science researchers: Learn how a randomized control trial can support a deeper understanding of the impact of a museum visit.

How does a visit to a science museum affect young adults? Understanding the impact a single museum visit can have on this group can be a powerful tool in advocating for young adults' inclusion within museum spaces. Prior research conducted by the Exploratorium showed that a single museum visit had a small but significant impact on young adults' *science self-efficacy* (SSE) - their belief in their ability to learn and do science. But *how* does a museum visit result in that impact? The present study sought to better understand this question of *"how,"* in addition to replicating the prior study's results. By uncovering what factors support increases in science self-efficacy, we may be better able to develop museum content that leads to positive outcomes - like increased science self-efficacy - among young adults visiting science centers.

In 2014, the Exploratorium conducted a study that surveyed young adults at the beginning and end of their visit to the museum, and then again three months later (Gutwill, 2018). Looking at the study sample overall, we found an increase in SSE at the end of the museum visit, but that increase did not remain when participants were surveyed again three months later. However, we were also curious whether the museum impact was the same for men and women. We looked at changes in SSE by gender and found that for *women*, SSE was higher at the end of the museum visit and it stayed high three months later. Men, on the other hand, had an immediate increase in SSE, but three months later, their SSE dropped back down to similar levels as before the museum visit. We also interviewed participants three months after their visit, and women in the study reported engaging in more activities following the museum visit that they considered science. We developed two hypotheses: (1) women may have *broadened* their view of what counts as science (so that things that they didn't previously consider to be science now counted as science), or (2) they may have increased their participation in science activities.

We focused on "emerging adults," young people 18-29 years old who had no children and were not married, because this phase of life allows for identity exploration (Arnett, 2006, 2012; Gutwill, 2018); we believed that adults in this life stage would be impressionable, and a visit to a science museum could potentially increase their *science self-efficacy* (Bandura, 1977; Britner & Pajares, 2006; Chen & Usher, 2013). Moreover, many museums are actively reaching out to emerging adult audiences through adult-only programing, like the Exploratorium's *After Dark,* or *NightLife* at the California Academy of Sciences. Better understanding the impact of a museum visit on this demographic could help motivate and inform adult-only programming in the future.

The current study, Cultivating Confidence, sought to improve on the original study design, replicate the findings from that study, and discriminate between our two hypotheses about what causes increases in SSE. Cultivating Confidence employed the same approach used in the prior study of surveying visitors before their visit, after their visit, and three months after their visit (along with an interview). However, in the present study, we utilized a Randomized Control Trial design, introducing a control condition, and we changed our recruitment methods. Specifically, we hired a recruitment firm to find a sample of emerging adults who would be representative of the San Francisco Bay Area in terms of age, gender, and race/ethnicity. The sample included both museum-goers and non-visitors, allowing us to measure the impact of a museum visit on emerging adults in general, even those individuals who don't necessarily identify as "museum people." The firm randomly assigned participants to either visit the Exploratorium (treatment condition) or go see a movie of their choice (control). (Participants in the two conditions were balanced in terms of gender, race/ethnicity, and studying/working in a STEM field.) Participants were paid to take part in the study, and were given two free tickets to their assigned venue, along with a travel stipend. Seeing a movie was chosen as a control activity because of its similarities to a museum visit in terms of time spent, entertainment value, and social experience. Ultimately, 199 people completed all three surveys, with 106 in the treatment group and 93 in the control group. Among them, 184 completed the interview. There were no differences in the demographics of participants in the two conditions, except that more self-described students ended up in the control condition. Unfortunately, despite random assignment, the control group happened to have a higher initial level of science self-efficacy before their excursion than the treatment group.

We again found an immediate increase in science self-efficacy after the museum visit.

The findings replicated and extended some results from the prior study in key ways. First, we found the same immediate increase in science self-efficacy after the museum visit. Importantly, the control group showed no such increase in SSE after seeing a movie. This suggests that the short-term effect of an Exploratorium visit, found in both studies, is reliable: the Exploratorium increases emerging adults' confidence in their ability to do or learn science. The effect size was small to medium (d = .42), which is noteworthy

given the small "dosage" of a single visit. In a second replication of the prior study, we found no long-term increase in SSE. However, this time there was no gender difference, which suggests that the prior study's gender effect may have been spurious.

Success and good feelings at hands-on exhibits increased science self-efficacy.

Digging further into the effects of the museum visit, we found that the treatment group more often reported two sources of science self-efficacy during their museum visit than the control group did during the movie: *performance interpretation*, where success at a task boosts confidence, and *physiological/affective experiences*, where positive emotions promote beliefs about one's ability (Bandura, 1977, 1986; Chen & Usher, 2013; Usher & Pajares, 2008). In the museum, participants had ample opportunity to successfully manipulate science exhibits and feel excitement, joy or satisfaction in the result. These kinds of experiences seem to have raised their science self-efficacy. Moreover, participants' interview responses revealed that positive performance interpretations were supported by two factors: the ability to self-pace their experiences and their perceptions of exhibits as "accessible." This concept of "accessibility" is supported in turn by three main exhibit design features, which participants described as (1) being "hands-on," (2) requiring no prior knowledge, and (3) "breaking it down," both in terms of information being broken down into "digestible" chunks and interactions broken down into simple steps.

Participants expanded what they think counts as science to include everyday activities.

We also extended the prior study by investigating the effect of the excursion (museum or movie) on *science activation*, that is, increases in interest in science or participation in science activities (Dorph et al., 2016), and on the *breadth of participants' view of science*, that is, what kinds of activities and topics "count" as science (Foushee et al., 2017; Foushee & Jansen, 2016). There were no differences in activation between treatment and control groups, as measured by change in self-reported science interest and by frequency of participation in science activities during the 3 months following the visit. However, Cultivating Confidence did find both an immediate and long-term broadening in the treatment group's view of science as compared to the control group's view, suggesting that a single visit to the Exploratorium durably expanded emerging adults' perspectives on what counts as science to include everyday activities such as cooking, bug collecting, and even movie watching.

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Interview data indicated that participants who broadened their view of science tended to (a) see themselves as doing science, (b) see their interests as part of science, or (c) make connections to science in their everyday lives. For example, one person said, "I think I kind of drew connections between the softer science-y things and the harder

science-y things, which I found quite interesting. [I] realized that some of the things that I'm doing are a form of science." Another explicitly linked their broadened view of science to SSE and physiological experiences: "There was an [exhibit] experiment with [frying] pans. It's when you see connections between your own life and science [...] something switches in my brain and I get excited. When you're excited about something, you don't even need confidence. You're just gonna go do it." However, the effects of broadening one's concept of science were not universally positive. A few participants felt that their newly expanded view made them less confident about their abilities, such as one person who stated, "With it being so broad, it tends to be really overwhelming to get into this field."

In summary, Cultivating Confidence found that a single visit to a science museum increased emerging adults' science self-efficacy in the short-term, likely by providing joyful learning activities in which people experience success at exhibits. The visit also broadened their view of science in both the short and long term, helping them recognize science within their everyday activities. The fact that the control group did not experience these benefits leads us to conclude that the impacts were due to the science museum visit, rather than from biased responses stemming either from pleasing an interviewer or from altering one's behavior when being observed ("Hawthorne Effect," 2023). Moreover, these findings support the notion that even after the typical period of K-12 science education, museums can have a significant positive impact on visitors. Emerging adulthood seems to offer another window of opportunity for affecting people's views of science, underscoring the value of increasing the inclusion and participation of young adults in museum experiences.

Key Takeaways:

For people creating museum content and programs: Emerging adults' science learning is enhanced by having positive emotional experiences and seeing themselves succeeding while doing science. Both can be supported by experiences that (1) are hands-on, (2) require no prior knowledge, and (3) break down information and simplify complex interactions.

For people securing support and funding: This study showed the efficacy of a single museum visit in creating a short term increase in science self-efficacy and a longer term expansion of what "counts" as science for emerging adults. Emerging adulthood seems to offer a window of opportunity after childhood for affecting people's views of science, underscoring the value of increasing the inclusion and participation of young adults in museum experiences.

For museum and learning science researchers: The use of a control group, and random assignment of participants to treatment or control group, increased the study's rigor and gave us more confidence that a museum visit was the causal factor underlying the beneficial impacts we found.

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