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The Educational Benefits of Cultural Institutions

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Abstract

A significant portion of the education children receive occurs outside of the traditional classroom and produces outcomes not typically captured by standardized achievement tests. This dissertation is part of an effort to expand the educational venues and outcomes educational researchers rigorously examine. In particular, I present the key results from experimental studies of the effects of school tours to the Crystal Bridges Museum of American Art in Bentonville, AR., and to the Museum of Discovery in Little Rock, AR.

Chapter 1 focuses on arts exposure and critical thinking outcomes. A problem for the arts' role in education has been a lack of rigorous scholarship that demonstrates educational benefits. A component of this problem has been a lack of available data. Analyzing original data collected through a randomized controlled trial of students visiting the Crystal Bridges Museum of American Art, I find positive effects of art museum visits on students' ability to critically examine a work of art.

Chapter 2 examines the theories of cultural reproduction and cultural mobility. Drawing upon the experimental data from the Crystal Bridges evaluation, I show that students' exposure to a cultural institution has the effect of creating "cultural consumers" motivated towards acquiring new cultural capital. Importantly, we find that the experience has the strongest impact on students from more disadvantaged backgrounds. As such, the intervention supports the theory of cultural mobility.

Finally, Chapter 3 experimentally examines the effects of students visiting a science museum. Many education policymakers are searching for ways to increase students' competency and interest in science. Existing research, however, suggests that classroom instruction and content

knowledge alone may not adequately cultivate an interest in science or increase aspirations for careers in science. In this paper I experimentally test how a school visit to a science museum alters students' attitudes towards science and future career aspirations. I find that there are positive effects from exposure to a science museum for students, though the effects seem to be especially strong for boys.

These findings have important policy implications for whether schools should devote their scarce resources to school tours of cultural institutions and for which types of students these experiences may be most important.

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List of Published Papers

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Introduction

A significant amount of the educational experiences children receive happen outside of the classroom. Out-of-school enriching experiences, however, like in-school experiences, are not of equal quality for all students. Students from upper- and middle-class families, and students with especially involved parents, receive what Lareau (2002) calls “concerted cultivation” because their parents organize culturally enriching activities for them. From an early age, children in these families may receive music, dancing, or acting lessons, enriching summer camps, reading in the home, and visits to culturally enriching experiences. Many of these experiences involve visiting museums, zoos, theaters, and other cultural institutions. Children from disadvantaged families visit cultural institutions at lower rates, and are therefore more reliant on their schools to provide them.

Most cultural institutions see education as one, if not the, primary reason for their existence. They spend roughly $2 billion a year on educational programs and staff, and serve roughly 90 million student visits (National Humanities Alliance, 2012). At the same time, there has been a documented decline of school visits to cultural institutions, particularly in the last decade (Blair, 2008; Lewin, 2010; Mehta, 2008; Plummer, 2014). Surveys of school administrators have put the blame on budgetary issues (Ellerson, 2010). Anecdotally, however, teachers and museum educators blame the increased amount of time and attention given to standardized test-prep. Because school officials do not see direct connections between visits to cultural institutions and standardized test scores, they are being deemphasized (Associated Press, 2012).

The decline of school visits to cultural institutions, however, is occurring in a research-vacuum. The field is lacking any rigorous research that might shed light on the types of benefits students acquire from visits to cultural institutions, and what might be lost as a result of their decline. Without quality research, the visits to cultural institutions are at a disadvantage in the policy realm. In a policy environment increasingly driven by data and rigorous analytic techniques, unmeasured and understudied policy areas face the risk of being marginalized for failure to demonstrate their value. The need for rigorous outcome-based research was articulated in an essay by the late Smithsonian Museum scholar Stephen E. Weil (2000), published by the Institute of Museum and Library Services. Weil noted that it is increasingly the case that museums must "demonstrate [their] competence and render a positive account of [their] achievements" or they run the risk of becoming irrelevant. Yet, fifteen years after those remarks, there is still hardly any evidence.

What explains the lack of rigorous research? The various people involved in research about cultural institutions are fragmented, with no clear field of study or training. The bulk of research is conducted by research firms hired by museums. These studies are typically little more than analyses of market trends or attempts to identify best practices. They are often not made public, and there is no third-party oversight. In the worst-case examples, museums can hire these firms to tell them that they are doing great, and if they can do that with minimal expense, even better.

In academia, there has also been very little rigorous work conducted. The research is mostly qualitative and correlational, and often focuses on instrumental benefits, such as test scores, instead of the types of outcomes cultural institutions actively promote. Moreover, the loose collection of academics doing this work lack a clearly defined field of study where scholars could reside and build a professional network of colleagues and a culture of rigorous inquiry. Scholars are fragmented across departments of sociology, psychology, education, public policy, art, museum studies, and economics, to name a few. Finding the right journal to publish this type of work is similarly fragmented. This lack of cohesion and direction has stunted the growth of the field.

This dissertation is an attempt to strengthen the research base regarding the educational benefits of cultural institutions. With the research presented here I hope to accomplish three broad goals. First, I conduct my analyses using experimental methods. This level of rigor, while increasingly common in educational research, is virtually unheard of in studies of cultural institutions. Second, I explore outcomes that are central to the mission of cultural institutions. That is, rather than determining whether or not museum visits raise standardized test scores, I explore outcomes that can be theoretically and practically expected from museum visits. Third, I attempt to highlight practices and outcomes that are relevant. Rather than examining esoteric outcomes in a laboratory, I focus on the concrete implications that visits to cultural institutions have for education policy in the real world.

Chapter 1 examines the results of a randomized control trial evaluation of student visits to the Crystal Bridges of American Art. The world of art museum and art education generally is littered with claims that exposure to the arts can improve critical thinking. Yet, to date, this claim has mostly relied on anecdotal evidence, qualitative case studies, and correlational studies. Using original essays collected from students, I am able to show that critical thinking about a work of art does improve for students who were randomly assigned to visit an art museum. Importantly, the effects are larger for students from ore disadvantaged backgrounds.[1]

[1] I make multiple comparisons when comparing effects for various subgroups. Some argue that statistical adjustments for significance are necessary in such cases (see, for example, Benjamini and Hochberg, 1995, "Controlling for the False Discovery Rate: A Practical and Powerful Approach to Multiple Testing." *Journal of the Royal Statistical Society*, Series B, 57(1): 289-300). However, in an attempt to avoid Type II errors, I have chosen not to incorporate this test.

Chapter 2 uses data from the same randomized control trial evaluation of student visits to the Crystal Bridges of American Art, but focuses on a different outcome. In particular, I assess whether or not the museum visit has the effect of creating "cultural consumers" motivated to acquire cultural capital. The literature surrounding cultural capital has established that it is an important and useful good that is acquired from the home in advantaged families. Moreover, it is seen as an important predictor of social class and status. Some have hypothesized that disadvantaged children may also benefit from cultural capital, but there has been very little evidence examining how they might acquire it. In my analysis, I show that when disadvantaged students visit an art museum, they are more likely to want to engage with the world of art museums and art in the future. As such, this study suggests that visits to cultural institutions have important implications for the acquisition of cultural capital for disadvantaged students. And, like the findings regarding critical thinking, the effects are generally larger for more disadvantaged students.

Chapter 3 experimentally examines students who visited a science museum. In this analysis, I examine the effects on what researchers have recently termed "science capital," which is analogous to cultural capital in the world of science. Specifically, I explore if students, as a result of visiting a science museum, are more likely to want to engage in science-related activities, as well as whether they aspire to study science in college or desire a career in science. I find that there are large effects on most of these outcomes, but that the effects are concentrated among male students. Thus, while the strategy seems an effective way to increase science engagement, science museums may need to develop better strategies to engage girls.

For more information concerning the case against adjustments for multiple comparisons, see Perneger, 1998, "What's Wrong with Bonferroni Adjustments,: *British Medical Journal*, 316(7139): 1236-1238.

It is my hope that these three pieces of research will be of value to the field and will help to serve as a catalyst for future research. There seems to be a small but growing number of researchers interested in conducting this type of work. With an increased amount of research in this area, perhaps better professional paths, networks, and publication outlets will follow. It's a classic chicken-and-egg problem—very few do research in this area because there are few external rewards and career paths, but perhaps there are few external rewards because the field of study is so underdeveloped. Currently, given the heated national conversations occurring regarding the right direction and focus of public education, it is an especially important and opportune time to make sure that the perspectives of cultural institutions and those who support them are given their fair weight in policy debates. I believe that these studies are a step in that direction.

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Chapter 1

Measuring Critical Thinking: Results from an Art Museum Field Trip Experiment

Abstract

Research shows that participation in school-based arts education has declined over the past decade. A problem for the arts' role in education has been a lack of rigorous scholarship that demonstrates educational benefits. A component of this problem has been a lack of available data. In this study, we use original data collected through a randomized controlled trial to measure the effects of school visits to an art museum. Building on previous work, we find positive effects of art museum visits on students' ability to critically examine a work of art. Importantly, we validate our previous findings with an additional experimental condition, adding extra validity to the assessment instrument and our results. Our research suggests that policymakers should more fully consider the educational benefits of arts education, and scholars should consider broader approaches to measuring student performance in non-tested subjects.

Keywords: experimental design, arts education, curriculum, informal learning

Introduction

Student achievement data focused on the arts and humanities are particularly rare, and rigorous methodological approaches to the study of arts education are rarer still. Most evaluations of student achievement predominantly focus on outcomes measured by standardized test scores in math and reading (Heckman & Rubenstein, 2001). Most of this work relies on the test score data generated under state accountability systems or other pre-existing datasets. This poses a problem for the arts in education. In a policy environment increasingly driven by data and rigorous analytic techniques, unmeasured and understudied subjects face the risk of being deemphasized for failure to demonstrate their value (Gadsden, 2008).

This is concerning for a number of reasons. First, the efficacy of the mission of educational research depends on the field being driven by academic inquiry, and not operating simply as an extension of state accountability systems. While there is no question that basic literacy and numeracy are central to education, it is unclear how much of the attention they receive in the research community is simply due to convenience. A lack of available measures of broader components of student achievement at least partially explains their neglected study (Heckman & Rubenstein, 2001). Such a situation is problematic, as emerging research demonstrates that alternative skills are vitally important for determining future life outcomes (e.g., Almlund et al., 2011; Heckman & Rubenstein, 2001; Jackson, 2013; Tough, 2012).

Moreover, the increased emphasis on accountability testing in core subjects has coincided with a notable decline in school-based arts exposure (Gadsden, 2008). A growing body of research is validating the suspected link between educators' increased focus on accountability testing and decreased emphasis on the arts and other non-tested subjects (Bassok & Rorem, 2014; West, 2007). Additional evidence suggests that the declines are disproportionately affecting disadvantaged students (Chappell & Cahnmann-Taylor, 2013; (Rabkin & Hedberg, 2011; Yee, 2014). A recent federal government report found that schools identified as needing improvement under the Federal No Child Left Behind Act and schools with higher percentages of minority students were more likely to experience decreases in the amount of time spent on arts education (Government Accountability Office, 2009). Without research demonstrating the educational benefits of the arts and humanities, practitioners and policymakers who determine where schools focus their resources are ill-equipped to make informed decisions.

Historically, a common method for exposing students to the arts and humanities has been through school facilitated visits to cultural institutions. Cultural institutions spend more than $2 billion per year on educational activities, and they receive more than 90 million student visits each year from K-12 school groups (National Humanities Alliance, 2012). Yet, similar to school-based arts exposure, school visits to cultural institutions are in decline (*Associated Press*, 2012; Blair, 2008; Ellerson, 2010; Lewin, 2010; Mehta, 2008; Plummer, 2014). Without evidence demonstrating the potential benefits of arts exposure, there is not a reliable method for policymakers to consider the costs of these declines.

The research we present here helps to address the lack of measured educational outcomes in non-tested subjects. First, using original data, we adopt a broader view of educational achievement than what is commonly measured in the study of student outcomes. Second, we expand our consideration of the source of educational enrichment by examining student visits to an art museum. This analysis speaks directly to the policy implications of the increasingly diminished role of the arts in education and the decline in school visits to cultural institutions.

We assess the academic benefits of exposure to the arts using two rounds of original data from a large-scale randomized controlled trial (RCT) involving nearly 8,000 grade 3-12 students assigned by lottery to participate in a facilitated school tour of an art museum. All students in our study completed a follow-up survey, which included a prompt to write essays in response to a work of art that was unfamiliar to them. The essays from the treatment and control groups were coded blindly on a 7-item rubric to assess the students' critical thinking skills. In a previous study, we examined the first round of data from this project and found that students randomly assigned to visiting an art museum demonstrated stronger critical-thinking skills when analyzing a representational work of art that was unfamiliar to them (Bowen, Greene, and Kisida, 2014). We build on this previous research with a new examination of 3,610 additional students who were part of a second experimental condition involving a work of abstract art. We find that students who were assigned by lottery to visiting an art museum also demonstrate significantly stronger critical thinking skills when analyzing an abstract work of art. The pattern of results, however, does not fully align with our previous findings.

In the next section we discuss existing research and theory about the potential educational benefits of arts-exposure. Next, we describe our sample design, data collection, and the treatment the students received. Then we discuss the critical thinking skills rubric and our empirical strategy. In the penultimate section we present our results. We conclude with a discussion of our findings, suggestions for future research, and the implications for education research and policy.

Theory and Research on the Educational Benefits of the Arts

Proponents for the inclusion of the arts in education have argued that it helps develop empathy, creativity, and self-expression (Dewey, 1919; Heilig, Cole, & Aguilar, 2010), and serves as a way to strengthen cognitive abilities and critical thinking skills (Eisner, 2002). A number of studies also claim that exposure to the arts has positive "transfer" effects to core subjects such as math and reading (see, for example, Baker, 2012; Catterall, Dumais, & Hampden-Thompson, 2012; Deasy, 2002). Critics, however, point out that these studies are typically correlational and unable to demonstrate causal links (Hetland & Winner, 2001; McCarty, Ondaatje, Zakaras, & Brooks, 2004; Winner & Cooper, 2000). Moreover, the attempts to justify the arts indirectly due to their potential to produce gains in other subjects has been described as self-destructive, with calls to develop theory and gather evidence that demonstrates the direct effects of arts exposure (Hetland & Winner, 2004).

Along these lines, some researchers have suggested that the most immediate effects of the arts on education are those “that pertain to the perception and comprehension of aesthetic features” (Eisner, 1999, p. 147). Similarly, previous research identifies certain “habits of mind” gained by studying art, which include observing, reflecting, envisioning, innovating, stretching and exploring, and engaging and persisting (Hetland, Winner, Veenema, & Sheridan, 2007). Previous studies have found relationships between arts participation and creativity measures (Luftig, 1994), theory-building and reflecting (Heath, 1999), student expressiveness and elaboration (Burton, Horowitz, & Abeles, 2000), tolerance and historical empathy (Greene, Kisida, and Bowen, 2014), and critical thinking skills (Korn 2007; Lampert, 2006; Burchenal & Grohe, 2007).

Most existing studies, however, have not been able to employ rigorous research designs and have lacked well-developed methods of measuring the types of outcomes theorized to be related to arts exposure. A notable exception resulted from a 2003 evaluation of a school partnership program at the Isabella Stewart Gardner Museum in Boston funded by the U.S. Department of Education’s Arts in Education Model Development and Dissemination grant program. The evaluation examined the impact of a curriculum and teaching method, Visual Thinking Strategies (VTS), which was implemented through the critical examination of art. A significant component of the evaluation was the development of a rubric for measuring the kinds of critical thinking skills theoretically related to learning through the arts (Luke, Stein, Foutz, & Adams, 2007). The final version of the rubric was composed of seven individual critical thinking skills: observation, interpretation, evaluation, association, problem-finding, comparison, and flexible thinking.

In the quasi-experimental evaluation of the program, researchers found that students in the intervention group demonstrated significantly more instances of the critical thinking skills (Adams, Foutz, Luke, & Stein, 2007). A separate report found that treatment group students' critical-thinking skills also extended to their writing skills (Desantis, 2009).

In a previous study employing this same rubric, we found that students randomly assigned to visit an art museum demonstrated stronger critical thinking skills when analyzing a work of representational art, and that the effects were higher for minority students, students from smaller towns, and students from higher-poverty schools (Bowen, Greene, and Kisida, 2014). We replicate and extend this research with a second experimental condition assessing the critical thinking outcomes of an additional 3,610 students who examined an abstract work art. As a result, we are able to consider whether the main effects and subgroup effects from the first experimental condition are consistent with the second experimental condition. We also consider the effects when both samples are aggregated, and conduct exploratory work that considers how the effects differ between representational and abstract art with regards to specific critical thinking components.

Sample and Data

In November of 2011, the Crystal Bridges Museum of American Art opened in Bentonville, Arkansas. With an endowment greater than $800 million, it is the first major American art museum to open in 50 years (Vogel, 2011). In March 2012, the museum established a program that offered school tours to area students. A substantial portion of the museum's endowment covers expenses related to the school tours, which allows school groups to visit the museum for virtually no cost. The endowment covers admission, transportation, lunch at the museum, substitute teachers, and pre/post visit curricular materials. Because the establishment of a significant art museum where one did not previously exist was a major event, and the cost of the tours was covered, demand for school tours was much higher than capacity. The museum received applications from 525 school groups representing 38,347 grade K-12 students during the first two semesters of the program. In the interest of fairness, we conducted a lottery in partnership with the museum to award available slots.

In order to ensure the comparability of the treatment and control groups, we implemented a stratified randomization procedure. The use of a stratified randomization procedure can increase the balance between treatment and control groups while preserving the advantages of random assignment (Schneider et al., 2007). To ensure that the treatment and control groups were equal on important baseline treatment characteristics, we paired applicant groups with similar demographics (e.g., grade, region, school free- and reduced-lunch status, and school percent minority) and performed isolated lotteries within these pairings. The applicant groups that won each lottery were assigned to the treatment condition, and the corresponding matched applicants that did not win the lottery were assigned to the control group. To incentivize participation in the study, applicants assigned to the control group were guaranteed a spot for the following semester if they participated in data collection.

After the matching process and assignment to treatment, we generated a random number for each applicant pair. This randomly generated number was then used to rank-order the pairs and award spots to the treatment groups until all available spots were filled. As a result, 74 total groups with students in grades 3-12 were randomly awarded a guided tour of the museum (the treatment groups), while another 74 groups had their tours deferred (the control groups). Forty of the application groups were awarded a tour in the first semester of randomization (spring 2012), while an additional 34 groups were awarded tours in the following semester (fall 2012). Applicant pairings not selected received apologetic letters and encouragement to apply in future rounds.

Trained members of the research team visited the students in their classrooms and administered surveys to both the treatment and its paired control group on average three weeks (M = 21.8 days, SD = 12.1) after the treatment group's visit to Crystal Bridges. Seven matched pairs that were originally part of the lottery were excluded from the study because of tour cancellations or erroneous application information. Because participation in data collection was packaged as a mandatory component of receiving an immediate or deferred school tour, all of the remaining treatment groups that visited the museum and their matched control groups completed surveys. In total, 67 matched treatment and control group pairs (35 in the spring and 32 in the fall) completed a critical thinking assessment, representing a total of 134 applicant groups, over 7,500 students, and 111 different schools.

The Treatment

Before they visited the museum, treatment group teachers were sent a packet containing a 5-minute orientation video for students and teachers to watch. The video emphasized the student-driven nature of the tours, and established that student discussions were a central component of the tour process. Teachers were also provided with information about the themes of the tour they had selected, a sample of three images that the students would see, and discussion questions to ask their students prior to the visit. The questions were intended to introduce students to the types of themes they would learn about and to prepare them for the dialogue driven nature of the tour. The museum also provided teachers with post-visit materials that included suggestions for classroom activities and factual information about the art works.

The museum tours were led by paid museum educators, tailored for specific grade-levels, and aligned with Common Core Curriculum Standards. During a typical tour, students were placed into small groups of 10 to15 that focused intensively on four or five paintings or sculptures in the museum. The goal of museum educators was to facilitate an open-ended, student-centered approach to discussing the works of art, encourage a deep level of engagement, and motivate students to seek out their own unique interpretations. When relevant, museum educators supplied sociological and historical information about the art in order to enhance student understanding. Guiding student-driven discussion, however, was the main goal of the museum educators.

Critical Thinking Assessment

The student surveys we administered contained questions regarding student demographics, art consumption and production, attitudes towards cultural institutions, and knowledge of art. After completing the survey items, students were shown a painting they had not previously seen—a relatively unknown work of art that was not part of the museum's collection. In the spring semester, students were asked to analyze Bo Bartlett's *The Box*. As a result of piloting multiple images with students prior to data collection, this example of representational art was chosen because students seemed to respond to the younger subjects in the painting, and the somewhat ambiguous nature of the painting provided a lot of opportunities for students to provide unique interpretations. Additionally, the painting has a number of objects that students were able to incorporate into their analysis.

In the following fall semester, we chose a more abstract painting which was also unfamiliar to the students—Marsden Hartley's *Eight Bells Folly: Memorial to Hart Crane*. By selecting a more abstract painting, we are able to broaden our application of the critical thinking rubric and determine if the museum experience improves the students' ability to critically examine different styles of art.

Once presented with a copy of the painting, students were given exactly five minutes to write an essay in response to the following two questions: 1) What is going on in this painting? 2) What do you see that makes you think that? These questions are often used as prompts by art educators when facilitating student-driven discussions about art and are part of the VTS learning approach. The first prompt asks students to construct a narrative about the work, while the second question "subtly asks the viewer to supply evidence to back up his answer to the first question" (Housen, 2001, p. 7).

Some essays were largely observational, while other essays provided deeper and more complex interpretations of the paintings. For example, in the following passage about *The Box* from a 10th grade girl, the student analyzes the objects placed throughout the painting and provides observations, interpretations, and associations:

> *"I believe the children are reminiscing on the loss of their father. The look on the children's faces is very mournful. In the open bucket you can see things that would be sent home if a loved one was lost in war. The Popeye doll seems like he would represent the father's strength. There is a wedding photo, probably for remembrance and what looks like communion, which represents religion that maybe the family was close to. Also, to me, the empty chair in the foreground shows where the father would be sitting if he were present."*

In this passage written about *Eight Bells Folly*, an 11th grade boy makes numerous observations, interpretations, and assigns an overall narrative to the painting:

> *"I see the ship as a life making decisions. I see that this ship is in a storm, it is trying to navigate through the storms of life. The waves are crashing high above the small ship's sails, the wind is blowing and it is a dark night. The eyes represent loved ones who are concerned with the oucome of the ship, and are there to give counsel when needed."*

Four researchers independently coded the student's written responses using Luke et al.'s (2007) critical-thinking skills checklist, and then tallied the number of observations, interpretations, evaluations, associations, instances of problem finding, comparisons, and instances of flexible thinking. In order to minimize bias, coders were not made aware of any student characteristics, including whether they were in the treatment or control group. To test for inter-rater reliability, the researchers coded a set of overlapping essays—750 in the spring sample and 250 in the fall sample. Descriptive statistics for both samples, as well as the percent agreement and the more conservative Cohen's weighted kappa for the overlapping items (Cohen, 1968) are provided in Table 1.

Similar to the federally-funded study that developed the rubric, observations and interpretations were the most common elements in the students' essays. Notably, observations were much more likely for the abstract work of art, while observations and interpretations both factored heavily in the scores for the more literal painting. It is possible that students found the abstract image more difficult to relate to, and thus harder to interpret.

The combination of all 7 items, which is the dependent variable used in our main outcome analyses, displays a high rate of reliability between coders in both samples (weighted kappa = .84, .89, respectively). When the items of the critical thinking scale are examined separately, most of the individual items also show high levels of intercoder reliability. The item "problem finding" is an exception in the spring sample, which is explained by the fact that occurrences in student essays were particularly rare. The same is true for "flexible thinking" in the fall sample. Additionally, instances of “comparisons” were too rare among the 250 overlapping essays in the fall sample for adequate reliability tests.

Table 1: Descriptive Statistics and Inter-Coder Reliability for Critical Thinking Items

	Spring Sample: *The Box* (Representational art)			Fall Sample: *Eight Bells Folly* (Abstract art)		
Item	**Average (Std. Dev.)**	**Percent Agreement**	**Weighted Kappa**	**Average (Std. Dev.)**	**Percent Agreement**	**Weighted Kappa**
Composite (Sum of 7)	8.16 (3.85)	99.4	0.84	8.69 (4.28)	99.3	0.89
Observation: identifying something; what something is; what is happening; locations; counts	3.97 (2.40)	99.4	0.78	6.08 (3.25)	99.3	0.91
Interpretation: relationships; feelings related to work of art; ascribing meaning	3.90 (2.35)	98.7	0.56	2.42 (2.00)	98.6	0.70
Evaluation: personal preferences and perceived merits of the work of art	0.02 (0.18)	99.6	0.40	0.07 (0.31)	98.9	0.48
Association: connecting art with previous knowledge or experience	0.06 (0.25)	96.8	0.37	0.03 (0.18)	99.5	0.53
Problem Finding: noting information needed to form a conclusion; requesting information	0.01 (0.12)	99.7	0.13	0.03 (0.22)	99.7	0.77
Comparison: noticing relationships; noticing patterns; noting similarities or differences	0.02 (0.15)	99.1	0.69	0.00 (0.05)	--	--
Flexible Thinking: seeing things from multiple perspectives; revising thoughts	0.17 (0.43)	98.7	0.84	0.05 (0.24)	98.8	.09

Empirical Strategy

Comparisons between the treatment and control groups on key variables show that the stratified randomization procedure largely achieved the goal of producing comparable groups, though as is often the case in randomized controlled trials, they are not perfectly identical (table 2). Raw means and differences are displayed for individual student-level, school-level, and community-level characteristics. The displayed p-values are from the coefficient on the treatment indicator when each covariate is regressed on the treatment variable and the matched pair indicators. Three of the differences are statistically significant. In the spring sample, the treatment group is slightly more likely to identify as Hispanic. The magnitude of the difference, however, is not substantial. The spring sample treatment group is also more likely to come from a town with a smaller population. Some slight imbalance on these measures makes sense, as pairs were matched based on a school's overall school percent minority, region, school-percent FRL, and grade. Percent Hispanic and town population were not explicitly incorporated into the creation of matched-pairs. In the spring sample, the only significant difference between the treatment and control groups is a slight difference in the number of previously reported cultural activities. For both samples, a joint f-test failed to reject the null hypothesis that the effects of the covariates on treatment are jointly equal to zero (spring sample p-value = 0.43, fall sample p-value = 0.12).

Table 2: Treatment/Control Balance on Key Characteristics

	Spring Sample				Fall Sample			
Characteristic	**Treatment (n = 1,720)**	**Control (n = 1,890)**	**Difference**	**p-value**	**Treatment (n = 1,747)**	**Control (n = 2,211)**	**Difference**	**p-value**
Percent females	53.37	52.28	1.10	0.24	50.37	50.47	-0.10	0.86
Percent white	61.45	58.94	2.51	0.18	54.67	60.74	-6.08	0.47
Percent Hispanic	20.58	20.26	0.32*	0.01	19.12	17.87	1.25	0.79
Percent black	3.02	4.92	-1.90	0.25	2.69	2.99	-0.29	0.05
Percent other	14.94	15.87	-0.93	0.70	23.53	18.41	5.12	0.16
Average grade	6.15 (2.56)	6.21 (2.71)	-0.07	0.12	5.76 (2.07)	5.65 (2.18)	0.11	0.31
Cultural activities	0.77 (1.00)	0.81 (1.04)	-0.05	0.67	1.04 (1.16)	0.92 (1.08)	0.12**	0.00
School FRL	50.94 (21.67)	53.00 (21.83)	-2.06	0.24	58.00 (23.73)	57.87 (20.40)	0.13	0.81
School size (100s)	6.83 (4.36)	8.10 (5.39)	-1.27	0.08	6.19 (2.57)	6.03 (2.73)	1.65	0.43
Town size (1000s)	37.94 (28.27)	55.19 (36.58)	-17.26*	0.04	38.91 (30.37)	30.16 (29.22)	8.75	0.85

** $p < .01$, * $p < .05$, two-tailed.

Note: School FRL, school size, and town size are measured at the applicant group level, other demographic variables are measured at the student level. School FRL = percentage of students receiving free or reduced-price lunch. Cultural activities are the sum of self-reported previous cultural activities students participated in outside of school, including dance lessons, music lessons, art classes, and theater participation. The reported p-value is from the coefficient on the treatment indicator when each covariate is regressed on the treatment indicator and the matched pair dummies (as in the base model for the impact model). Treatment and control group means and differences are actual. Standard deviations of continuous variables are shown in parentheses. A joint F-test from a model regressing the treatment indicator on the full list of covariates failed to reject the null hypothesis that the effects of the covariates are jointly equal to zero (spring sample p-value = 0.43 , fall sample p-value = 0.12).

Because randomization generated comparable treatment and control groups, we can use straightforward analytic techniques to estimate the impacts of the school tour of an art museum. In its most simple form, this technique could estimate simple mean differences using the following equation for outcome *CTS*, the standardized critical thinking score, of student *i* in matched pair *m*:

(1) $CTS_{im} = \alpha + \beta_1 Treat_i + \boldsymbol{Match_i \beta_2} + \boldsymbol{Grade_i \beta_3} + \varepsilon_{im}$

The indicator variable $Treat_i$ is equal to 1 if the student was in the treatment group randomly assigned to visit the museum for a school tour and is equal to 0 otherwise. Because we used a stratified randomization procedure within matched applicant group pairs, $\boldsymbol{Match_{im}}$ is also included in the model as a vector of dummy variables that have the statistical effect of estimating within, as opposed to across, matched pairs. Moreover, we include dummy variables to control for student grade level because in some cases matched pairs were composed of adjacent grades within the same school. Finally, ε_{im} is a stochastic error term clustered at the applicant group level to account for the spatial correlation of students nested within applicant groups.

While proper randomization generated comparable groups, they are not perfectly identical. The basic regression model may be improved by adding additional controls for observable characteristics to increase the precision of the estimated impact by accounting for minor differences between the treatment and control groups. Moreover, by adding observable characteristics to the regression model, we can examine the relationship between these characteristics and the outcome measures. This yields the following equation to be estimated:

(2) $CTS_{ims} = \alpha + \beta_1 Treat_i + \boldsymbol{Match_i\beta_2} + \boldsymbol{X_i\beta_3} + \boldsymbol{Z_s\beta_4} + \varepsilon_{ims}$

Where $\boldsymbol{X_i}$ is a vector of student characteristics and $\boldsymbol{Z_s}$ is a vector of school and community characteristics. Important student characteristics are gender, grade level, and ethnicity. We include gender in our models as a binary measure equal to 1 if the student is female, and we collapse ethnicity into a simple binary measure indicating if the student is nonwhite. Additionally, we are able to include a measure of students' prior cultural activities, which could potentially moderate the effects of the museum tour. Students reported if, outside of their school, they had ever taken dance lessons (21 percent responded yes), music lessons (28 percent responded yes), art classes (20 percent responded yes), or participated in theater (23 percent responded yes). We sum the number of affirmative responses to these questions into a baseline measure of cultural activities. School characteristics are school level percent free- and reduced-lunch (FRL) and school size. Finally, we use the population of the children's town of residence as an indicator of rural status.

In addition to overall impacts, we also test for the heterogeneous effects across particular types of students. We test for heterogeneous effects by modifying equation 2 to include interactions between the binary treatment variable and student and school characteristics. For our analysis, we explore potential interaction effects using our baseline measure of cultural activities, ethnicity, school FRL levels, school size, and town size.[2] These measures serve as potential indicators of students' disadvantaged status and students' previous exposure to the arts and

[2] For continuous variables (school size, town size, school FRL-levels, and cultural activities), our tests for heterogeneity impose a linear structure on the relationship between the treatment and the treatment impact. To investigate non-linearity, we also examined heterogeneity by collapsing the continuous variables into roughly equal subgroups. The results were largely consistent with our preferred analysis. In a few instances, evidence of heterogeneity for both experimental conditions is statistically stronger when not treated as continuous.

cultural activities, which may moderate responses to the treatment. Our measure of previous cultural activities measures this directly. Additionally, minority students, students from higher-FRL schools, students in smaller schools, and students in smaller towns have likely had fewer opportunities to participate in enriching cultural activities.

Results

Regression estimates for the spring sample who analyzed a work of representational art are shown in table 3. In the most parsimonious model (column 1), the impact of the treatment is 10 percent of a standard deviation. Adding student, school, and community characteristics does little to change the overall effect size (0.11 SD), which is to be expected with experimental data (column 2), though it does improve the precision and the statistical significance. Descriptively, female students, on average, score higher on the critical thinking measure than do male students. Our measure of previous cultural activities is also positive and significant. Each additional cultural activity a student reported having previously done (dance classes, music classes, etc.) was associated with a 9 percent of a standard deviation increase in our critical thinking measure. The size of a student's town, which serves as a measure of how urban or rural a student's community is, is significant and negatively related to the outcome.

Table 3: Regression Estimates of Treatment Effects on Student Critical Thinking About Representational Art

	(1) Effect Size (SE)	(2) Effect Size (SE)	(3) Effect Size (SE)	(4) Effect Size (SE)	(5) Effect Size (SE)	(6) Effect Size (SE)	(7) Effect Size (SE)	(8) Effect Size (SE)
Treatment	0.10*	0.11**	0.08	0.05	0.12**	0.24**	-0.26**	0.20
	(0.05)	(0.03)	(0.04)	(0.04)	(0.04)	(0.07)	(0.05)	(0.11)
Female		0.38**	0.35**	0.38**	0.38**	0.38**	0.38**	0.38**
		(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Nonwhite		-0.04	-0.04	-0.10*	-0.04	-0.04	-0.04	-0.04
		(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Cultural activities		0.09**	0.09**	0.09**	0.10**	0.09**	0.09**	0.09**
		(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
School size		0.61	0.62	0.60	0.60	0.62	0.64	0.65
		(0.36)	(0.35)	(0.36)	(0.35)	(0.33)	(0.33)	(0.36)
School % FRL		0.71	0.71	0.78	0.68	0.46	0.50	0.34
		(0.72)	(0.72)	(0.73)	(0.71)	(0.63)	(0.64)	(0.71)

Town size		-0.03*	-0.03*	-0.02*	-0.03*	-0.02	-0.02**	-0.03
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Treat X Female			0.06					
			(0.05)					
Treat X Nonwhite				0.13*				
				(0.06)				
Treat X Activities					-0.02			
					(0.03)			
Treat X School size						-0.17		
						(0.09)		
Treat X % FRL							0.73**	
							(0.11)	
Treat X Town Size								-0.02
								(0.02)
Observations	3,610	3,610	3,610	3,610	3,610	3,610	3,610	3,610
R^2	0.22	0.29	0.29	0.29	0.29	0.29	0.29	0.29

** $p < .01$, * $p < .05$, two-tailed.

Note: Estimates are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group. All models control for grade level and lottery pair. Effect sizes are in terms of standard deviation units. School percentage FRL = percentage of students receiving free or reduced lunch. Cultural activities are the sum of self-reported previous cultural activities students participated in outside of school, including dance lessons, music lessons, art classes, and theater participation. School size is expressed in 1000s. Town size is expressed in 10,000s.

When we interact the treatment variable with the other covariates (columns 3-8), two of the 6 interaction terms are significant. Nonwhite students and students attending schools with higher proportions of FRL-eligible students have critical thinking outcomes that are significantly higher as a result of the treatment.

The overall effect for the fall sample, who analyzed a more abstract work of art, is similar in magnitude to the spring results (table 4). The effect size in the parsimonious model (column 1) is 13 percent of a standard deviation, while the effect size in the model that includes covariates is 8 percent of a standard deviation (column 2). Presumably some differences between the treatment and control groups at baseline were corrected by the inclusion of covariates. Similar to the spring results, female students score higher, as do students who have had more experience with cultural activities. In this case, students from larger towns score higher.

Table 4: Regression Estimates of Treatment Effects on Student Critical Thinking About Abstract Art

	(1) **Effect Size** **(SE)**	**(2)** **Effect Size** **(SE)**	**(3)** **Effect Size** **(SE)**	**(4)** **Effect Size** **(SE)**	**(5)** **Effect Size** **(SE)**	**(6)** **Effect Size** **(SE)**	**(7)** **Effect Size** **(SE)**	**(8)** **Effect Size** **(SE)**
Treatment	0.13**	0.08*	0.09	0.04	0.09	0.18*	-0.10	0.05
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)	(0.09)	(0.16)	(0.08)
Female		0.31**	0.32**	0.31**	0.31**	0.31**	0.31**	0.32**
		(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Nonwhite		0.00	0.00	-0.04	0.00	0.00	0.01	0.01
		(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Cultural activities		0.07**	0.07**	0.07**	0.07**	0.07**	0.07**	0.07**
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
School size		-0.06	-0.06	-0.06	-0.06	-0.00	-0.09	-0.03
		(0.13)	(0.13)	(0.13)	(0.13)	(0.14)	(0.14)	(0.12)
School % FRL		0.55	0.55	0.53	0.55	0.58	0.34	0.62*

		(0.34)	(0.34)	(0.34)	(0.34)	(0.36)	(0.41)	(0.34)
Town size		0.07**	0.07**	0.08**	0.07**	0.07**	0.08**	0.07**
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Treat X Female			-0.01					
			(0.07)					
Treat X Nonwhite				0.09				
				(0.06)				
Treat X Activities					-0.01			
					(0.03)			
Treat X School size						-0.17		
						(0.12)		
Treat X % FRL							0.29	
							(0.22)	

Treat X Town Size								0.01
								(0.01)
Observations	3,958	3,958	3,958	3,958	3,958	3,958	3,958	3,958
R-squared	0.12	0.16	0.16	0.16	0.16	0.16	0.16	0.16

** *p* < .01, * *p* < .05, two-tailed.

Note: Estimates are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group. All models control for grade level and lottery pair. Effect sizes are in terms of standard deviation units. School percentage FRL = percentage of students receiving free or reduced lunch. Cultural activities are the sum of self-reported previous cultural activities students participated in outside of school, including dance lessons, music lessons, art classes, and theater participation. School size is expressed in 1000s. Town size is expressed in 10,000s.

The effects across subgroups, however, do not align with the spring results (columns 3-8). When examining a more representational work of art, the treatment had a larger effect on minority students and students at higher-FRL schools. In the fall sample, however, none of the six interaction terms are significantly different from zero. That is, when analyzing a more abstract work of art, we find no differential effects across different student, school, or community characteristics as a result of the treatment.

It is possible that the different pattern of heterogonous findings between the two experimental conditions is related to issues of statistical power. It could be the case that the second experimental condition had sufficient power to detect an overall effect similar to the first experiment, but lacked the power to detect similar heterogeneity. We tested this possibility by pooling the data from both experiments and running a pooled analysis (see Appendix tables 1 and 2 for descriptive characteristics and results). When the data are pooled, however, the evidence of heterogeneous effects gets weaker. This suggests that a lack of power in the second experiment is not the issue, or that the existence of differential effects in the first experiment is a spurious finding.

A second reason for finding a different pattern of results could be due to the differences in the chosen images. We know that descriptively, students tended to make more observations than interpretations when analyzing *Eight Bells Folly*, while observations and interpretations were nearly evenly represented when analyzing *The Box* (table 2). To shed some additional light on this aspect, we examined impacts on observation and interpretation separately within each experiment (see Appendix table 3). The same evidence of heterogeneity we saw for our main outcome measure is consistent for the Spring sample when observation and interpretation are examined separately. Specifically, all of the point-estimates for the interactions when examining representational art are positive, and three of four are statistically significant. However, we also see some evidence of heterogeneity when looking at these separate outcomes for the abstract painting. In particular, there is a positive and statistically significant interaction for minority students when the outcome is observation, and a positive and significant interaction for students at higher-FRL schools when the outcome is interpretation. Thus, while the descriptive findings suggest that abstract art may be more difficult for students to interpret, the isolated results indicate a similar pattern of heterogeneity as we observed for representational art. Due to the inherent noisiness in looking at these items in isolation, however, it is difficult to draw firm conclusions.

Discussion

Students have traditionally received exposure to the arts from their schools and through visits to cultural institutions. In both cases, however, the amount of exposure has been declining. Moreover, this decline is occurring without an adequate consideration of the academic benefits that these experiences might provide. Amidst a lack of data and rigorous research approaches, the costs of reduced exposure to the arts are unknown to parents and policymakers. In our analysis, we find that a relatively modest amount of arts exposure produced modest but significant effects. Students were briefly exposed to curricular materials in their classrooms, and they spent a day of their schooling at an art museum with museum educators. For many of these students, this was their first school facilitated visit to an art museum. Because Crystal Bridges is the first major art museum to be built within a reasonable travel distance, schools in the area had previously been unable to provide this experience. In this environment, even a minimal intervention produced significant changes in the students' ability to think critically about a work of art they had not seen previously. Our two samples analyzed very different works of art, yet our overall results are consistent. Because museum visits were randomly assigned, we can be particularly confident that the museum exposure received by the treatment group caused the effects.

When analyzing a more representational work of art, we find that the treatment effect is greater for students from more disadvantaged backgrounds. Specifically, the effects were greater for minority students and students attending schools with higher proportions of FRL-eligible students. For the students who analyzed a more abstract work of art, however, there was no clear evidence of differential effects. Across both samples, female students and students with higher previous levels of cultural activities demonstrated a significant advantage when asked to critically examine a work of art, though there was no differential treatment effect across those particular variables.

For the representational image, the effects are concentrated among minority students and students at poorer schools. These students may have had an easier time relating to the image of *The Box* after they were exposed to the treatment. The painting depicts two children in a realistic setting, surrounded by literal representations of objects. Examining the more abstract *Eight Bells Folly* may have been more difficult, resulting in modest gains across the full sample that were not concentrated among any particular types of students. This could also be due to the difficulty involved when analyzing more abstract art. An exploratory examination of key components of our critical thinking outcome, however, suggests disadvantaged students may also receive a greater benefit from the treatment when examining abstract art, but the pattern is less consistent. Treatment effects are greater for minority students when the outcome is observation, while the treatment effects on interpretation are concentrated among students at poorer schools. Future research should further examine the issue of heterogeneous effects with regards to different forms of art.

There are important limitations to this study. It is important to note that the main source of the variation in our critical thinking outcome is generated by observations and interpretations. It may be an overreach to conclude that these two items are sufficient to demonstrate improved critical thinking about art generally. Though others in the field have theorized that observation and interpretation "may often serve as building blocks for other skills, such as comparison and flexible thinking," this is an area where future research is needed (Adams, et al., 2007, pp. 13).

Additionally, because our study examines an area where few cultural institutions exist, our findings may only generalize to students with little prior exposure to such experiences. It is possible that the benefits for students living in areas with more cultural opportunities would not experience similar benefits, though even in culturally rich areas it is likely that disadvantaged students lack access. Additionally, we were only able to assess students a short time after the experience. Future research could evaluate whether the benefits of an educational arts experience endure over a longer period of time. Moreover, this research does not establish which components of the art museum experience were essential for increases in critical thinking skills, or if these same effects could be generated from school-based arts exposure. Finally, data limitations prevent us from directly testing to determine if there are spillover effects in other academic subjects. Winner and Cooper (2000), however, suggest that enhancements in critical thinking produced by arts experiences may not be limited to the arts. They suggest that skills such as observation, critical thinking, and problem solving could transfer to other academic areas.

Rigorous study of the arts, humanities, and other untested subjects is woefully lacking in education policy research. With noted declines in these subjects coinciding with a policy environment increasingly driven by data and quantitative research, more empirical studies of their educational benefits are needed. Often this will require the generation of original data, as state accountability and administrative datasets are typically insufficient for examining subjects beyond reading, math, and science. Advocates make numerous claims about the benefits of the arts and humanities—increased student engagement, increased social responsibility, increased creativity, increased empathy, and increased tolerance, to name a few. Such outcomes seem paramount and fundamental to the mission of education. Yet, surprisingly, few of these claims have been empirically examined with rigorous research designs.

Our findings have important policy implications. To the extent that academic research influences policymakers, it is crucial that policymakers receive information about the broad spectrum of educational benefits available to students. Here, we have established that an arts experience can have a significant impact on critical thinking skills. This suggests that there are measurable, negative consequences when the arts are reduced in schools. Our results also suggest that in some instances, disadvantaged students may reap the greatest benefits from arts exposure facilitated by their school. Because disadvantaged students receive fewer arts experiences outside of school, public education plays a crucial role in providing those students with access to art. With this and additional research, policymakers and educators may be able to make better informed decisions about where and how to concentrate school resources that extend beyond the task of maximizing performance in core subjects.

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Appendix

Appendix Table 1: Treatment/Control Balance on Key Characteristics

	Combined Sample			
Characteristic	**Treatment (n = 3,467)**	**Control (n = 4,101)**	**Difference**	**p-value**
Percent females	51.86	51.30	0.56	.37
Percent white	58.03	59.91	-1.88	.18
Percent Hispanic	19.84	18.97	0.87	.17
Percent black	2.86	3.88	-1.02	.09
Percent other	19.27	17.24	2.03	.31
Average grade	5.95 (2.34)	5.91 (2.46)	0.04	.07
Cultural activities	0.90 (1.09)	0.87 (1.06)	0.03	.07
School FRL	54.50 (23.00)	55.63 (21.21)	-1.13	.79
School size (100s)	6.51 (3.58)	6.98 (4.29)	-0.47	.06
Town size (1000s)	38.43 (29.34)	41.70 (35.10)	-3.27	.11

$^{**}p < .01$, $^{*}p < .05$, two-tailed.

Note: School FRL, school size, and town size are measured at the applicant group level, other demographic variables are measured at the student level. School FRL = percentage of students receiving free or reduced-price lunch. Cultural activities are the sum of self-reported previous cultural activities students participated in outside of school, including dance lessons, music lessons, art classes, and theater participation. The reported p-value is from the coefficient on the treatment indicator when each covariate is regressed on the treatment indicator and the matched pair dummies. Standard deviations of continuous variables are shown in parentheses. A joint F-test from a model regressing the treatment indicator on the full list of covariates failed to reject the null hypothesis that the effects of the covariates are jointly equal to zero (p-value = 0.88).

Appendix Table 2: Regression Estimates of Treatment Effects on Student Critical Thinking About Art (Combined Samples)

	(1) Effect Size (SE)	(2) Effect Size (SE)	(3) Effect Size (SE)	(4) Effect Size (SE)	(5) Effect Size (SE)	(6) Effect Size (SE)	(7) Effect Size (SE)	(8) Effect Size (SE)
Treatment	0.11**	0.14**	0.03	0.10**	0.08	0.22**	0.12**	0.14**
	(0.03)	(0.03)	(0.08)	(0.04)	(0.07)	(0.06)	(0.04)	(0.03)
Female		0.34**	0.34**	0.34**	0.34**	0.34**	0.33**	0.34**
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Nonwhite		-0.02	-0.02	-0.06*	-0.02	-0.02	-0.02	-0.02
		(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Cultural activities		0.07**	0.07**	0.07**	0.07**	0.07**	0.07**	0.08**
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
School size		0.36	0.35	0.35	0.36	0.37*	0.36	0.36
		(0.23)	(0.22)	(0.23)	(0.23)	(0.21)	(0.23)	(0.23)

School % FRL		0.69	0.61	0.71	0.87*	0.62	0.69	0.69
		(0.41)	(0.42)	(0.42)	(0.41)	(0.37)	(0.42)	(0.41)
Town size		0.02	0.03	0.03	0.02	0.03	0.02	0.02
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Treat X Female			0.02					
			(0.05)					
Treat X Nonwhite				0.09*†				
				(0.04)				
Treat X Activities					-0.00			
					(0.02)			
Treat X School size						-0.12		
						(0.08)		
Treat X % FRL							0.19	

							(0.12)	
Treat X Town Size								0.01
								(0.01)
Observations	7,568	7,568	7,568	7,568	7,568	7,568	7,568	7,568
R-squared	0.17	0.21	0.21	0.21	0.21	0.21	0.21	0.21

$^{**}p < .01$, $^{*}p < .05$, two-tailed.

Note: Estimates are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group. All models control for grade level and lottery pair. Effect sizes are in terms of standard deviation units. School percentage FRL = percentage of students receiving free or reduced lunch. Cultural activities are the sum of self-reported previous cultural activities students participated in outside of school, including dance lessons, music lessons, art classes, and theater participation. School size is expressed in 1000s. Town size is expressed in 10,000s. A joint f-test failed to reject the null hypothesis that the effects of the covariates on treatment are jointly equal to zero (p-value = 0.43).

Appendix Table 3: Regression Estimates of Heterogeneous Treatment Effects on Observations and Interpretations

	Spring Sample/ Representational Art		**Fall Sample/Abstract Art**	
	Observations	**Interpretations**	**Observations**	**Interpretations**
Treatment (Full Sample)	0.08**	0.06	0.12**	-0.01
Treat X Nonwhite	0.09*	0.07	0.14*	0.01
Treat X % School FRL	0.57**	0.36*	0.14	0.41**
Observations	3,610		3,958	

** $p < .01$, * $p < .05$, two-tailed.

Note: Estimates are expressed as effect in terms of standard deviation units and are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group. Each cell is from a separate regression that includes the outcome variable, a binary variable indicating treatment status, the full set of covariates used in tables 4 and 5 (gender, minority status, cultural activities, school size, school percent FRL, town size, grade level, lottery pair, and coder), and the interaction of interest when examining the heterogeneous effects. School FRL = percentage of students receiving free or reduced lunch.

Chapter 2

Creating Cultural Consumers: The Dynamics of Cultural Capital Acquisition

Abstract

The theories of cultural reproduction and cultural mobility have largely shaped the study of the effects of cultural capital on academic outcomes. Missing in this debate has been a rigorous examination of how children actually acquire cultural capital when it is not provided by their families. Drawing upon data from a large-scale experimental study of schools participating in an art museum's educational program, we show that students' exposure to a cultural institution has the effect of creating "cultural consumers" motivated towards acquiring new cultural capital. Importantly, we find that the experience has the strongest impact on students from more disadvantaged backgrounds. As such, our analysis reveals important aspects about the nature of cultural capital acquisition. To the extent that the evidence supporting cultural mobility is accurate, it may be because disadvantaged children can be activated to acquire cultural capital, thus compensating for family background characteristics and changing their habitus.

Creating Cultural Consumers: The Dynamics of Cultural Capital Acquisition

Introduction

Bourdieu identified cultural capital as a valuable resource that acts as a gateway to children's future academic, social, and economic success. Additionally, Bourdieu's theory of cultural reproduction posits that cultural capital is inherited primarily at an early age within privileged families, but lacking in disadvantaged families. As a result, cultural capital inequalities reproduce social-class inequalities (Bourdieu 1977; Bourdieu and Passeron 1977).

Later, DiMaggio (1982) put forward a theory of cultural mobility which suggests that cultural capital can be acquired throughout life, and that the benefits of cultural capital extend across social classes. DiMaggio further suggested that returns from cultural capital may actually be larger for children from disadvantaged families. As some scholars have noted, the reproduction and mobility arguments emphasize differences not only with respect to who is most likely to benefit from cultural capital, but also in terms of where and how it is acquired (Nagel, Damen, and Haanstra 2010; Roksa and Potter, 2011).

A large body of research attempts to adjudicate between the theories of cultural reproduction and mobility, but the processes that drive the acquisition of cultural capital have not been sufficiently studied. To address this, we focus on the motivation for possession of cultural capital rather than the effects of possession. The theory of cultural reproduction suggests that without the transmission of initial cultural capital from the family, additional cultural capital cannot be sufficiently acquired. Cultural mobility theory suggests that disadvantaged children can effectively acquire cultural capital from sources outside of the family. But under what conditions might disadvantaged students acquire cultural capital? Though cultural capital is generally assumed to be transmitted from one generation to the next in high status families, the impetus for children to acquire cultural capital in disadvantaged families is unknown and largely unexplored. If cultural mobility exists, then at some point the process of disadvantaged children acquiring cultural capital must be initiated, even though their disadvantaged status inhibits them from doing just that.

We provide a new perspective on children's attitudes towards cultural activities and the characteristics that drive cultural capital acquisition using original data from a large-scale experimental study of school facilitated visits to an art museum. Learning more about the nature of cultural capital acquisition and the formation of cultural tastes for disadvantaged populations informs the dynamics of cultural reproduction and cultural mobility, as well as the dynamics of habitus and its formation. Such empirical evidence is particularly relevant in a time when data suggest that cultural consumption has been declining, especially among disadvantaged children (Rabkin and Hedberg 2011).

Theoretical Framework

Bourdieu defined cultural capital as "instruments for the appropriation of symbolic wealth socially designated as worthy of being sought and possessed" (Bourdieu 1977: 488). Bourdieu's theory of cultural reproduction holds that cultural capital is inherited early in life from one's family, and the successful accumulation of additional cultural wealth is dependent on this early family bestowal (Bourdieu 1977). As such, "it is difficult to break the cycle where cultural capital is added to cultural capital," leading to a situation where inequalities in cultural capital are consistently reproduced and reinforce existing class disparities (Bourdieu 1977: 493).

Bourdieu articulates various forms of cultural capital that are relevant to childhood education. Embodied cultural capital includes the knowledge and skills necessary to appreciate and understand cultural goods; objectified cultural capital refers to material goods such as books or paintings in the home; and institutionalized cultural capital refers to educational credentials or qualifications that are socially recognized by the upper class (Bourdieu 1997). Embodied cultural capital, if properly activated, provides the basis for the acquisition of additional embodied, objectified, and institutional cultural capital.

Bourdieu also argues that schools reinforce cultural capital inequalities because they are only effective in transmitting cultural capital to individuals who have gained an understanding of the world of art from their family in early life (Bourdieu 1977). In this way, the education system "demands of everyone alike that they have what it does not give" (Bourdieu 1977: 494). As a result, schooling provides greater academic capital to students with existing cultural capital.[3]

DiMaggio (1982) suggests that cultural capital deficiencies in disadvantaged populations may be more mutable. Unlike Bourdieu, who views family-based cultural capital as a necessary primer, DiMaggio suggests that cultural capital acquisition also occurs for disadvantaged children, and the cultural capital they acquire in childhood and adolescence can still have positive academic and social benefits. Under this view, cultural capital is assumed to benefit all children, but children from disadvantaged backgrounds aspiring towards upward mobility may choose to acquire cultural capital to compensate for their disadvantaged status. Because disadvantaged students typically lack other family background characteristics that they can use to their advantage in status cultures, returns on investments in cultural capital may be highest for children from disadvantaged backgrounds.

Most empirical studies on the effects of cultural capital have followed Bourdieu's three categorizations. Institutionalized cultural capital has been measured using parental education (e.g., Kraaykamp and van Eijck 2010). Objectified cultural capital has been measured using

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[3] Bourdieu's portrayal of schools was largely influenced by the time and place of his work (1960s France). It is important to note that his depictions were not explicitly directed at schools in the United States.

home possessions related to high-culture, such as art works, books of poetry, and classical literature (e.g., Byun, Schofer, and Kim 2012; Marteleto and Andrade 2014; Yamamoto and Brinton 2010). The bulk of research, however, has focused on embodied cultural capital, which has been measured using student attendance at cultural institutions or involvement in cultural activities like art, music, or dance lessons. Notably, a large number of studies have included visits to museums or art galleries as a measure of embodied cultural capital (e.g., Byun et al 2012; De Graaf De Graaf and Kraaykamp 2000; DiMaggio 1982; Dumais 2002; Jæger 2009; Kaufman and Gabler 2004; Nagel, Damen, and Haanstra 2010). Bourdieu noted that analyzing museum attendance as a measure of cultural capital was especially informative because in many cases the economic constraints that dictate class differences are removed, yet the relationship between class and attendance remains robust (Bourdieu 1977). Empirical studies in the United States have confirmed a strong relationship between socioeconomic status and children's museum attendance (Dumais 2006).

Using these measures, the generally positive relationship between cultural capital and socioeconomic status has been well-established (e.g., Byun et al 2012; DiMaggio and Useem 1978; Roksa and Potter 2011; Roscigno and Ainsworth-Darnell 1999). There is also plenty of evidence that cultural capital is transmitted from one generation to the next (e.g., DiMaggio and Useem 1978; Kraaykamp and van Eijk 2010; Roksa and Potter 2011). The exact effects of cultural capital on academic outcomes and social mobility, however, are less clear. A growing body of research has found a positive relationship between measures of cultural capital and academic achievement (e.g., Aschaffenburg and Mass 1997; DiMaggio 1982; Dumais 2002; Roscigno and Ainsworth-Darnell 1999; Yamamoto and Brinton 2010). Jæger (2011), however, has demonstrated that the academic effects are often overstated and subject to significant omitted variables bias and endogeneity concerns.

In terms of the competing theories of cultural reproduction and cultural mobility, the research is even less clear. Some studies find evidence supporting cultural mobility theory (e.g., De Graaf et al 2000), others support cultural reproduction theory (e.g., Roscigno and Ainsworth-Darnell 1999), while still more find mixed evidence that supports both perspectives (e.g., Aschaffenberg and Mass 1997; DiMaggio 1982; Jæger 2011; Roksa and Potter 2011).

Though some research has demonstrated the presence of intergenerational cultural mobility (Roksa and Potter 2011), existing research does not clearly identify the causal mechanisms underlying cultural capital acquisition, particularly for disadvantaged families. If cultural mobility actually occurs, then somehow the process of disadvantaged families choosing to acquire cultural capital must be initiated, yet their status, according to cultural reproduction theory, inhibits them from doing so. Prior research has hinted at potential ways in which the disadvantaged might acquire cultural capital. Some have speculated that some upwardly mobile working-class parents adopt what Lareau (2002) refers to as ‘‘concerted cultivation’’ by organizing culturally enriching activities for their children (Roksa and Potter 2011; see also Kaufman and Gabler 2004). Furthermore, there is evidence that children play an active role in determining their own cultural interests that is distinct from that of their parents. In their ethnographic study, Chin and Phillips (2004) find that children actively contribute to the process of acquiring cultural capital. They identify what they refer to as “child capital,” which includes children’s own human capital, social capital, and cultural capital. They argue that child capital strongly influences children’s activities, “sometimes compensating for parents’ lack of resources and sometimes impeding parents’ efforts” (185).

A child's preferences to acquire cultural capital can be viewed as a component of a child's habitus—a set of internal dispositions and attitudes derived from social class that provide an orientation to the world and ultimately shape one's expectations and aspirations (Bourdieu 1984; Dumais 2006; McClelland 1990).[4] Some have suggested that Bourdieu's conception of habitus works as an important mediator of cultural capital (Gaddis 2013; Reay 2004). Unfortunately, the role of habitus has scarcely been operationalized alongside the concept of cultural capital (Dumais 2002), and little is known about the potential for a child's inherited habitus to be changed. Some have criticized Bourdieu's theory of cultural reproduction and his notion of habitus for depicting children as overly determined by their parents' status with no opportunity for mobility (Giroux 1983; King 2000; Lareau 1987). Such a definition would fail to account for the independent choices and preferences of children, whose relationship to their parents' dispositions may involve rejection as much as duplication (Connell et al. 1982). Others have argued that Bourdieu's notion of habitus is dynamic and allows for individuals to be transformed by processes that change one's expectations or aspirations (Lee and Kramer 2013; McClelland 1990; Reay 2004).[5] A surprisingly limited amount of empirical research has examined the transformation of one's habitus (Lehmann 2014), and fewer examine the transformation as a function of deliberate school policies (Barrett and Martina 2012). Moreover, the malleability of one's habitus has rarely been examined using experimental methods. An

[4] Empirical studies examining habitus have typically operationalized the concept as academic, educational, or professional aspirations (see, for example, Dumais 2002; Dumais 2006; Gaddis 2013; and McClelland 1990). Bourdieu's complete concept of habitus, however, is broadly described as the "unifying, generative principle of all practices," which certainly includes dispositions and attitudes towards cultural capital and its acquisition the (Bourdieu, 1984, pp. 173).

[5] King (2000) points out the discrepancy between Bourdieu's originally strict depiction of habitus in text versus Bourdieu's later characterizations of the concept when confronted with claims that it was overly deterministic.

exception is a study of a policy experiment that introduced a cultural and artistic education program to teenagers in Dutch schools which found no significant effects on cultural participation or attitudes (Nagel, Damen, and Haanstra 2010).

To address these gaps in the literature, we examine a scenario where students are activated to express an interest in acquiring cultural capital. To the extent that the evidence supporting cultural mobility is accurate, it may be because disadvantaged children can be activated to acquire cultural capital, thus compensating for family background characteristics and changing their habitus.

Sample and Data

The Crystal Bridges Museum of American Art opened in Bentonville, Arkansas in November of 2011.[6] With a permanent endowment exceeding $800 million, it is the first major museum dedicated to American art to open in 50 years (Vogel 2011). In March of 2012, the museum launched a program that offered tours to area students. A generous portion of the museum's endowment covers the cost of the school tours, which allows school groups to visit the museum at virtually no cost to the school or students. This endowment covers transportation, admission, substitute teachers, lunch at the museum, and pre/post-visit curricular materials. Because the opening of a major art museum in an area where one did not previously exist was a significant event, and the cost of the tours was covered, demand for school tours far exceeded availability. The museum received applications from 525 school groups representing 38,347 grade K-12 students during the first two semesters of the program. The majority of applicants were for entire elementary or middle school grade levels at a single school. In order to allocate visits to the

[6] Located in northwest Arkansas, Bentonville had a population of just over 35,000 in 2010. The city resides in a larger metropolitan area approaching a half-million residents which is surrounded by a mostly rural area. The most recently reported median family income was $46,558, while the median family income for the metropolitan area was $38,118.

museum in a fair method, available slots were awarded through a lottery that we conducted in partnership with the Crystal Bridges Museum.

In order to strengthen statistical power, we incorporated a stratified randomization procedure. The use of a stratified randomization procedure can increase the balance between treatment and control groups while preserving the advantages of random assignment (Schneider et al. 2007). Given that we were especially interested in ensuring that the treatment and control groups had equal representation of important pre-treatment characteristics, we first paired applicants with similar demographics (e.g., grade, region, and school free or reduced lunch status) and performed separate randomizations within these pairings. The applicant groups that won the lottery comprise the treatment group, and the corresponding matched applicants that did not win the lottery comprise the control group. As an incentive to participate in the study, applicant groups that did not win an immediate spot but participated in our data collection efforts (control group applicants) were guaranteed a spot for the following semester.

Through the random allocation of available slots, 92 groups with students in grades K-12 were randomly awarded a guided tour of the museum in the spring and fall of 2012 (the treatment groups), while another 92 groups had their tours deferred (the control groups). Applicant groups not selected to be in the treatment or control groups received apologetic letters informing them that they had not been selected to visit the museum during this period and encouraging them to apply in future rounds.

The Treatment

Prior to their visit, teachers of treatment group students who were randomly awarded a museum visit were sent a packet containing a 5 minute video orientation for teachers and students to watch. In addition to covering museum etiquette, the video emphasized that the tours would be student-driven, and emphasized that students would be encouraged to contribute to discussions about art. Teachers were also provided with a selection of 3 images that the students would see on their tour, information about the themes of the tour, and essential questions to ask their students before the visit. These questions were intended to familiarize students with the types of themes they would learn about on their tour and to familiarize them with the dialogue-driven nature of the tour.

Tours were led by trained museum educators who followed a constructivist-based learning approach. In a typical tour, students were split into groups of 10-15 that focused intensively on 4 or 5 paintings or sculptures in the museum’s collection. This open-ended, student-centered approach, facilitated by museum educators, encouraged the group of students to think together, engage with each work of art on a deep level, and seek out their own unique interpretations. When appropriate, museum educators supplied historical and sociological contexts of the works in order to facilitate greater student understanding.

Trained members of the research team visited the students in their classrooms and administered surveys to both the treatment and its paired control group on average three weeks (M = 21.8 days, SD = 12.1) after the treatment group’s visit to Crystal Bridges. In total, 160 matched applicant groups (80 treatment and 80 control) representing a total of 10,912 grade K-12 students at 123 different schools completed surveys. Twelve matched pairs that were originally part of the lottery were excluded from the study because of tour cancellations or erroneous application information. Because participation in data collection was packaged as a mandatory component of receiving an immediate or deferred school tour, all of the remaining treatment groups who visited the museum and their matched control groups completed surveys.

The survey contained questions regarding student demographics, attitudes towards cultural institutions, attitudes towards art consumption, and knowledge of art.

Outcome Measures

We measured how the museum experience affected students' interest in cultural capital acquisition in two ways—with survey items and a behavioral measure. The surveys administered to the treatment and control groups contained a number of items intended to capture the students' attitudes towards future cultural capital acquisition through visiting an art museum or similar cultural institution.

For students in grades 3-12, we included 8 items in the survey designed to gauge student interest in visiting an art museum or cultural institution. Together the responses to these items demonstrate a high level of internal consistency, with a Cronbach's Alpha of .90. We included a second set of survey questions designed to gauge students' interest in engaging with art more generally. The internal consistency of these measures is strong, with a Cronbach's Alpha of .80. We report the means, standard deviations, and ranges of all variables used in our outcome measures in Table 1.

Table 1: Descriptive Statistics of Individual Survey Components of Outcome Measures

Interest in Engaging with Art Museums	Mean	S.D.	Min.	Max.
I plan to visit art museums when I am an adult.[1]	1.99	0.99	0	3
Trips to art museums are interesting. [1]	2.17	0.89	0	3
I would tell my friends that they should visit an art museum. [1]	1.83	1.03	0	3
Trips to art museums are fun. [A]	2.14	0.92	0	3
How interested are you in visiting art museums? [B]	1.92	0.93	0	3
If your friends or family wanted to go to an art museum, how interested would you be in going?[B]	2.01	0.93	0	3
Would your friend like to go to an art museum on a field trip?[C]	0.63	0.48	0	1
Would you like more museums in your community? [C]	0.78	0.41	0	1
Interest in Engaging with Art				
I like art class.[A]	2.13	0.98	0	3
I feel comfortable talking about art. [A]	1.90	0.99	0	3
Art is an important part of our country's culture and history. [A]	2.29	0.85	0	3

Art is interesting to me. [A]	2.14	0.97	0	3

Note: Response categories for the survey items: A= strongly disagree/somewhat disagree/somewhat agree/strongly agree; B= not interested/a little interested/interested/very interested; C=no/yes.

For the analyses that follow, we convert the responses to these two sets of questions into two indices of cultural consumption by first converting each set of responses into standard deviation units. We then take the average of the standardized measures across all items for each student. Finally, we rescale this composite to have a mean of zero and a standard deviation of 1. This approach allows us to express any outcomes in terms of standard-deviation effect sizes.

Finally, we incorporated a behavioral measure of acquiring cultural capital. All students in grades K-12 who participated in the study during the first semester of data collection (*N*= 5,791), including those who did not receive a tour, were provided with a coupon that gave them and their families free entry to a special exhibit at Crystal Bridges. The coupons were coded so that we could determine the applicant group to which students belonged. Students had as long as five months to use the coupon.

Hypotheses

Cultural reproduction theory suggests that initial cultural capital is an important prerequisite to additional cultural capital acquisition. As Aschaffenburg and Mass (1997) point out, if early cultural socialization is required to activate future returns, then students who already possess cultural capital should be the most likely to desire more. Cultural mobility theory, however, suggests that more-disadvantaged students might have a greater incentive to acquire more. Along these lines, we consider the following hypotheses. First, we hypothesize that baseline indicators of students' advantaged status will be positively related with the desire to acquire additional cultural capital. That is, absent any additional activation, student characteristics will align with Bourdieu's model of cultural reproduction.

When turning to the experimental part of our analysis, it is important to note that in the population we are examining, most students have never been to an art museum. Our surveys indicate that only a third of the students in both the treatment and control groups had ever visited Crystal Bridges outside of the context of the school tour. Additionally, fewer than ten percent had ever previously visited any other art museum. This is largely due to the fact that Crystal Bridges is the first major art museum to be built within a reasonable travel distance to this population. As such, we hypothesize that being randomly assigned to visit the art museum, and exposure to pre- and post-tour activities, will serve as a catalyst that activates an interest in cultural participation for the treatment group.

Finding a treatment effect in itself, however, does not fully inform the dynamics of cultural capital acquisition. The effect of the treatment could be driven primarily by advantaged students, or it could be driven by disadvantaged students. To investigate this, we test for heterogeneous treatment effects which may be moderated by prior levels of cultural capital and other socioeconomic and community indicators. Thus, we hypothesize that the treatment will have differential effects on students based upon important indicators of their social status. If we observe larger effects for more advantaged students, it would suggest that cultural reproduction is likely to persist, even when disadvantaged students are introduced to a cultural experience. If, however, we find that the treatment experience has greater effects on the dispositions of disadvantaged students, our findings would add an important contribution to our understanding of the process of cultural mobility.

Empirical Strategy

Because mere chance determined whether or not a group was selected, the treatment and control groups are largely identical except for whether they were selected participate in the museum's program. As a result, any outcomes that differ between the treatment and control groups can confidently be attributed to participating in the school tour of the museum and related activities. Comparisons between the treatment and control groups on key variables show that the stratified randomization procedure achieved the goal of producing comparable balance. The bulk of the analysis reported here comes from students in grades 3-12 (*N* = 8,239), as these students were given surveys that collected deeper information. A comparison between the grade 3-12 treatment and control groups is shown in table 2. The average grade for students was approximately 6^{th} grade (*M*=5.9; *SD*=2.4). In terms of the distribution, over half of the students were in grades 3-5 (54.3%), slightly less than a third were in grades 6-8 (31.0%), and the remaining students were in grades 9-12 (14.7%). As can be seen, there are no significant differences between the treatment and control groups in terms of student characteristics including, gender, ethnicity, grade, and student reports of previous cultural activities. School and community characteristics are also comparable.

Table 2: Treatment/Control Balance on Key Characteristics, Grade 3-12 Analytic Sample

Characteristic	**Treatment (n = 3,746)**	**Control (n = 4,493)**	**Difference**
Percent females	51.98	51.25	0.73
Percent white	59.21	59.96	-0.75
Percent Hispanic	18.84	18.76	0.08
Percent black	2.80	3.72	-0.91
Percent other ethnicity	19.14	17.56	1.58
Cultural activities	0.93	0.89	0.04
Grade	5.90	5.81	0.10
School Percent FRL	54.20	55.86	-1.66
School size	634.82	672.94	-38.12
Town Size	39,814	43,078	-3,263

Note: Bivariate regression revealed no significant differences across treatment and control groups on any items. School percent FRL is the percent of students receiving free or reduced lunch. An additional 2,634 students from grades K-2 were also randomized and participated in data collection. While the amount of demographic information collected from this younger sample was less detailed, there were no significant differences between the treatment (N = 1,445) and control (N = 1,189) groups on percent female, school free- and reduced-lunch levels, average grade, distance to the museum, school size, or town size.

Because randomization generated comparable treatment and control groups, we can use straightforward analytic techniques to estimate the impacts of the treatment. In its most simple form, this technique could estimate simple mean differences using the following equation for outcome *CC*, the standardized cultural consumption score, of student *i* in matched pair *m*:

(3) $CC_{im} = \alpha + \beta_1 Treat_i + \beta_2 Match_{im} + \beta_3 Grade_{im} + \varepsilon_{im}$

The binary variable $Treat_i$ is equal to 1 if the student is in the treatment group that was randomly assigned to participate in the museum's school tour program and is equal to 0 otherwise. Because the groups were created using a stratified randomization procedure within matched applicant group pairs, $Match_{im}$ is also included in the model as a vector of dummy variables that have the statistical effect of estimating within, as opposed to across, matched pairs. Moreover, dummy variables for grade level are included to statistically adjust for matched pairs that were composed of adjacent grades in the same school. Finally, ε_{im} is a stochastic error term clustered at the applicant group level to take into account the spatial correlation from students nested within applicant groups.

While proper randomization generates experimental groups that are comparable, they are not perfectly identical. The basic regression model may be improved by adding controls for observable characteristics to increase the precision of the estimated impact. Moreover, by adding observable characteristics to the regression model, we can examine the effects of these characteristics on the outcome measures. This yields the following equation to be estimated:

(4) $CC_{ims} = \alpha + \beta_1 Treat_i + \beta_2 Match_{im} + X_i\beta_3 + Z_s\beta_4 + \varepsilon_{ims}$

Where X_i is a vector of student characteristics and Z_s is a vector of school and community characteristics. Important student characteristics are gender and ethnicity. We include gender in our models as a binary measure equal to 1 if the student is female, and we collapse ethnicity into a simple binary measure indicating if the student is nonwhite. Additionally, we included a measure on our surveys of students' prior cultural activities, which serves as an indicator of baseline levels of cultural capital. For this measure, students reported if, outside of their school, they had ever taken dance lessons (21 percent responded yes), music lessons (28 percent responded yes), art classes (20 percent responded yes), or participated in theater (23 percent responded yes). We sum the number of affirmative responses to these questions into a composite measure of cultural activities. School characteristics are school level percent free or reduced lunch (FRL) and school size. Finally, we use the population of the children's town of residence as an indicator of rural status.

In addition to estimating overall impacts, we test for the possibility of heterogeneous effects on particular types of students. Heterogeneous effects are estimated by augmenting equation 2 to include interactions between the binary treatment variable and student and school characteristics. For our analysis, we explore potential interaction effects using ethnicity, our baseline measure of cultural activities, school FRL levels, school size, and town size. All of these measures serve as indicators of students' socioeconomic and cultural status. Minority students tend to face more economic disadvantages, as do students at higher FRL schools. Moreover, students in smaller schools and smaller towns likely have had fewer opportunities to acquire cultural capital.

Results

The results show that randomly receiving a school tour increases students' desire to engage with an art museum. The overall treatment effect is 9 percent of a standard deviation in the parsimonious model (table 3, column 1), a modest but meaningful effect in the overall context of randomized studies of group-based educational interventions (Lipsey et al. 2013 p. 34).

Expressed another way, an average student who began at the 50th percentile on our outcome measure would move to the 54th percentile after the intervention. Adding control variables does little to change the overall effect, which is to be expected when analyzing experimental data (column 2). Moreover, interesting patterns emerge with the inclusion of these baseline characteristics. Female students, on average, show greater levels of interest in engaging with art museums, as do nonwhite students. Our measure of pre-existing cultural capital is also positive and significant. Students with higher existing levels of cultural capital are, on average, more interested in engaging with cultural institutions, with each reported activity (ever receiving music, dance, art, or theater lessons outside of school) corresponding with a 9 percent of a standard deviation increase. We find no significant relationship between school FRL levels and our outcome.[7]

When we interact our various measures of students' status, we see no differential effects for female and male students, nor do we observe differential effects for white and nonwhite students. The interaction of treatment and cultural activities, however, is negative and significant (column 5). A student with no reported participation in cultural activities experiences a 14 percent of a standard deviation gain in our outcome measure, which translates to a move from the 50th percentile to the 56th percentile on our outcome measure. The interaction of treatment and school size is also negative and significant, suggesting that the effect is stronger for students in smaller schools, while the interaction of treatment and town size is negative and marginally significant, suggesting that students from smaller towns receive a greater effect from the

[7] In a separate analysis, we find larger overall treatment effects for the grade K-2 sample (*N* = 2,634; *ES* = .20), and a similar positive relationship for female students using a similar outcome measure. However, we find no interaction effects when examining school size, school FRL levels, or town size (we do not have data on cultural activities or ethnicity for the K-2 sample). Potentially, the lack of interaction effects for these younger students signals that their underlying characteristics have yet to translate into differential preferences.

treatment. Finally, the interaction of treatment and school-FRL levels is positive and highly significant, demonstrating that the treatment effect is larger for students attending higher poverty schools. Based upon our statistical model, the average impact for a student attending a school with 75 percent FRL students, all else equal, would be 17 percent of a standard deviation (equivalent to moving from the 50^{th} to the 57^{th} percentile on our outcome measure), while the effect for a student at a school with 90 percent FRL students would be 23 percent of a standard deviation (equivalent to moving from the 50^{th} to the 59^{th} percentile).[8]

In sum, the data consistently show that disadvantaged students have larger gains in their attitude towards acquiring cultural capital as a result of the treatment. This is true for students with less pre-existing cultural capital, students at schools with higher FRL levels, students at smaller schools, and students from rural areas.

[8] Percent FRL of schools in our sample ranged from 9% to 96%.

Table 3: Regression Estimates of Treatment Effects on Students' Interest in Visiting Art Museums

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Effect size	Effect size	Effect size	Effect size	Effect size	Effect size	Effect size	Effect size
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Treatment	0.09***	0.09***	0.11**	0.09**	0.14***	0.22***	-0.14	0.17***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.06)	(0.08)	(0.05)
Female		0.32***	0.34***	0.32***	0.32***	0.32***	0.32***	0.32***
		(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Nonwhite		0.09***	0.09***	0.09**	0.09***	0.09***	0.09***	0.09***
		(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Cultural activities		0.09***	0.09***	0.09***	0.11***	0.09***	0.09***	0.09***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
School size		0.03	0.03	0.03	0.03	0.03	0.03	0.03
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)

Percent FRL		0.33	0.34	0.33	0.31	0.22	0.13	0.11
		(0.33)	(0.34)	(0.34)	(0.33)	(0.30)	(0.32)	(0.34)
Town size		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Treat X Female			-0.04					
			(0.05)					
Treat X Nonwhite				0.01				
				(0.05)				
Treat X Activities					-0.05**			
					(0.02)			
Treat X School size						-0.02***		
						(0.01)		
Treat X Percent FRL							0.41***	
							(0.14)	
Treat X Town size								-0.02*

								(0.01)
Observations	7,835	7,835	7,835	7,835	7,835	7,835	7,835	7,835
R-squared	0.11	0.15	0.14	0.15	0.15	0.15	0.15	0.15

*** $p < .01$, ** $p < .05$, * $p < .10$, two-tailed.

Note: Estimates are obtained from OLS regression models estimated on survey outcome data from grade 3-12 study sample. Effect sizes are in terms of standard deviation units. Robust standard errors are clustered by applicant group. All models control for grade level and lottery pair. School percent FRL is the percent of students receiving free or reduced lunch. Cultural activities are the sum of self-reported previous cultural activities students participated in outside of school, including dance lessons, music lessons, art classes, or theater participation. School size is expressed in 100s.Town size is expressed in 10,000s.

Next, we examine our outcome that assesses students' desire to engage with art generally (table 4). Results on this outcome are less robust than our measure of art museum engagement, but the pattern of results is similar. Consistent with our previous results, female students and students with higher levels of pre-existing cultural capital have more positive attitudes towards the arts, independent of the treatment. The overall treatment effect is weak, and only marginally significant in the model including control variables (column 2). When we look at the treatment interacted with other variables that signal students' cultural and socioeconomic status, however, the pattern of findings is similar to our previous outcome measure. Students from smaller schools, students from poorer schools, and rural students are affected the most from the treatment. In sum, disadvantaged students are more likely to express an interest in engaging with art as a result of being randomly selected to receive the treatment experience.

Table 4: Regression Estimates of Treatment Effects on Students' Interest in Engaging with Art

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Effect size	Effect size	Effect size	Effect size	Effect size	Effect size	Effect size	Effect size
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Treatment	0.03	0.04*	0.04	0.03	0.06*	0.13***	-0.10*	0.13**
	0.03	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)	(0.06)	(0.05)
Female		0.39***	0.39***	0.39***	0.39***	0.39***	0.39***	0.39***
		(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Nonwhite		0.00	0.00	-0.01	0.00	0.00	0.00	-0.00
		(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Cultural activities		0.12***	0.12***	0.12***	0.13***	0.12***	0.12***	0.12***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
School size		0.04	0.04	0.04	0.04	0.04*	0.04	0.04
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Percent FRL		0.05	0.05	0.06	0.04	-0.02	-0.08	-0.22

		(0.33)	(0.33)	(0.33)	(0.33)	(0.31)	(0.32)	(0.32)
Town size		0.01	0.01	0.01	0.01	0.01	0.01	0.01
		(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Treat X Female			0.00					
			(0.05)					
Treat X Nonwhite				0.03				
				(0.05)				
Treat X Activities					-0.02			
					(0.02)			
Treat X School size						-0.01**		
						(0.01)		
Treat X Percent FRL							0.27***	
							(0.09)	
Treat X Town size								-0.02**
								(0.01)

Observations	7,810	7,810	7,810	7,810	7,810	7,810	7,810	7,810
R-squared	.08	0.15	0.15	0.15	0.15	0.15	0.15	0.15

*** $p < .01$, ** $p < .05$, * $p < .10$, two-tailed.

Note: Estimates are obtained from OLS regression models estimated on survey outcome data from grade 3-12 study sample. Effect sizes are in terms of standard deviation units. Robust standard errors are clustered by applicant group. All models control for grade level and lottery pair. School percent FRL is the percent of students receiving free or reduced lunch. Cultural activities are the sum of self-reported previous cultural activities students participated in outside of school, including dance lessons, music lessons, art classes, or theater participation. School size is expressed in 100s.Town size is expressed in 10,000s.

While the results from our survey data shed light on the workings of cultural participation and habitus formation, they are limited to self-reports. Importantly, we also have a behavioral measure in the form of coded coupons that verify whether students are actually more likely to return to the museum as a result of the treatment. The coupons contained codes that indicated whether they were used by members of the treatment or the control group, and identified the school they attended. Unfortunately, we lack detailed individual level data to examine the full range of characteristics of the students who used the coupons. We are limited to analyzing their treatment status and school and community level characteristics.

Treatment group students comprised 49 percent of this sample, yet they accounted for 58 percent of all students who used a coupon to return to the museum and 58 percent of accompanying adults (table 5). In other words, the families of students who received a tour were 18 percent more likely to return to the museum than we would expect if their rate of coupon use was the same as their share of distributed coupons. We did not detect any statistically significant interaction effects between the treatment and school or community characteristics, a fact which may be due to the smaller sample size of coupon users.

The overall effect is noteworthy given that the treatment group students had recently visited the museum. Their desire to visit a museum might have been satiated, while the control group might have been curious to visit Crystal Bridges for the first time. Yet, despite having recently been to the museum, students who received a school tour came back at higher rates. Considering that most of these students had likely never visited an art museum previously, these results further suggest that some amount of initial cultural exposure is necessary to activate an interest in acquiring cultural capital. Further, these results demonstrate that the student self-reports are meaningful indicators of students' intentions, giving extra validity to our findings from survey responses.

Table 5: Behavioral Measure of Cultural Interest: Observed and Expected Rates of Students Returning to the Museum

	Treatment Observed Rate	Treatment Expected Rate	Treatment Effect
All Visitors	57.8%	48.8%	+9.0%***
Adults	58.0%	48.8%	+9.2%***
Children	57.4%	48.8%	+8.6%**

*** p<0.01, ** p<0.05
NOTE: Significance between expected and observed rates of treatment group usage of coupons generated with a chi-square test. A total 658 visitors returned to the museum with coupons (adult *N* = 374; student *N* = 284).

Discussion

The experience the students in the treatment group received was modest: they were briefly exposed to curricular materials in their classrooms, and they spent roughly half of a day at a world class art museum with museum educators. Yet, for many of these students, this was the first time they had ever visited an art museum. In this instance, even a minimal intervention produced significantly positive and meaningful changes in the students' desire to consume culture. Because these results are derived from a randomized controlled trial, we can be especially confident that the experience caused the impacts we observe.

Descriptively speaking, our data indicate that students with higher levels of pre-existing cultural capital show a greater interest in cultural consumption, which is consistent with cultural reproduction theory. However, being randomly assigned to receive a school tour causes an increase in students' desire to consume culture. This finding alone, however, does not tell us which students are driving the treatment effect. When we examine the interaction of a number of characteristics that signal students' status, however, we observe strong and consistent evidence that the treatment had the strongest effect on disadvantaged students. Whether we examine students' disadvantaged status as measured by pre-existing cultural capital levels, school indicators, or community indicators, the pattern is consistent. When students are activated through some initial exposure to a cultural institution, it interacts with characteristics associated with low cultural capital and produces higher preferences for cultural consumption. Cultural mobility is likely driven in part by disadvantaged children becoming activated to acquire cultural capital, thus compensating for family background characteristics and changing their habitus.

Our findings have important implications for the processes by which cultural mobility can occur. Cultural reproduction theory may not fully consider the dynamic way in which cultural capital acquisition can be driven by children's own interests. Reproduction theory largely depicts students as dependent on inheriting initial cultural capital from their families in order to acquire more. At the same time, prior research supporting cultural mobility has been unable to determine how disadvantaged populations might become activated to invest in cultural capital. Our results help to clarify two important aspects of cultural consumption. First, our results show that students with more cultural capital, on average, show more enthusiasm for cultural consumption. Second, disadvantaged students, who typically receive less cultural capital from their families, can be activated to have a more favorable attitude towards cultural consumption through a cultural experience. In this case, disadvantaged students, as a result of being randomly assigned to experience a cultural activity, experienced larger gains in their desire to consume culture than advantaged students. When disadvantaged students are activated through some form of initial exposure to culture, future cultural capital acquisition is more likely to occur.

Our study does have important limitations. We cannot be certain which specific aspects of the exposure received by the treatment group caused them to have more favorable attitudes towards cultural institutions and art. Though an experimental design is often considered the most reliable way to determine the causal impact of an experience, we are unable to determine the precise mechanisms driving our results. The effects could be driven by exposure to the art itself, the museum setting, or the combination of both. It is important to consider that the tour was a deliberate and structured experience, not simply a day of play at an art museum. Our survey data suggest that students were not simply responding positively to missing a day of school.[9] Rather, the data suggest that learning about art likely played an important role. In our surveys, we found that students retained a great deal of factual information about the art they viewed on the tour, including many historical and sociological themes (Greene, Kisida, and Bowen 2014). This suggests that viewing the art itself was a memorable and thought-provoking experience for the

[9] It is unlikely that visits to cultural institutions were seen by the students simply as a chance to escape the drudgery of school. On the student surveys, all students were asked to respond if they "liked school," or if they thought "school was boring." When we add these measures to the regressions that produce our results, we see a positive and statistically significant relationship between liking school and our outcome measures, and a negative and significant relationship between thinking school is boring and our outcome measures. There is no significant interaction, however, between these variables and the treatment. In other words, students who like school are interested in acquiring cultural capital, but the treatment effect does not seem to be mediated through the relationship of a student's affinity for school. Finally, in our sample, the relationship between school percent-FRL and liking school is positive and significant, while thinking school is boring is negatively related to school percent-FRL. That is, disadvantaged students tended to report liking school at higher levels. Because of this relationship, it would be difficult to explain the heterogeneous effects we see for disadvantaged students as a function of their distaste for school.

students. Future research could attempt to unpack the precise aspects of cultural experiences that increase the desire for cultural consumption.

We also cannot specifically say that possessing cultural capital will lead to academic advantages and social mobility for these students. First, we do not know if these disadvantaged students will seek to increase their level of cultural capital in the long term. Students in our sample were surveyed on average three weeks after they visited the museum, yet some were surveyed as long as eight weeks later. When we interact this temporal measure with our outcomes of interest we see no signs of the effects diminishing over this time period. While this provides some support that the desire to participate in cultural activities may endure, we cannot rule out the possibility that these effects will fade. Future research should examine the longer-term effects of cultural exposure on the dispositions of disadvantaged students.

We also cannot determine if the change in the students' disposition towards cultural activities will effectively translate into embodied cultural capital, or lead to the acquisition of objectified or institutional cultural capital. Students may be showing an interest in cultural activities because they find the activities enjoyable, but they may not acquire the skills needed to decipher cultural codes. As Lareau and Horvat note (1999), there is a difference between the possession of cultural capital and its effective use.

From a policy perspective, this research demonstrates that schools can play a meaningful role in providing disadvantaged students meaningful cultural experiences. Exposure to the arts within schools, however, has been decreasing (Rabkin and Hedberg 2011), and the amount that U.S. schools are facilitating visits to cultural institutions has also declined (Blair, 2008; Ellerson, 2010; Lewin, 2010; Mehta, 2008; School field trips in decline amid standardized testing, 2012). It is also likely that disadvantaged families that want their children to gain an interest in cultural activities might be able to engage in the same types of concerted cultivation (Lareau 2002) as advantaged families. In this regard, however, material inequalities will remain an obstacle (Chin and Phillips 2004).

Finally, though a large body of research demonstrates that cultural capital is a valuable good with important academic and social benefits, a number of researchers have noted that participation in highbrow arts activity may have limited utility as an indicator of cultural capital in the American context because elite culture is more diverse (Dumais 2006; Peterson 1992; Peterson and Kern 1996). This would be particularly important if the academic benefits of cultural capital are obtained mostly by signaling elite group membership and preferential treatment from teachers, as Bourdieu suggested. It is also possible, however, that familiarity with cultural knowledge and participation in highbrow cultural activities leads to legitimate increases in academic competence. In a separate analysis, we find that students in the treatment group demonstrate stronger critical thinking skills when composing an essay about a work of art, and those benefits were greatest for disadvantaged students (Bowen, Greene, and Kisida 2014). While limited, this finding is in line with previous research that has shown that cultural capital is more important for reading achievement than other subjects (Chiu 2010; DiMaggio 1982; Hampden-Thompson, Guzman, and Lippman 2008). It may be that participation in cultural activities sparks a genuine interest in learning and thinking more deeply about the world. Kaufman and Gabler (2004) find that active participation in arts activities is especially predictive of college attainment, suggesting that enriching arts activities, more than simple exposure, may increase students' investment in school and enhance their intellectual curiosity. This "modified cultural capital" perspective suggests that cultural capital operates more as a form of human capital, and not simply as a credentialing mechanism. Still, this and most existing research on the effects of cultural capital have significant endogeneity concerns, and the ability to draw strong casual inferences is limited (Jæger 2009). As such, it is difficult to separate the benefits of various forms of cultural capital from other advantageous family and student characteristics. Future experimental work that examines the influence of different types of exogenously derived cultural capital on the academic achievement and social mobility of different populations would be an especially valuable contribution.

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Chapter 3

The Educational Benefits of Visiting a Science Museum: A Consideration of Science Capital

Abstract

Many education policymakers are searching for ways to increase students' competency and interest in science. Existing research, however, suggests that classroom instruction and content knowledge alone may not adequately cultivate an interest in science or increase aspirations for careers in science. The emerging concept of "science capital" recognizes that attitudes and aspirations towards science are shaped not only by what happens inside of the classroom, but also by students' family characteristics and out of school experiences. In this paper we experimentally test how a school visit to a science museum alters students' attitudes towards science and future career aspirations. We find that there are positive effects from exposure to a science museum for students, though the effects seem to be especially strong for boys. Our results suggest that accumulating science capital is likely a key component of students' science-related educational and occupational aspirations, but such strategies may not have equal benefits across gender lines.

The Educational Benefits of Visiting a Science Museum: A Consideration of Science Capital

Introduction

Improving science education is a key focus of educators and policymakers. At the federal level in the United States, a number of initiatives have recently been adopted to promote science education. Explicit in these efforts is the belief that more students should pursue careers in science in order to compete in a global marketplace. The President's Council of Advisors on Science and Technology (PCAST) recently articulated a two-pronged strategy, recommending a focus both on science "preparation" and "inspiration." In terms of preparation, federal efforts to improve science, technology, engineering, and math (STEM) education in the United States have manifested through initiatives such as the *Educate to Innovate* and *Change the Equation* campaigns (whitehouse.gov).[10] Goals of these programs include significantly increasing federal investment in STEM education, recruiting and training 100,000 new STEM teachers, and a $90 million campaign focused on increasing opportunities for female and minority students[11] who have traditionally been underrepresented in STEM-related disciplines. In terms of inspiration, PCAST has also called for policies that expose students to mentors and provide exciting science-based experiences to students outside of typical school experiences (PCAST, 2010). Specific efforts include increased funding for robotics competitions and other tech challenges, as well as increased funding for partnerships with science centers. PCAST suggests that out of class

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[10] https://www.whitehouse.gov/issues/education/k-12/educate-innovate
[11] https://www.whitehouse.gov/the-press-office/2015/03/23/fact-sheet-president-obama-announces-over-240-million-new-stem-commitmen

experiences, such as afterschool programs and field trips, may be particularly important methods for inspiring students who are underrepresented in STEM fields.

In related literature, researchers in science education have been developing the concept of "science capital" to explain the differential mechanisms by which science aspirations and participation are shaped (Archer, Dawson, DeWitt, Seakins, & Wong, 2015a; Archer, DeWitt, Osborne, Dillon, Willis, & Wong, 2012). Borrowing from the notion of cultural capital in sociology (Bourdieu 1977, Bourdieu and Passeron 1977), Archer et al. (2015a) argue that science capital is a "scientific form of cultural capital and social capital" embodied through "knowledge, consumption, credentials, and social networks" (pp. 2). Like cultural capital, the possession of science capital provides advantages for those who possess it, particularly in terms of understanding the pathways to and the value of science-related careers (Archer, Dawson, Seakins, & Wong, 2015b in press).

Similar to cultural capital, science capital is typically more prevalent among students from advantaged social groups, and girls and minority students also tend to have lower levels. Research also suggests that the possession of science capital can lead to the accumulation of additional science capital which may exacerbate inequalities (Archer, et al., 2015b; Dawson 2014).

Research has shown that the desire to acquire some forms of cultural capital can be activated in disadvantaged populations through exposure to informal learning environments (Kisida, Greene, and Bowen 2014). Similarly, exposure to a science museum may be a gateway to the future acquisition of science capital and may have an impact on science-related educational and occupational aspirations.

We examine the effect of a science museum visit to the Museum of Discovery in Little Rock, AR. on the desire to acquire future science capital, as well as the effect on educational and science-related career aspirations. We do this by examining the self-reported survey responses of roughly 1,800 students who were randomly surveyed either before or after their visit to the Museum of Discovery in Little Rock, AR. We find that visiting a science museum has positive effects on students' desire to engage with science museums, science generally, and science educational and occupational aspirations. The effects, however, are stronger for male students, suggesting that pre-existing gender differences in science-related dispositions may be difficult to overcome without more deliberate interventions.

Policy Environment and Previous Research

Much of the concern about science achievement in the United States stems from average or lower than average performance on international comparison tests. Despite spending more per student than most countries, the U.S. performed about average among industrialized countries on the most recent Trends in International Mathematics and Science Study (TIMSS) (www.nces.ed.gov). Another internationally comparable test, the Programme for International Student Assessment test (PISA) ranks the United States 20th in science achievement. (www.oecd.org).[12]

Postsecondary indicators paint a similarly troubling picture for the United States. Individuals acquiring degrees in the natural sciences or engineering are growing especially fast in Asian countries. Since the early 1990s, doctorates in natural science and engineering awarded in Japan and India have increased by more than 70 percent, while the number awarded in South

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[12] http://www.oecd.org/pisa/keyfindings/PISA-2012-results-US.pdf

Korea has tripled, and doctorate degrees in China have increased by more than tenfold. At the same time, more than half of the doctorates received in sciences or engineering in the United States are acquired by foreign students, half of which are from East Asia. In engineering, for example, the share of U.S. doctorates earned by temporary and permanent visa holders rose from 51 percent to 68 percent during the period from 1999 to 2007, three quarters of which were earned by students from East Asia (National Science Board, 2010).

Another facet of the policy dilemma facing post-secondary STEM education and careers is the lack of equal representation across gender and ethnic categories. In 2007, for example, men earned 81 percent of bachelor's degrees in engineering, 81 percent in computer sciences, and 79 percent in physics. African-American and Hispanic students also obtain science and engineering degrees at far lower rates than white and Asian students (National Science Board, 2010). In the science and engineering workforce, though women's share grew from 12 percent to 27 percent from 1980 to 2007, they remain underrepresented. Additionally, African-American and Hispanic, only constitute about 10 percent of the science and engineering occupation workers, even though they make up more than 30 percent of the overall population in the U.S. (National Science Board 2010).

Research suggests that careers in science are largely predicted by early interest and engagement (Maltese & Tai 2010; Tai, Liu, Maltese, & Fan, 2006), a fact that underscores the importance of early encouragement. Similar evidence suggests that the lack of representation of women in STEM pursuits is heavily driven by their generally lower interest levels. Though they perform at similar levels across a range of achievement measures, they are much less likely to express that they like science or consider it one of their favorite subjects (Cunningham, Hoyer, and Sparks 2015). Along these lines, Barton and Brickhouse (2006) convincingly argue that the key to increasing girls' success in science should focus on increasing engagement, rather than efforts to increase achievement on standardized tests.

Informal learning environments, such as science centers, may be particularly well-suited to develop increased interest in and enjoyment of science activities (Dewitt and Storcksdieck 2008). Research examining the effects of informal learning environments has identified both cognitive (e.g. Bowen, Greene, and Kisida 2014) and affective outcomes (e.g., Archer et al., 2015b; Falk and Dierking 1997; Kisida, Greene, and Bowen, 2014), though the short nature of school visits likely makes them better equipped to bring about changes in affective domains (Dewitt & Storcksdieck, 2008). Additional research suggests that affective outcomes may contribute to learning that extends well past the museum visit (e.g., Falk & Dierking, 1997, Knapp, 2000), and may generate an interest in pursuing science careers (Jarvis and Pell 2005). Despite these recognized benefits, however, school trips to informal learning environments have declined in recent years (Dewitt and Storcksdieck, 2008; Greene, Kisida, and Bowen, 2014).

Viewed through the lens of science capital, if visits to science museums increase students' interest and dispositions towards science, then this would have an effect on a student's habitus—the set of attitudes and experiences that shape how they view and navigate the social world (Archer et al., 2015b). In many ways a habitus aligned with positive views of science is in itself a form of embodied cultural capital, as well as a characteristic that could lead to the future acquisition of cultural capital, eventually leading to an increase in students' decisions to pursue science education and careers. Thus, exposure to a source of science capital (a science museum) may lead to the acquisition of future science capital which may help students navigate pathways into science careers or pursue science-based educational activities.

Additionally, the accumulation of science capital through school visits to a science museum may help to reduce existing inequalities in science capital. Though recent analysis has found that science capital is unevenly distributed among students, with female and minority student tending to have lower levels of science capital (Archer et al., 2015b), exposure to a science museum may serve as a way to positively expose the world of science to disadvantaged groups. With these frameworks in mind, we turn to the empirical components of our investigation.

Sample

Working with the museum, we received a list of school groups who had scheduled upcoming tours to the museum in the spring and fall of 2012. Some contact information was available for each school group, and missing or incomplete contact information was obtained from school websites. The teachers who had scheduled the visits were initially contacted via email. We informed the teachers that we were working with the museum and asked them to participate in a study we were conducting. Out of the 85 groups who had scheduled museum tours, we were able to recruit 42 to participate (49 percent). As a result, this study has low external validity because we cannot be sure that the sample of participants is representative of the larger sample of student groups who took tours.

Teachers who responded to us and indicated that they would participate in the study were randomly assigned to be in the "treatment" group or the "control" group. Teachers were sent student surveys, as well as opt-out forms to be sent home to parents, via fed-ex. In email correspondence, and in the fed-ex packets, teachers were given explicit and detailed information emphasizing the importance of obtaining accurate information from the students and explaining that they were not to help the students complete the surveys in any way.

Classrooms randomly selected to be in the control group were instructed to administer the surveys *prior* to the museum visit, while treatment group teachers were asked to administer the student surveys at least one week *after* the museum visit. In essence, this generates a two-group posttest-only randomized experiment. In theory, the differences on our outcome measures between the treatment and control groups can be reliably attributed to the museum visit, because only chance determined whether the students took their surveys before or after the visit. That said, some students in the control group had likely visited a science museum in previous years. Based upon student surveys, 33 percent of students in the control group had visited a science museum previously on a field trip.

Enclosed in the mailed packets were pre-paid fed-ex envelopes for the return of completed surveys. Also included were surveys for the teachers, Teacher surveys were dated, which allowed us to check that the surveys were completed prior to the visit in the case of control groups, and after the visit in the case of the control groups. Dated surveys indicate that on average, groups administered the treatment group surveys 14 days after the visit, while the control group completed their survey roughly one week before their visit.

Once teachers agreed to participate and mailing packets were sent out, the rate of return was generally high. Seventy-nine percent of the mailed packets were returned with completed surveys, with a rate of 76.2 percent for the treatment group and 81.0 percent for the control groups. This reasonably high response rate, together with similar response rates across the treatment and control groups, increase the internal validity of the study. In total, 1,871 students completed the survey from 31 different schools, the majority of which were in grades 3-5. Demographic characteristics of the student sample show that the groups are roughly comparable (table 1). Notably, the treatment group has a higher percentage of black students, and a lower percentage of white students. These differences, however, fall short of statistical significance, suggesting the randomization was successful.

Table 1: Treatment/Control Balance on Key Characteristics

Characteristic	**Treatment (n = 880)**	**Control (n = 991)**	**Difference**	**p-value**
Percent females	52.16%	52.47%	-0.31%	0.93
Percent white	60.45%	73.86%	-13.41%	0.24
Percent black	22.73%	11.40%	11.32%	0.24
Percent Hispanic	6.48%	5.95%	0.52%	0.83
Percent other ethnicity	10.34%	8.78%	1.56%	0.44
Average grade	4.72	4.80	-0.08	0.87
School percent FRL	58.27	52.51	5.76	0.50
I like school	2.95	2.98	-0.04	0.67

Note: School FRL = percentage of students receiving free or reduced-price lunch, and is measured at the applicant group level; all other demographic variables are measured at the student level. “I like school” was measured using a 4 item Likert test, ranging from “strongly disagree” to “strongly agree.” The reported p-value is from the coefficient on the treatment indicator when each covariate is regressed on the indicator. A joint F-test from a model regressing the treatment indicator on the full list of covariates failed to reject the null hypothesis that the effects of the covariates are jointly equal to zero (p-value = 0.72). Standard errors are clustered at the applicant group level to account for the spatial clustering of students nested in classrooms.

The Treatment

Students in this study visited the Museum of Discovery located in Little Rock, Arkansas. The mission of the Museum of Discovery is “To ignite a passion for science, technology, and math in a dynamic, interactive environment.” When a classroom teacher or principal contacts the museum to arrange a visit, a coordinator from the museum speaks with the teacher to get details about the size of the group, grade level, and goals of the visit. The museum offers various types of specific programming that schools can sign up for. These programs are aligned with Common Core frameworks and can be tailored for the age of the students. School groups get a discounted admission to the museum.

Specific programs are roughly an hour long, are led by museum professionals, and cover topics such as biology and health (e.g. biology, anatomy, physiology, taxonomy, and forensics), earth and environmental science (e.g. meteorology, geology, archeology, and astronomy), tinkering labs (e.g. simple machines, robotics, and electricity), physics and chemistry (e.g. engineering, chemical experiments, and Newton’s laws), and social science (e.g. anthropology and history). The majority of schools opt for a single program, but it is not uncommon for groups to sign up for multiple programs for a single visit.

In addition to specific programs, students typically spend an additional 1-3 hours at the museum and experience the gallery exhibits in an open format. There are three permanent galleries at the museum: Amazing You (biology, anatomy, and health), Discovery Hall (physics, engineering, and electricity), and Earth Journeys (earth and environmental sciences). Two additional galleries feature travelling exhibits. During the study period, the most popular travelling exhibits were "Dinosaurs: Ancient Fossils, New Ideas" and "Extreme Deep"—an exhibit that highlighted oceanography and marine biology.

The vast majority of the offerings in the exhibits are hands-on and interactive. Museum staff and volunteers, many with science backgrounds and training, are available to students throughout the galleries and their goal is interact with students and facilitate engagement with the exhibits from an educational perspective to ensure that visitors are gaining as much as possible from the experience.

Data and Methods

In addition to demographic characteristics, the student surveys included a range of items that captured student attitudes about science museums, desire to engage with science, and aspirations for studying science in college and choosing a science career (see Appendix table 1 for descriptive characteristics of the complete list of outcomes).

Archer et al. (2015a) identify science capital in three domains: Science-Related Cultural Capital (e.g. scientific literacy, scientific-related dispositions), Science-Related Behaviors and Practices (e.g. consuming science media, after-school or out-of-school science activities such as a science club or visiting a science museum), and Science-related Social Capital (e.g. knowing someone who works in a science-related job, parental science qualifications). They hypothesize that these measures of science capital, mediated by field and habitus, determine science-related outcomes. Like cultural capital, Archer et al. (2015b), argue that "science capital is more a means to an end, rather than an end in itself" (pp. 3). In particular, the outcomes they identify are future science affinity (e.g. aspiring towards science educationally or occupationally) and science identity (considering oneself as "scientific").

In our experimental setting, we are able to examine components in two of Archer et al.'s science capital domains (science-related dispositions and science-related behaviors), as well as future science affinity outcomes (educational and occupational aspirations). In our examination, however, we treat the components of science capital and their hypothesized effects as outcomes. That is, we are interested in the effects of an intervention that offers one form of science capital (visiting a science museum) on attitudes towards the acquisition of future science capital and engagement with science, as well as the effects of the visit on educational and occupational aspirations.

Outcomes from our survey that are related to dispositions and behaviors include attitudes toward science museums and plans to visit them, interest in joining a school science club, and attitudes towards science generally. For these six survey outcomes, students indicated their level of interest or agreement using 4 category Likert-scales. For our analysis, we average these six outcomes into a single scale that serves as a measure of the science capital students may have gained from the intervention. The six items are highly correlated, with a Cronbach's Alpha of 0.82. In order to better understand the effects on the underlying components, we also examine them independently. Both the scale and the individual items have been converted into standard deviation units and thus any impacts are expressed as effect sizes.

In terms of science aspirations, we investigate the treatment effect on students' reported interest in studying science in college and pursuing a career in science. The measure of students' interest in studying science in college, like our measure of science capital, was scored on a 4 item Likert measure. For the career measure, students were asked a simple open-ended question: "What do you want to be when you grow up?" These items were analyzed blindly with regards to treatment group status and occupations that could be reasonably attributed to the intervention were coded as science-related careers. In many of these cases, students simply wrote “scientist,” making the coding straightforward. In other cases, students wrote occupations like biologist, anthropologist, paleontologist, and marine biologist. Other straightforward examples included “science teacher,” and even a few instances of “worker at the Discovery Museum.” We also separately coded medical careers (e.g. doctor, surgeon, etc.) because the science museum has some programs and a gallery that emphasize biology, anatomy, and physiology). Potentially, students may be more likely to aspire towards a degree in medicine as a result of their visit.

Because we randomly determined whether students took the survey before or after their visit, estimating the impact of the treatment is straightforward. This could be done by estimating simple mean comparisons between the treatment and control groups on our outcome measures. However, there are instances where the treatment and control groups are not perfectly identical, and the basic regression model can be improved by controlling for observable characteristics and to account for minor differences and to increase the precision of the estimated impact. Therefore we estimate the following equation for each standardized outcome of science capital *SC* of student *i* in school *s*:

$$(1) \qquad SC_{is} = \alpha + \beta_1 Treat_i + \boldsymbol{X_i \beta_2} + \beta_3 FRL_s + \varepsilon_{is}$$

Where $\boldsymbol{X_i}$ is a vector of student characteristics and FRL_s is the percent of a students’ school population that is eligible for free or reduced lunch. Included student characteristics are gender, grade level, and ethnicity. We include gender in our models as a binary measure equal to 1 if the student is female and 0 if male, a series of dummy variables indicating student grade, and a series of dummy variables indicating if a student is black, Hispanic, white, Asian, Native American, or a mixed race/other category. Finally, ε_{im} is a stochastic error term clustered at the applicant group level to account for the spatial correlation of students nested within applicant groups or schools.

In addition to overall impacts, we also test for heterogeneous effects across particular types of students. We do this by modifying equation 1 to include interactions between the binary treatment variable and student characteristics. For our analysis, we explore potential interaction effects using student gender and student minority status. To construct our binary measure of student minority status, we combine white and Asian students, since previous research suggests that these groups are more likely to hold higher levels of science capital and our particular interest is in examining heterogeneous effects for traditionally disadvantaged minority students with regards to science capital. We expect that female students and disadvantaged minority students could have characteristics that may moderate responses to the treatment.

Findings

Effects on Science Attitudes

Across our science capital scale, and five of the six of the individual components, there are positive treatment effects. As a result of visiting the science museum, students are more likely to think that science museums are interesting and fun, and they express that they plan to visit science museums when they are adults. Effect sizes range from around a quarter to a third of a standard deviation. Students are also more likely to feel that science is an important part of their lives, and indicate that they would join a science club if their school offered one.

Table 2: Effect Sizes of Visiting a Science Museum on Science Attitudes

	Effect Size
Science Capital Scale	0.22***
Trips to science museums are interesting.	0.28***
Trips to science museums are fun.	0.36***
I plan to visit science museums when I am an adult.	0.31***
Science is an important part of my life.	0.14*
Interested in learning about science.	0.02
I would join a science club if my school offered one.	0.20***

*** $p < .01$, ** $p < .05$, * $p < .10$, two-tailed.
Note: Estimates are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group. Effect sizes are in terms of standard deviation units.

When looking separately at effects by subgroup, there is a consistent pattern of heterogeneous effects by gender. In the combined scale, and across all six components, there is evidence that the effects are greater for boys (Table 3). While there are positive effects for both boys and girls across all three measures of attitudes towards science museums, the effects are roughly twice as large for boys and the differences between the effects are itself statistically significant (^ indicates the significance of the interaction terms, not shown). On the other 3 outcomes, the effects are also larger for boys, and in all 3 cases the effects for girls are not statistically significant, though in all three cases the *differences* in the effects between girls and boys is statistically significant. On the other hand, effects across white and minority students are largely consistent. Though there are some sporadic differences in magnitude across the effect sizes, none of the differences themselves are statistically significant.

Table 3: Effect Sizes of Visiting a Science Museum on Science Attitudes for Subgroups

	Males	Females	White	Non-white
Science Capital Scale	0.31***^	0.14***	0.29***	0.31***
Trips to science museums are interesting.	0.39***^	0.18***	0.32***	0.18*
Trips to science museums are fun.	0.48***^	0.26***	0.37***	0.32***
I plan to visit science museums when I am an adult.	0.40***^	0.23***	0.28***	0.36***
Science is an important part of my life.	0.20**^	0.10	0.11	0.21**
How interested are you in learning about science?	0.10^	-0.06	0.01	0.01
I would join a science club if my school offered one.	0.31***	0.10	0.18**	0.27***

*** p < .01, ** p < .05, * p < .10, two-tailed.
Note: ^ Indicates that the interaction term used to estimate subgroup differences is statistically significant. Estimates are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group. Effect sizes are in terms of standard deviation units.

Effects on Science Aspirations

The first aspirational measure we examine is students' reported interest in studying science in college (Table 4). Though the overall effect size for the full sample is positive, it is not statistically significant. When we examine the effects by gender, however, we see that the effect size for boys is positive and statistically significant, the effect for girls is not significant, and the difference between the groups is itself statistically significant. When we look at effects by minority status, the effects for nonwhite students are statistically significant and greater in magnitude, while the effects for white students fall shy of statistical significance. The difference between white and nonwhite students, however, is not statistically significant.

Table 4: Treatment Effects on Desire to Study Science in College

	Treatment	Control	Difference	Effect Size
Full Sample	2.91	2.82	0.09	0.09
Males	3.01	2.78	0.22***^	0.21***^
Females	2.82	2.84	-0.02^	-0.02^
White	2.85	2.79	0.07	0.07
Nonwhite	3.07	2.90	0.16*	0.16*

*** $p < .01$, ** $p < .05$, * $p < .10$, two-tailed.
Note: ^ Indicates that the interaction term used to estimate subgroup differences is statistically significant. Estimates are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group. Survey responses about wanting to study science in college were collected via a 4 item Likert scale with response categories of strongly disagree (1), somewhat disagree (2), somewhat agree (3), and strongly agree (4). Effect sizes are in terms of standard deviation units.

The second measure of science-related aspirations we examine is the percent of students who indicated that they wanted to pursue a science-related career. Across the full sample, there is a positive and statistically significant effect amounting to nearly five percentage points. Consistent with prior results, the effects of the treatment on aspiring toward a career in science are concentrated among boys, and the difference in effects between boys and girls is statistically significant. The effects appear roughly equal across minority and white students, and the difference between them is not statistically significant.

Table 5: Treatment Effects on Percent Saying They Want a Science-Related Career

	Treatment	Control	Difference
Full sample	16.41	11.59	4.82***
Males	20.19	13.22	6.97**^
Females	12.98	10.10	2.88^
White	17.39	12.47	4.93**
Non-white	13.61	9.06	4.55

*** p < .01, ** p < .05, two-tailed. ^ Indicates that the interaction term used to estimate subgroup differences is statistically significant.
Note: Estimates are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group.

Finally, we consider students who indicated they would like to pursue a career in medicine (table 6). Though not everyone considers medical careers to be explicit STEM careers, the Museum of Discovery has programs that emphasize biology and anatomy. Thus, there is reason to suspect that the tours of the science museum could have an effect on aspirations towards medical careers. Across the full sample, there is a slight increase of around 3 percentage points of students indicating an interest in a medical career. When looked at by gender, we find that this particular effect is concentrated among the girls in the sample, and the difference in effects between boys and girls is statistically significant. The effects for white and non-white students are roughly the same.

Table 6: Treatment Effects on Percent Saying They Want a Medical Career

	Treatment	Control	Difference
Full sample	9.41	6.61	2.80**
Males	4.38	4.48	-0.10^
Females	13.97	8.54	5.43**^
White	13.44	10.50	2.94
Non-white	8.44	5.36	3.08**

*** p < .01, ** p < .05, two-tailed. ^ Indicates that the interaction term used to estimate subgroup differences is statistically significant.
Note: Estimates are obtained from ordinary least squares regression models with robust standard errors clustered by applicant group.

Discussion

We have shown that visits to a science museum can produce increases in students' science-related attitudes and aspirations. Students who visited a science museum showed an increase in their desire to engage with science through future museum visits, were more likely to want to join a science club, and were more likely to view science as an important part of their lives. In terms of educational and occupational aspirations, we also find evidence that exposure to a form of science capital by visiting a science museum has positive effects on students' aspirations for post-secondary science studies and science-related careers. Generally speaking, these results provide convincing evidence that when students acquire this form of science capital, their positive attitudes towards science related-behaviors increase and the acquisition of future science capital is more likely. This, in turn, could lead to increases in the number of students in science-related jobs later in life.

It appears that the effects are not particularly different depending on students' minority status. Our analysis, however, reveals significant limitations in terms of increasing science capital for girls through this particular strategy. Across nearly every outcome measure, the effects for girls were significantly lower when compared to the effects for boys. And though girls certainly showed some gains on some of the attitudinal measures, we find no effect for them regarding educational and traditional STEM occupational aspirations. We do, however, see an increase for girls in their desire to pursue medical careers.

This study has important limitations. First, we only examine the effects of visits to a single science museum. We do not know if visits to other science museums would produce a similar set of findings. Second, though we use experimental methods, the study is limited to classrooms whose teachers first agreed to participate in data collection. Third, we are only able to measure the effects of visiting a science museum a couple weeks after students visit. We do not know how much the effects might decay over time for many of the students. Third, we rely exclusively on students' self-reported attitudes and aspirations. We can only speculate that students would actually change their behavior by joining a science club, taking college courses in science, or entering a science-related profession. Future studies could attempt to adjudicate these concerns by studying different locations, measuring the effects over a longer period of time, and tracking students' revealed preferences using behavioral measures.

It is also imperative that future research shed more light on the differential effects we observed between boys and girls. Our results suggest that different strategies may need to be employed to close the gender gap in science-related dispositions. It is possible that the specific instructional practices of the science museum used in this study were framed in a way that appealed more to boys. It is also possible that pre-existing characteristics simply made it more difficult for girls to be receptive to the science museum visit. Research has found that girls are steered away from science before they even enroll in school (Brickhouse, Lowery, & Schultz, 1999). Yet, we did observe a positive increase as a result of the treatment for girls' interest in medical careers. This finding suggests that perhaps certain aspects of science-related careers appeal more to girls. Future research could more deeply examine the types of science-related careers that appeal to boys and girls and determine the factors that explain such differences.

Related research finds that girls' attitudes towards science are moderated by whether or not they see science as inherently unfeminine (Archer, Dewitt, Osborne, Dillon, & Wong 2013), and girls with higher science aspirations are more likely to describe themselves as "not girly" (Archer et al., 2012b). There is also a perception that boys are more gifted in science-related domains, which can lead to negative performance by females due to stereotype threat (Good, Aronson, & Harder, 2007; Nguyen & Ryan, 2008). Stereotype threat is the fear of doing something that would confirm a negative stereotype, and this extra cognitive burden (such as believing that women are not good at science) has been shown to decrease performance. Other research has shown, however, that stereotype threats can be countered by exposing students to positive role models (McIntyre, Paulson, & Lord, 2003). Future research should explore the ability to increase interest in science by providing girls with positive role models, whether in science museums or in other venues.

As our results show, science museums seem well-equipped to raise interest in students' attitudes and aspirations in science. Yet, persistent challenges remain for educators and policymakers concerned with increasing the scientific literacy of the citizenry and reducing the unequal distribution of scientific interest and engagement. This study is but one additional step to help understand the accumulation of science capital and its effects. Ultimately, further studies will need to identify the types of interventions that can produce long-term changes and remedy inequalities in science capital and its effects.

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Appendix

Appendix Table 1: Descriptive Characteristics of Individual Survey Outcome Measures

Survey Item	Mean	Standard Deviation	Minimum	Maximum
Trips to science museums are interesting.[a]	3.46	0.75	1	4
Trips to science museums are fun. [a]	3.48	0.77	1	4
I plan to visit science museums when I am an adult. [a]	3.07	0.94	1	4
Science is an important part of my life. [a]	3.01	0.96	1	4
How interested are you in learning about science? [b]	3.01	0.94	1	4
I would join a science club if my school offered one. [a]	2.72	1.10	1	4
I would like to study science in college. [a]	2.84	1.04	1	4
Indicating wanting a science career.	0.14	NA	0	1

a. Response categories: strongly disagree, somewhat disagree, somewhat agree, and strongly agree.
b. Response categories: not interested, a little interested, interested, and very interested.

Conclusion

As these three studies demonstrate, there are measurable effects from students' visits to cultural institutions. In particular, this research shows that visits to cultural institutions can successfully generate the types of outcomes that institutions are aiming for. Generally speaking, the outcomes are content-specific. Students are better able to critically examine art, for example, and students are more interested in consuming the good provided, whether it be art museums or science museums. This is important, because student interest and engagement are key ingredients necessary for academic success.

Purposefully, this research does not look at the potential for transfer effects in other subjects. Such outcomes are not the goals of these programs, and such exxpectations are likely to dissapoint. Ultimately, while it can be shown that there are measurable benefits that relate to the interventions, whether or not these outcomes are desirable is a normative question. Educators, parents, and policymakers will ultimately need to decide if the benefits gained from students visiting cultural institutuions are desirable, much in the same way they must decide if the benefits of all math and literacy instruction are desirable.

If, however, stakeholders do value the benefits of cultural institutions, then steps must be taken to reverse the decline of school visits to these institutions. Policymakers must ensure that schools have the necessary resources to fund these types of experiences. School administrators must decide to use their limited resources for such trips. And, if cultural insitutions are going to reverse their decline, they need to actively take a role in helping to produce the type of rigorous research educational and polictical decisionmakers will find persuasive.