Predicting College Enrollment for Students Who Partake in Music or Dance Lessons Using Propensity Score Matching and Logistic Regression

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Abstract

Research has highlighted the benefits of students' interest and involvement in music and dance in school or in after school activities. However, less is known on the impact of such participation on post-secondary educational aspirations. This study examined relations of participating in after-school dance or music lessons with educational aspirations of high school students. The analysis uses propensity score matching to provide a comparison group to assess relationships. By using a propensity score matched comparison group, the analyses control for background variables including race/ethnicity, grade, age, and free or reduced-priced lunch status (as a proxy for socioeconomic status). Logistic regression results from a sample of students in grades 9 and 11 (N = 30,056) from 2016 show that participation is positively associated with educational aspirations (OR = 1.27, 95% CI [1.19, 1.35]).

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Introduction

It is well known that students who partake in artistic activities, such as music and dance, tend to outperform their non-artistic peers in academic outcomes. The cognitive field has an extensive list of research studies linking the academic outcomes of students who are involved in different types of musical training (see Hetland & Winner, 2001). Similarly, those in the kinesthetic field have highlighted the benefits of physical activity and, at the same time, emphasized that students who are less physically active have academic achievements far below those who are more active (e.g., Carlson et al., 2008). Unfortunately, developing an experimental study to test whether these associations are causal is not feasible. However, utilizing advanced statistical tools, such as propensity score matching to minimize the impact of non-randomization (Lane & Hanson, 2010), we can provide a comparison group to assess relationships controlling for background variables including race/ethnicity, grade, age, and free or reduced-priced lunch status.

Perspective

Dance and Academic Achievement

The relationships between physical activities, including dance, with academic outcomes have been shown to be positive and, depending on the type of research study, with strong effects. Some studies have shown relationships, albeit small, between dance education and improved reading as well as increased achievement in non-verbal reasoning skills, such as visual-spatial skills (Hanna, 2001). In addition, kinesthetic activities such as dance have enhanced geometrical concepts, problem-solving skills, and increased ability in written communication, in particular for kinesthetic learners (Bonbright, Bradley, & Dooling, 2013). Dance has also been shown to

increase engagement, critical thinking skills and creativity, as well as positive self-concept (Fegley, 2010). Engagement and participation in dance have also been linked to increased reading achievement (Rabkin, Rose, & Parks, 2002). Several studies found higher grades and grade point averages for dancers versus non-dancers or for those involved in dance activities versus non-dance related activities (Bonbright, Bradley, & Dooling, 2013). It ought to be noted that most of the studies on the associations between dance and academic outcomes are of a subjective or qualitative nature, with some being simply anecdotal, due to the difficulty to validate and standardized measurement tools of dance (Bonbright, Bradley, & Dooling, 2013).

Music and Academic Achievement

Although dance and physical activity have demonstrated benefits on academic outcomes, the literature on cognitive studies between musical training or participation is stronger and more established. Several researchers have noted areas of transference from the skills and abilities developed through music to academia and student learning in the classroom. A meta-analysis notes the large causal relationship between spatial reasoning and learning to playing and making music, with the effects appearing in both the at-risk student body and the general student body (Hetland & Winner, 2001). Prolonged (moderate to intensive) musical training has been linked to significantly higher ability to perform on tasks relating to geometric properties and relations, such as spatial abilities (Spelke, 2009). In addition to geometric tasks, another study indicated significant mean differences in algebraic achievement of students who engaged in formal music or choral instruction in middle school versus those who did not (Helmrich, 2010). Music has also been linked to increased reading ability and fluency where, in one study, 16 percent of the variance was explained by musical training compared to those who did not have music training (Wandell, 2008; 2009). However, it is good to note that concerns exist about whether the achievement is the

result of the music instruction itself, the natural ability of the student, or other tertiary benefits of studying music associated with student success (Helmrich, 2010).

Music and Dance Lessons

It is clear that students who partake in music or dance lessons tend to show better academic outcomes and skills. Overall, students specializing in music and dance showed increased geometric sensitivity performance, outperforming others on a geometric map task (Spelke, 2009). Regarding standardized assessments, the 2016 College Board Total Group Profile Report on College-Bound Seniors found that the students who took four years of arts and music coursework outperformed their peers who had taken arts and music coursework for only half a year or less by 56 points on the Reading portion of the SAT, by 37 points on the SAT Math Test, and by 55 points on the Writing and Language section of the SAT (College Board, 2016). Lastly, due to structural brain changes through the strengthening of executive attention networks that happen when students participate in an art form, such as music, student attention has been shown to increase in the classroom (Cole, 2011). The engagement, concentration, attention, cognitive, and non-cognitive skills and abilities that students exhibit in the classroom that are enhanced through the arts, such as music and dance, lead to higher academic achievement in general, and it is our hypothesis that it will lead to higher educational aspirations.

It is the aim of this research investigation to highlight the relation between the participation in dance or music lessons and the educational aspirations of high school students, while strengthening the statistical rigor by utilizing propensity score matching.

Methodology

Data

Minnesota Student Survey (MSS). Data from the MSS are provided by public school students in Minnesota (MN) via local public-school districts and managed by the MSS Interagency Team, including the MN Departments of Education, Health, Human Services, Public Safety, and Corrections. The MSS is administered every three years to students in public schools in grades 5, 8, 9, and 11 (Minnesota Department of Education, 2016). In 2016, a total of 168,733 students participated.

Procedure

Logistic regression analysis was performed to estimate the associations between music and dance participation and the educational aspirations of ninth and eleventh grade students, including 45,309 from grade 9 and 36,576 from grade 11. The majority of students were White (71.8%), with 6.2% Asian American, 6.0% African American, 9.0% Hispanic American, and 7.0% Multiracial. About half of the students were female (49.7%). Students who reported being American Indian, Pacific Islander, or did not report their race were dropped from the analyses due to small samples.

Propensity Score Matching. Propensity score-matching uses probability scores, which are single composite summaries of covariates, through a conditional probability mode, that estimate the likelihood of a participant being assigned to either the original group or the comparison group, while controlling for a set of covariates (Rosenbaum & Rubin, 1984). In the case of this investigation, propensity score matching took into account each student's race/ethnicity, grade, age, and Free or Reduced-priced Lunch (FRL) status (a proxy of socioeconomic status). By using propensity score matching, we are able to create and compare groups that are similar on these key characteristics, allowing us to draw conclusions without concern for baseline differences.

Dependent Variable. Educational aspiration was derived from one Minnesota Student Survey item regarding post-high school plans where students were asked about their main plan to do right after high school graduation, an item with nine response options. The nine response options were dichotomized whether students plan to attend a two- or four-year technical college, community college, or university versus other plans (80.0% versus 20.0% of the sample, respectively).

Regression Analysis. The analysis for this paper includes a logistic regression analysis conducted with the R 3.4.4 statistical software (R Core Team, 2018). The logistic model was fitted to the data to test the hypothesis regarding the relationship between the likelihood for students to plan to attend a two- or four-year college or university and their participation in dance or music lessons as an after-school activity, controlling for race/ethnicity (dummy variables for African American, Asian American, Hispanic American, and Multiracial students with White as reference group), FRL (i.e., SES proxy), gender, and grade.

Results

Propensity score matching was used to identify a matched comparison group of students who did not participate in any music or dance after-school activities. Matching variables were race/ethnicity, grade, age, and Free or Reduced-priced Lunch (FRL) status. Before matching (N = 77,942; 15,110 students reported taking dance or music lessons after school and 62,832 students reported not taking any dance or music lessons after school), all four aforementioned variables were statistically significantly different. After matching (N = 30,056: 15,028 students remained in the group that had taken music or dance lessons and 15,028 students remained in the group that did not take music or dance lessons after school), no variables remained significant, meaning that

these two groups in the new sample are statistically similar and share almost exactly the same characteristics.

The logistic regression model investigated the effects of participation of dance or music lessons on academic aspirations. The result showed that the log of the odds of a student planning to attend a two- or four-year college or university was positively related to their participation in music or dance lessons after school, $p < .001$, see Table 1. In other words, students who participated in music or dance lessons after school were more likely to plan to attend a two- or four-year college or university than students who reported not participating in either activity. In fact, the odds of a student who participated in music or dance lessons were 1.27 (i.e., $e^{0.24}$) times greater than the odds for a student who did not participate, controlling for race/ethnicity, FRL, gender, and grade.

Table 1

Summary of Logistic Regression Analyses for Variables Predicting College Plans, controlling for background variables

	Model 1					Model 2				
	B	SE(B)	e^B	CI [2.5%, 97.5%]		B	SE(B)	e^B	CI [2.5%, 97.5%]	
Intercept	1.325	0.027				1.243	0.029			
Race/Ethnicity (Ref = White)										
Asian American	0.406 ***	0.064	1.501	1.326	1.703	0.403 ***	0.064	1.496	1.322	1.697
African American	0.088	0.071	1.092			0.083	0.071	1.087		
Multiple Races	-0.274 ***	0.056	0.760	0.682	0.849	-0.275 ***	0.056	0.759	0.681	0.848
Hispanic	-0.395 ***	0.053	0.673	0.607	0.748	-0.400 ***	0.053	0.671	0.604	0.745
SES (Low)	-0.829 ***	0.037	0.437	0.406	0.469	-0.831 ***	0.037	0.436	0.405	0.469
Gender (Female)	0.690 ***	0.031	1.994	1.876	2.120	0.638 ***	0.032	1.892	1.778	2.015
Grade (11th Grade)	0.278 ***	0.032	1.320	1.240	1.407	0.276 ***	0.032	1.318	1.238	1.405
Music or Dance Participation						0.237 ***	0.032	1.268	1.191	1.350
					Wald's χ^2			56.133		
					df			1		
					p			<.001		

In summary, the odds of planning to attend a two- or a four-year college or university after high school graduation increases by 27 percent for those students who reported attending music or dance lessons. Model comparisons between the null deviance and the residual deviance shows

that when adding the music or dance participation variable to the null model the residual deviance is reduced significantly, $p < .001$.

Educational Significance

The current study shows that involvement in dance or music lessons after school has statistically significant effects on the educational aspirations of students. Specifically, students who report participating in music or dance lessons are planning on attending a two- or a four-year college or university at a higher rate than those who do not participate in such activities. In fact, the odds for students participating in music or dance lessons increase by a sizeable 27 percent. Furthermore, with the use of propensity score matching to create a matched comparison group, the study allowed for a better determination of the relations of participating in music or dance lessons with educational aspirations.

After the implementation of the No Child Left Behind Act (NCLB) in 2001, the shift in schools to focus on testing left academic areas like art, music, and dance to fight for their worth in the curriculum of the school, despite the arts being defined as a core subject area in NCLB (see ESEA Title IX, Part A, Section 9101(1) (D) (11)). In addition to NCLB, budget cuts to school funding have become an all too common occurrence, with the arts always being one of the first areas on the chopping block. In some schools, these academic areas became after-school programs that were delegated to be taught by teachers and community artists, dancers, and musicians (Holcomb, 2007). While after-school programs might pose a solution to keeping the arts in schools, for some students who have to ride the school bus or go to work after school, offering the arts only through after school programs would make the arts unattainable to them. As another avenues to keeping the arts alive in school districts, some teachers and schools are forced to apply

for grants to keep the arts in their schools; others are redesigning curriculum to incorporate the arts into the core subjects, sometimes at the expense of hiring artists, dancers, and choreographers to help; and others are requiring teachers to split their time between multiple schools just to keep the arts going (Holcomb, 2007; Jehlen, 2008). Clearly, given the importance of the arts in the academic outcomes of students, these budget and curriculum issues must be addressed.

One of the biggest additional issues facing education in the arts is that some administrators view the arts as expendable, incorrectly noting that they are not academic or of a cognitive nature. However, teachers are now realizing the importance of diversifying the ways concepts are taught and have been including the arts in the day to day classroom. For example, teachers are turning to dance and art to further explain and connect math concepts to the lives of their students (Jehlen, 2008). Teachers are following the advice from organizations such as the Kennedy Center Alliance for Arts Education Network that highlight the arts as a fundamental curriculum area because the student experience of the arts builds cognitive, emotional, and psychomotor pathways in the brain (Boyd et al. 2009). In a shift to viewing the arts as having an impact in academic outcomes, and the recognition of the cognitive facets of the arts, the academic value and potential of the arts can hopefully be viewed in a more positive fashion and more highly valued. The results from this study add to this rhetoric, students who participate in music or dance lessons have higher odds to attend a college or university. While it is well known that budget cuts to school funding is common, it is clear that funding for the arts should be considered with more weight than it has been given since NCLB went into effect.

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