Spring 2015

The Effect of Music Participation on Academic Achievement

Daniel Intolubbe-chmil
Daniel.Intolubbechmil@Colorado.EDU

The Effect of Music Participation on Academic Achievement:

A Comparative Analysis of Ordinary Least Squares and Fixed Effects Models

By: Daniel Intolubbe-Chmil

Department of Economics, University of Colorado at Boulder

Defended April 2, 2015

Advised by: Dr. Francisca Antman, Dept. of Economics

Defense Committee:
Dr. Francisca Antman, Dept. of Economics
Dr. Nicholas Flores, Dept. of Economics
Dr. David Rickels, Dept. of Music Education

Abstract

Music and arts programs have diminished in importance since the passage of No Child Left Behind, upon which accountability standards have focused on progress in STEM subjects as the sole metrics of success (Beveridge 2010). Research on the importance of music and arts suggests standards need to be reset and success redefined. This study looks at how music participation affects academic achievement for individuals participating in high school band. The hypothesis being tested expects for music to facilitate higher achievement; the null predicting music has no effect on achievement. Using data from the National Longitudinal Study of Adolescent to Adult Health or *Add Health*, Ordinary Least Squares (OLS) and Fixed Effects Models (FEM) reveal contrasting results when analyzing academic achievement, GPA. Past research reflects the contrasting results in this study, where researchers may manipulate methodology in order to get desired results. This research topic, as raised in prior researched, is subject to concerns of endogeneity and selection bias. To address these concerns, I compare simple OLS Models and FEM, the latter of which controls for unobserved heterogeneity or omitted bias from time invariant influences. Research from Miksza (2010) and Elpus (2013) employ OLS and FEM, respectively, in which the disparate results reflect inadequate analytic techniques using panel data. The preferable model for this longitudinal data is the FEM, which shows no significant results for music participation. The nature of the *Add Health* data is limited for education research so the sample I draw from consists of n=11,172 observations across three cohorts, with n=356 music participants. These cohorts describe the overlapping of two waves of data collection within four years of high school transcript data, drawn from a study called the Adolescent Health and Academic Achievement transcript study (AHAA) conducted during the third wave of Add Health. After implementing both models, the coefficient estimates for marching band participation are significant in the OLS model but not in the FEM. Using a unique data set to this research topic, the results confirm past research.

Introduction

Accountability standards are necessary for progress in public education in which a relative level of success must be met in order to prepare individuals for higher education and the work force. These accountability pressures can also prove to be harmful to those who fall victim to education inequity as a result of their socioeconomic status and racial makeup. My research addresses a single aspect of the many ways in which equity can be achieved across disparate socioeconomic borders. Specifically my research answers the question: what are the effects of music education on academic achievement, and how does music education facilitate educational growth? Furthermore, my research elucidates the methodological reasons why past studies reach contrasting results, and asserts the preferred methods and data for future research.

This research topic holds importance for education policy in providing opportunity to increase the likelihood of success for lower socioeconomic students; though this is but one aspect of an approach to education policy that will decrease disparities in opportunity. Economics plays an integral role for education policy analysis to develop the most efficient and effective policies targeting the sources of educational inequity. As annual yearly progress (AYP) benchmarks become a growing reality for public schools, those most detrimentally affected by such standards are often those who need increasing support from state and federal programs. This support needs to encapsulate the most effective ways to actualize educational opportunity as explicated in past and future research. Thus, accurate and adequately designed research needs to set the stage for future policy to make educational equity a reality.

The research regarding this topic is controversial and has contrasting results that reflect inadequate modeling. I will draw from two past researchers Peter Miksza and Kenneth Elpus to contribute a comparison of a simple OLS and FEM analysis. This is a unique contribution to the literature in that it explicates the reason for contrasting results depending on the models employed. The question of my topic then redirects from inquisition into policy to the methodological approaches of policy and program analysis themselves. As Elpus (2013) pointed out, OLS models are often wrought with selection bias and issues of unobserved heterogeneity within this particular area of research. My research contributes to the topic by observing these issues in data that hasn't been used for this particular research before through a comparative analysis of the OLS and FEM.

Aside from the comparative methodological contributions, I also posit that music education can still be used as a means to provide opportunity to the demographics most effected by "education disparities and intergenerational economic inequality" (Carter & Welner 2013).

Carter & Welner find that those who start off in this "at-risk" environment, often face a predetermined fate of underachievement in academia and the professional world. In their book *Closing the Opportunity Gap*, the idea of educational equity is achieved by diminishing the achievement gap by addressing disparities in opportunity. They find that the opportunity gap reflects the limited resources available to those of "at-risk" demographics. Those who are considered "at-risk" are caught in a cyclical educational and economic trap of disparate achievement in which compounding adverse effects define their reality of equity—thus economic equality.

In another study using the *Add Health* data, the effects of friends often contribute to a relative level of achievement in which the influence of friends reflects the capacity to progress and succeed (Flashman 2014). Furthermore, friend groups are often composed of individuals of similar demographics, so the *friend effect* described above can continually reinforce the compounding adverse effects of disparities in opportunity as posited by Carter and Welner. One way music education is a vital part of education curriculum is that it breaks down typically stratified tracked education and allows for social transgression between individuals that would otherwise never experience a positive *friend effect*. Music education allows for heterogeneous socioeconomic interaction in which the positive friend effects of those more predisposed for success and achievement can engage in a diverse social environment. The general concept being, a positive influence across the socioeconomic spectrum can be garnered in a diverse educational setting i.e. in the setting of music education.

The results of my research reinforce the existing contrasts in past literature, observing significance in the music coefficient using simple OLS models but not in the FEM. The explanation for such results is the limitation the OLS model has in mitigating unobserved

heterogeneity. Music participation is often correlated with predispositions for higher achievement including socioeconomic status and parent education level. Even after controlling for these in the OLS model, unobserved endogeneity still exists as an indicator for individuals who will inherently be more successful in academia. In this setting, where music could facilitate an interaction and growth between individuals on contrasting sides of the socioeconomic spectrum, a positive peer influence can be seen as an externality of this social and educational transgression.

Literature Review

Economics has a particularly strong foothold in the realm of education research. Delving into the literature regarding music education, I find that there are myriad inquisitions on the claims of the association between music participation and academic achievement. In recent studies, the topic turns towards the relationships by which causality can be claimed. These economic analyses entail multi-level (student and school) models accounting for the number of concerns with academic achievement and music education research—particularly selection bias and omitted variable bias (Miksza 2010; Elpus 2013). Upon observing the relevant research, the question I will address is: what is the effect of music participation on academic achievement, in this case GPA? Using data from the National Longitudinal Study of Adolescent to Adult Health or Add Health, I intend to compare multi-level OLS and fixed effects regression modeled by Miksza (2010) and Elpus (2013), and extrapolate the differences in analytic techniques to gauge true impacts of music education.

Motivation

Recent neuroscience research claims significant biological evidence of cognitive development resulting from two years of formal music education (Kraus, et al. 2014). This specific study

observes children 80-112 months that are randomly selected from L.A. gang-reduction zones (areas of high violence) to participate in a music program called the Harmony Project (Kraus, et al 2014). The results confirm a significant relationship between two years of formal music education, under the Harmony Project curriculum, and neurophysiological development associated with speech and reading skills. This contributes to education policy in that there is now hard empirical evidence of cognitive development resulting from music participation. This is particularly important when discussing how to address disparities in opportunity that materialize into achievement gaps beginning in pre-K and primary education.

Application to Policy

The significance of this recent neuroscience research is the implication it has for future interventions in at-risk school demographics that face accountability pressures from state and national standards. Under standards set by No Child Left Behind (NCLB), schools are faced with pressures to achieve adequate yearly progress (AYP), entailing a certain level of proficiency in reading, math and science state test scores (Beveridge 2010; Elpus 2014). As a result most music programs are left to the discretionary measures of administration, responding to teacher and community support for the continuation of music programs (Major 2013). In saying that, more research needs to be done in order to explicate the externalities of NCLB and to fortify empirical arguments for music and arts programs.

The nature of enrollment trends is controversially observed after the implementation of NCLB, with one study observing exacerbated disparities in enrollments for certain demographics (Hispanic, English language learners, and students with Individualized Education Plans) but little deviation for other student demographics (Elpus 2014). In a study of a national survey of principals done by Abril & Gault (2008), there is a significant observation that NCLB has a negative impact on music programs. Upon reviewing the relevant literature, the arts and music

programs are threatened by a shift in focusing on standardized testing and AYP benchmarks (Abril & Gault 2008; Beveridge 2010; Miksza 2007). In lieu of these observations, music education holds an important role in determining effective future education reform.

A concept explored by prior Add Health researchers is the effect of peers on achievement. Drawing from anecdotal experience, music and arts programs distinguish themselves from typically tracked student course structures, in that within these courses the students who are brought together may span from opposite sides of the social spectrum. While the nature of this structure may differ between schools, districts and regions, the concept of tracked education is prominent nationwide; with opportunity gaps present and educational equity not achieved, music and art programs offer a viable opportunity for peer influences to transgress more scripted peer relations. As Flashman (2014) observes from a study of Add Health data, minority students are generally isolated in the current structure of public school stratification and tracked education, often interacting strictly with those within their ethnic and socioeconomic identity. Furthermore, Lee & Wong (2004) conducted research on the educational inequity that emerges as a result of accountability pressures, reflecting racial and socioeconomic disparities in school resources. Music and art allows for a transgression of this social homogeneity, in which students are bound together by a creative drive, an interdependence of expression, and thus elevated to a common ground of educational and social equity. The argument for the positive effects of peer influences through the medium of music and arts programs may prove significant and useful for future advocacy of liberal arts education.

Concerns in Prior Research

A large concern is the selection bias that may result from the sample data. A study by Elpus (2013) reveals the reality of selection bias in observing a predisposition for higher achievement in those who participate in music programs. Particularly, when observing the long-term effects

of music, there are observations of high participation and associated achievement amongst students of a higher affluent demographic (Southgate & Roscigno 2009; Gault & Miksza 2014). A simple OLS model cannot control for every aspect of the unobservable influences, thus the FEM is vital for the accurate depiction of the effect of music participation.

In terms of measuring the desired achievement outcome variable, a number of variables affecting the student's academic performance need to be controlled for in order to limit biasedness. Fixed effect regression models can be used to control for the impact of unobserved variable bias. In the models implemented by Miksza (2010) and Elpus (2013) control variables reflect individual and school-level influences, including demography (minority status), prior achievement, family background including socioeconomic status (SES), duration/intensity of participation, and attitudes towards school. The FEM does not include many of these as they are not time-variant, such as SES or parent education. However the model I develop does include student level influences such as perception of school connectedness and intelligence. Miksza (2010) points out a number of concerns with research on music education in the last decade or so, including inadequate reliability and validity of measures and inappropriate regression techniques, limited samples (geography and demography), lacking theoretical explanations for emergence of particular outcomes, and theoretical studies addressing a more general analysis of the arts rather than music participation specifically. These will be guidelines for my research as well as the concerns raised by Elpus as discussed below.

As my research evolves, I will develop a unique study of music participation in terms of extra-musical social and educational outcomes, addressing these concerns using the unique Add Health data set. These data are used to study the effects of social development such as friendship and racial disparities in academic achievement (Flashman 2014) or health effects associated with

achievement. Moving forward in my research, I will also address the concern of a diminishing effect over time by observing outcomes into the respondents' adult life. I anticipate the data to reveal the forces of socioeconomic stratification trump any high school educational experiences.

This topic in education research has become prominent since the turn of the century stemming from discussions of reformative policies to close the achievement gap. Though a successful educational intervention seeks out a solution for the opportunity gap, defined by Carter and Welner (2013) as a shift from the outcomes of interventions to the inputs. This idea of addressing the opportunity gap is at the heart of my research, addressing the "deficiencies in society, schools and communities that produce significant differences in educational outcomes" (Carter & Welner 2013). It has been observed that formal music education can lead to cognitive development and if this resource is provided, in one form of arts education or another, perhaps the widening disparities in our education system will begin to diminish--though educational equity cannot be achieved with a single cure-all.

Former Research Models

The methodological approaches for this topic involves multi-level analyses implementing fixed effect regression or quasi-experimental designs using longitudinal studies from the NCES. I hope to utilize the Add Health data set to develop a unique analysis of academic achievement outcomes--GPA. In doing so, I will develop an OLS model based on Miksza's research in 2010 accounting interactive student and school level influences that contribute to a student's outcome. The FEM I develop is based on Elpus's (2013) OLS model with fixed effects that addresses the two main concerns in this research topic—omitted variable bias and selection bias. Comparing these two models will show the strengths of the FEM as the preferred approach when analyzing the effect of music education on achievement as posited by Elpus (2013).

Methodology

Data

This study draws from the National Longitudinal Study of Adolescent to Adult Health or *Add Health*, a series of four waves of data collection of adolescent health and behavior. The data are nationally representative, collected from 20,745 adolescents with 17,670 parent interviews in the first wave, and approximately 15-16,000 of the original respondents in the second, third and fourth waves. The first two waves were conducted in 1994-95 and 1995-96, with the Wave III follow-up in 2001-02. Wave III is complemented by a transcript study called the Adolescent Health and Academic Achievement (AHAA) study, which focused on the effects of education on academic achievement, adolescent behavior, and cognitive and psychosocial development. After merging these data sets, the relevant sample is reduced to three cohorts that encapsulate two years of student and school level variables in conjunction with four years of transcript data. The composition of these data are shown in Table 1 below:

Table 1: *Add Health and AHAA data (Population Research Center, University of Texas at Austin)*

Add Health Surveys				In-School & Wave I	Wave II					Wave III
Academic Year	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	01-02
Cohort										
7th grade				*7*	*8*	9 Year 1	10 Year 2	11 Year 3	12 Year 4	
8th grade				*8*	9 Year 1	10 Year 2	11 Year 3	12 Year 4		
9th grade				9 Year 1	10 Year 2	11 Year 3	12 Year 4			
10th grade			9 Year 1	10 Year 2	11 Year 3	12 Year 4				
11th grade		9 Year 1	10 Year 2	11 Year 3	12 Year 4					
12th grade	9 Year 1	10 Year 2	11 Year 3	12 Year 4						

The three cohorts of interest are the individuals in grades 9-11 at the time of Wave I. The Add Health follows these students through Wave II in which they have proceeded to grades 10-12. In order to run the fixed effects model and portray any time varying effects, the sample is reduced to these three cohorts. The result is two observations for each individual representing two years of high school transcript data from the AHAA study with time varying student and school level variables drawn from Add Health.

Although this is unique data for this particular research topic, the independent variable of interest, music participation, is not ideal. Observing marching band participation is a limited scope of general participation in music, which past research has observed multiple courses within music education, generally ensemble participation—including band, orchestra and chorus. However, the positive effects speculated from ensemble participation should still be reflected in marching band participation as the fundamental aspects of music education are consistent.

The dependent variable as a metric of academic achievement is grade point average (GPA). GPA can be a misleading metric of achievement due to variation in grading practices including teacher expectations affecting achievement and the level of academic competitiveness at a given school (Kaplan & Owings 2013). Nonetheless, GPA was the most accurate and adequate reflection of academic performance in the data. These concerns were not directly controlled for in the modeling, however GPA was standardized to control for any non-normal distributive properties resulting from variation across schools ((Freund & Holling 2008; Erkman et al. 2010). In the sample where n=11172, the average GPA is 2.58; the average GPA for those in marching band (n=356) is 2.93 and non-participants is 2.57 (n=10816). GPA as a metric of achievement in music participants might skew grading as music courses may be more relaxed in terms of grading—naturally inflating GPA for music participants. To look at the nature of this

issue, math and science GPA are also observed. In both areas music participants on average have higher GPAs. GPA statistics by demographic are shown in Table 2 below:

Table 2: GPA descriptive statistics

	No Marching Band				Marching Band				Total			
	Overall GPA	Math GPA	Science GPA	N	Overall GPA	Math GPA	Science GPA	N	Overall GPA	Math GPA	Science GPA	N
Minority												
White	2.64	2.27	2.41	6906	3.06	2.59	2.66	245	2.65	2.29	2.42	7151
Non-white	2.42	1.99	2.13	3910	2.64	2.14	2.23	111	2.42	2	2.13	4021
Sex												
Male	2.42	2.06	2.16	5214	2.75	2.28	2.22	129	2.42	2.06	2.16	5343
Female	2.69	2.27	2.43	5602	3.03	2.55	2.68	227	2.7	2.28	2.44	5829
Music												
Marching Band									2.93	2.46	2.54	356
No Marching Band									2.58	2.2	2.32	10816

Observing generally higher GPA across subject areas in music participants reflects the idea that those participating in music are often predisposed for high achievement—hence selection bias.

Controls

In each of the following student and school level categorical variables, the reference group is the lowest value of the categorical variable. For example, if a variable ranks 1-5, the reference group would be the 1st level in the ranking and the coefficients would read, "Compared to level 1, level 4 has on average a .15 higher GPA."

Student Level Influences

Measuring SES

The first measure of socioeconomic status in the OLS model is income. Income class is a categorical variable with 5 ordinal rankings calculated from past research using Add Health. The indicators of income class take into account household size and income. Using a procedure

outlined by Montgomery et al. (1996), each class was adjusted to the 1994 poverty threshold. Montgomery et al. (1996) define poverty as 1.5 times the threshold set by the U.S. Census. Referencing another study using Add Health data, the class structure follows this adjustment with class 1 as 1.5 times the poverty threshold; class 2 as 1.5 to less than 2.5 times the poverty threshold; class 3 as 2.5 to 4 times the poverty threshold; class 4 as 4 times the poverty threshold to less than the top 5%; and class 5 being the top 5% of household income in 1994 (Goodman 1999).

The second variable accounting for SES is parent education. Following Goodman's (1999) procedure, the metric of parent education was organized by the self-reported education level of respondent's parent; if data was available for two parent families, the higher of the two reported education levels was used as the indicator for parent education. Parent education was then organized into an ordinal ranking 1-4, with 1 being no high school; 2 being HS and some college; 3 being college graduate; and 4 indicating advanced degree or professional training beyond a four year degree.

School and Social Connectedness

School connectedness has been observed to facilitate a perception of school that fosters social and academic engagement increasing the likelihood of success (Blum 2005; Bond et al. 2006). The variable indicates how much the respondent agreed on a scale 1-5, strongly agree to strongly disagree, to the statement "You feel like you are a part of your school." The coefficient reads negative on this variable showing a positive relationship between school connectedness and GPA—as respondents identify less with the statement above, GPA on average decreases.
The respondent also reported the degree to which they feel socially accepted on a scale from 1-5, 1 being feeling very much socially accepted.

Self-efficacy

Self-efficacy has been observed to positively affect academic motivation (Linnenbrink & Pintrich 2002). Self-efficacy is defined by Schunk (1991) as "an individual's judgments of his or her capabilities to perform given actions." In the OLS and FEM, self-efficacy is controlled for by including variables indicating a self-reported likelihood that the respondent would attend college and self-reported intelligence.

Other controls such as alcohol use, parent composition (single/dual parent family), and household language are variables suggested in prior research (Bond et al. 2006; McLeod et al. 2012; Elpus 2013). Each has a significant contribution to student achievement and help to dispel selection and omitted variable bias.

School Level Variables

Miksza (2010) implemented a multilevel analysis including school level influences such as urbanicity and school type. Included in the OLS regression are these school level variables. Urbanicity is ranked 1-3 with 1 indicating urban, 2 suburban and 3 rural. School type is binary variable indicating private or public school. Region is also part of school level controls (West, Midwest, South, Northeast).

Research Design: A comparative analysis

Two models were utilized to test the hypothesis that participation in marching band positively affects academic achievement or GPA. A comparative analysis of an OLS and FEM reveals the purported claims raised by Elpus (2013) to be true: music participation has a positive *correlation* to achievement in which endogeneity and selection bias skew the observed effects of participation, eliminating claims of a causal relationship. As these models were drawn from

Elpus (2013) and Miksa (2010), Elpus emphasizes the difficulty in encapsulating the myriad of influences to control for omitted variable and selection bias.

Simple Ordinary Least Squares Model

The basic OLS model drawn from Miksza (2010) and Elpus (2013) is shown in **Equation 1**:

$$Y_{it} = \boldsymbol{\alpha} + \boldsymbol{\beta}_1 Music_{it} + \boldsymbol{\varphi}_t + \boldsymbol{\varepsilon}_{it}$$

Where Y_{it} is GPA for individual, *i*, at time, *t*, with time fixed effects, φ_t, which represent the duration of the relevant Add Health data spanning from 1994-1996. A developed OLS model with a vector of control variables is show in **Equation 2**:

$$Y_{it} = \boldsymbol{\alpha} + \boldsymbol{\beta}_1 Music_{it} + X_{it}\boldsymbol{\gamma} + \boldsymbol{\varphi}_t + \boldsymbol{\varepsilon}_{it}$$

Where $X_i\gamma$ is a vector of student and school level covariates, which are listed in the table below. Year dummies included in $X_{it}\boldsymbol{\gamma}$ account for the multi-cohort design where year 1 serves as a base year, in this case freshman year. This simple OLS model was done similarly to Miksza (2010) where omitted variable and selection bias still exists in the coefficient for marching band as a result of the choice of model. Elpus (2013) addresses these concerns with an OLS fixed effects model controlling for unobserved time invariant heterogeneity.

Fixed Effects Model

The fixed effects model varies slightly from the OLS in that variables such as parent education or household income are omitted due to limitations in the Add Health data. **Equation 3** shows the full FE model:

$$Y_{it} = \boldsymbol{\alpha} + \boldsymbol{\beta}_1 Music_{it} + X_{it}\boldsymbol{\gamma} + \eta_i + \boldsymbol{\varphi}_t + \boldsymbol{\varepsilon}_{it}$$

Where Y_{it} is overall GPA for individual, *i*, at time, *t*, with year fixed effects and a vector of controls including year dummies. These time varying influences mitigate unobserved bias though due to limitations in the data, much of this unobserved heterogeneity still exists in the error term

as there are few covariates, available in the Add Health study in conjunction with the AHAA transcript study. The FE model introduces a new term, η_i, representing individual fixed effects.

Results

The following table shows the results for the OLS models 1-4 with added controls. The coefficients show the relationship as a unit change in an independent variable eliciting a unit change in GPA. The coefficient on marching band can therefore be read, "Those who participate in marching band on average have a GPA .410 points higher than those who do not participate." Table 3 shows the results for the OLS model with student and school level fixed effects:

Table 3: OLS Model for overall GPA

	(1)	*(2)*	*(3)*	*(4)*
Marching Band	0.410***	0.361***	0.313***	0.111*
	(0.054)	(0.053)	(0.054)	(0.067)
Minority Status		-0.262***	-0.225***	-0.292***
		(0.019)	(0.023)	(0.029)
Female/Male		0.308***	0.327***	0.216***
		(0.019)	(0.020)	(0.024)
Income Class: 1			Reference Group	Reference Group
2			0.185***	0.226***
			(0.038)	(0.046)
3			0.316***	0.247***
			(0.036)	(0.043)
4			0.389***	0.284***
			(0.035)	(0.042)
5-Top 5%			0.352***	0.227***
			(0.060)	(0.068)
Parent Education: 1 No HS			Reference Group	Reference Group
2			0.196***	0.091*
			(0.039)	(0.048)
3			0.488***	0.207***
			(0.044)	(0.054)
4 Advanced Degree			0.721***	0.335***
			(0.047)	(0.058)
Single Parent			-0.225***	-0.186***
			(0.054)	(0.060)

	(1)	(2)	(3)	(4)
English Speaking Household			-0.137***	-0.150***
			(0.040)	(0.049)
Private/Public			0.276***	0.160***
			(0.041)	(0.050)
Urbanicity: Urban			Reference Group	Reference Group
Suburban			0.093***	0.133***
			(0.025)	(0.030)
Rural			0.075**	0.151***
			(0.032)	(0.038)
Region: West			Reference Group	Reference Group
Midwest			-0.107***	-0.166***
			(0.029)	(0.035)
South			-0.045	-0.080**
			(0.028)	(0.033)
Northeast			-0.260***	-0.282***
			(0.035)	(0.040)
School Connectedness: 1				Reference Group
2				-0.038
				(0.031)
3				-0.105***
				(0.039)
4				-0.300***
				(0.046)
5 Strongly Disconnected				-0.386***
				(0.069)
Likely to Attend College: 1				Reference Group
2				0.062
				(0.074)
3				0.181***
				(0.060)
4				0.420***
				(0.057)
5 Very Likely				0.742***
				(0.055)

	(1)	(2)	(3)	(4)
Self-Reported Intelligence: 1 Moderately Below Avg.				Reference Group
2				0.052
				(0.142)
3				0.118
				(0.130)
4				0.416***
				(0.131)
5				0.632***
				(0.131)
6 Extremely Above Avg.				0.782***
				(0.139)
Socially Accepted: Strongly Agree 1				Reference Group
2				0.145***
				(0.028)
3				0.233***
				(0.044)
4				0.310***
				(0.072)
5 Strongly Disagree				0.252
				(0.185)
Alcohol Use: Every day 1				Reference Group
2				-0.310***
				(0.115)
3				-0.149
				(0.103)
4				-0.041
				(0.101)
5				0.046
				(0.100)
6				0.073
				(0.100)
7 Never				0.111
				(0.104)
Observations	11,172.0	11,172.0	8,509.0	4,572.0

* p<*0.1;* ** p<*0.05;*
***p<*0.01*

As expected, the coefficient on marching band is statistically and practically significant showing an average .111 increase in GPA with participation in model 4. This effect diminishes significantly once certain student level controls are added, as shown between Model 3 & 4.

Selection bias arises when not controlling for certain covariates that are characteristic of the sample population—music participants. As more covariates are added, such as income class and parent education, this endogeneity is slightly mitigated and even more so when we control for things like self-efficacy and academic expectations. The diminishing coefficient on marching band suggests that the estimate in Models 1-3 are significantly biased upward, where unobserved endogeneity still exists in the error term.

It is only when we run the FEM that we can control for this unobserved heterogeneity. Selection bias, as discussed by Elpus (2013) can only be accounted for by including a number of covariates addressing an inherent bias in the sample—this is a shortcoming of the model that follows. The results for the FEM are shown in table 4:

Table 4: FEM for overall GPA

	(1)	(2)	(3)
Marching Band	0.107	0.090	0.165
	(0.066)	(0.065)	(0.124)
School Connectedness: 1		Reference Group	Reference Group
2		-0.033*	-0.020
		(0.018)	(0.032)
3		-0.081***	-0.041
		(0.025)	(0.043)
4		-0.106***	-0.123**
		(0.030)	(0.050)
5 Strongly Disagree		-0.141***	-0.219***
		(0.047)	(0.072)
Likely to Attend College: 1		Reference Group	Reference Group
2		-0.065	-0.218***
		(0.046)	(0.073)
3		0.021	-0.087
		(0.041)	(0.066)
4		0.091**	-0.017
		(0.042)	(0.067)
5 Definitely		0.160***	0.037
		(0.042)	(0.068)

	(1)	*(2)*	*(3)*
Feels Socially Accepted: 1			Reference Group
2			0.022
			(0.030)
3			0.026
			(0.048)
4			0.049
			(0.074)
5 Strongly Disagree			0.231
			(0.169)
Alcohol Use: Every day			Reference Group
2			-0.151
			(0.103)
3			-0.072
			(0.094)
4			-0.055
			(0.093)
5			0.005
			(0.092)
6			0.013
			(0.093)
7-Never			0.073
			(0.100)
Observations	*11,172.0*	*10,820.0*	*5,928.0*

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

FEM (3) is included to show the contrasting results that yield complete insignificance of variables that revealed some significance in the simple OLS model. Introducing the last two variables changes the coefficients on all other independent variables, making the coefficient on marching band appear more positively biased and insignificant. The coefficient on school connectedness increases as alcohol use and social acceptance are introduced, following the pattern of being a strong predictor of higher overall GPA.

None of these FE models yield significant results for marching band participation. One explanation of this is that unobserved biases still result due to limitations in the data. These endogenous influences affect the coefficient on marching band as certain variables are

introduced (as we see in the estimates' variation across models). As issues of endogeneity are certainly the main concern with this study, another concern with the independent variable of interest, marching band, was the limited scope of ensemble participation entailed in the variable itself. With limited covariates available in the Add Health data, it is difficult to come to any definitive conclusions about how marching band truly affects GPA. Although the results returned insignificant, the FE model is the most adequate approach to this particular research topic, mitigating much of the concern of the unobservable influences affecting GPA.

The established literature comes to contrasting conclusions when using different models of analysis. The FE model with a myriad of covariates proves to be the most adequate procedure in accounting for omitted variables bias when measuring academic achievement. As my research attempted to take a unique data set and develop a comparative model analysis, the data was not thorough enough to ensure an accurate depiction of the true effects of music participation. In conclusion, we cannot reject the null hypothesis that marching band has no significant effect on overall GPA.

Conclusion

The role for empirical research in education is vital. It is integral for policy and curriculum to be rooted in an infrastructure of cause and effect, where visions of change can actualize from hypotheses. This particular research topic is controversial when discussing the next steps for national education standards. The conversation of providing educational equity extends to funding policies, in which compounding generational inequities still define current disparities seen at the beginning of the 20th century; these disparities often fall along racial lines and in the form of massive differences in funding (Carter & Welner 2013).

Disparity in opportunity arises from systemic inequities related to socioeconomic status, such inequity perpetuated in part through our education system (Wong & Lee 2004). Closing this opportunity gap is one of the biggest challenge education policymakers and researchers face today. Music and arts is by no means the single solution to this, but has potential to facilitate advancement in education contexts, when success in STEM programs stagnates growth, and particularly among at-risk youth. The disparities in achievement are a results of disparities in opportunity, which reflect an explicit dissonance of resources across socioeconomic boundaries. This dissonance can be alleviated through the provision of educational programs and initiatives that target the root of development, such as music and arts.

These initiatives and educational interventions reflect the need to upgrade the crumbling infrastructure of our public education. The advent of annual benchmarks are imperative for the success and progress of our public education system, but the standards for the infrastructure of our schools need to rise to the academic standards set by policymakers. Redistributive policy is necessary on a national scale in order to actualize a reality of equity, the pursuit of which can be seen by the Harmony Project and other nonprofits.

My research targeted the fundamental incentive behind this redistribution: are we right and justified in reallocating resources towards an *at-risk* investment? The ideas outlined in this study and past ones have set the stage for a precedent of economic analysis that achieves the most effective allocation of resources—that is not biasedly driven to achieve desired results. The answer to this question of justifiable redistribution was not conclusively revealed in my results, but the research done by Northwestern shows promise for the development of music and arts policy.

Opportunity can come in the form of music and arts programs, STEM initiatives,

vocational education, or community outreach. The standards to which our policymakers must ascend are those set by the Harmony Project, or El Sistema (a Colorado music education nonprofit). These organizations are focusing on the neighborhoods that are most forgotten by our policymakers, where opportunity to find success in school is a shot in the dark. With the provision of equity, the reality of economic equality will follow close behind.

The solution for effective and efficient policies lies in the scientific methods of economic analysis. In saying that, future research regarding this topic needs to find data that focuses on early education tracking young children through programs such as the Harmony Project to look at the long-term effects of music education. The methodology has been outlined by past researchers, and the comparative modeling put forth in this paper exemplifies the need for attentive and adequate analysis. Research in education should not be guided and manipulated by desired results but by a desire to find the ways in which our research can ripple through the academic community in a positive and equitable fashion.

Works Cited

Abril, C. R., Gault, B. M. (2008) *The State of Music in Secondary Schools, The Principal's Perspective.* Journal of Research in Music Education. Vol. 56(1), 68-81.

Beveridge, Tina (2010). *No Child Left Behind and Fine Arts Classes.* Arts Education Policy Review. 111, 4-7

Blum, R. W. (2005). *A Case for School Connectedness*. The Adolescent Learner. Vol. 62 No. 7 16-20.

Bond, L. et al. (2006) *Social and School Connectedness in Early Secondary School as Predictors of Late Teenage Substance Abuse, Mental Health, and Academic Outcomes.* Journal of Adolescent Health 40 (2007) 357.e9 –357.e18.

Carter, P., Welner, K. G. (2013). *Closing the Opportunity Gap*. Oxford University Press. NY, NY

Catterall, J. (2012). *The Arts and Achievement in At-Risk Youth: Findings from Four Longitudinal Studies.* National Endowment for the Arts.

Elpus, Kenneth (2013). *Is it the Music of is it the Selection Bias? A Nationwide Analysis of Music and Non-Music Students' SAT Scores*. Journal of Research in Music Education. Vol. 61, 175-194.

Elpus, Kenneth (2014). *Evaluating the Effect of No Child Left Behind on U.S Music Course Enrollments*. Journal of Research in Music Education.

Erkman, F. et al. (2010). *Influence of Perceived Teacher Acceptance, Self-Concept, and School Attitude on the Academic Achievement of School-Age Children in Turkey*. Cross-Cultural Research, 44(3) 295–309, SAGE Publications.

Flashman, J. (2014). *Friend Effects and Racial Disparities in Academic Achievement*. Sociological Science 1: 260-276

Freund, P. A., & Holling, H. (2008). *Creativity in the Classroom: A Multilevel Analysis Investigating the Impact of Creativity and Reasoning Ability on GPA*. Creativity Research Journal, 20:3, 309-318, DOI:10.1080/10400410802278776

Gault, B. M., & Miksza, P. (2014). *Classroom Music Experiences of U.S. Elementary School Children: An Analysis of the Early Childhood Longitudinal Study of 1998–1999*. Journal of Research in Music Education.

Goodman, E. (1999). *The Role of Socioeconomic Status Gradients in Explaining Differences in US Adolescents' Health*. American Journal of Public Health.

Kaplan, L. & Owings, W. (2013). *Culture Re-boot: Reinvigorating School Culture to Improve Student Outcomes*. Corwin, A SAGE Company. *pg. 146-154.*

Kraus, N., Slater, J., Thompson, E. C., Hornickel, J., Strait, D. L., Nicol, T., White-Schwoch, T. (2014). *Music Enrichment Programs Improve the Neural Encoding of Speech in At-Risk Children.* The Journal of Neuroscience. 34, 11913-11918.

Lee, J. & K. Wong (2004) The Impact of Accountability on Racial and Socioeconomic Equity: Considering Both School Resources and Achievement Outcomes. American Educational Research Journal. 41(4), 797-832.

Levinowitz, L. M. (2009). *Research Findings on the Music Together Preschool Program Model.* Music Together LLC.

Linnenbrink, E. A., & Pintrich, P. R. (2002). *Motivation as an Enabler for Academic Success*. Psychology Review, 02796015, 2002, Vol. 31, Issue 3.

Major, M. L. (2013). *How They Decide: A Case Study Examining the Decision-Making Process for Keeping or Cutting Music in a K-12 Public School District.* Journal of Research in Music Education. 61(1), 5-25.

Miksza, P. (2007). *Music Participation and Socioeconomic Status as Correlates of Change: A Longitudinal Analysis of Academic Achievement.* Bulletin of the Council for Research in Music Education. No. 172, 41-58.

Miksza, P. (2010). *Investigating Relationships between Participation in High School Music Ensembles and Extra-musical Outcomes: An Analysis of the Education Longitudinal Study of 2002 using a Bioecological Development Model. Bulletin of the Council for Research in Music Education.* University of Illinois Press. No. 186, 7-25

Montgomery, L. E, et al. (1996). *The Effects of Poverty, Race, and Family Structure on US Children's Health: Data from the NHIS, 1978 through 1980 and 1989 through 1991.* American Journal of Public Health, Vol. 86, No. 10, 1401-1405.

Schunk, D. H. (1991). *Self-efficacy and academic motivation. Educational Psychologist*, 26, 207-231.

Southgate, D. E., & Roscigno, V. J. (2009). *The Impact of Music on Childhood and Adolescent Achievement*. Social Science Quarterly, 90(1), 4-21.

Van Matre, Valentine, & Cooper (2000). *Effect of Students' After-School Activities on Teachers' Academic Expectancies.* Contemporary Education Psychology 25, 167-183.

Table 1: Add Health and AHAA Multi-cohort design. Population Research Center, University of

Texas at Austin. http://www.laits.utexas.edu/ahaa/descrip/ahaarelatedaddhealth