

12TH GRADE ACADEMIC OUTCOMES ASSOCIATED WITH MIDDLE- AND
HIGH-SCHOOL MUSIC ENROLLMENT AMONG LOW-INCOME, ETHNICALLY
MINORITIZED STUDENTS

by

Alenamie Namata Alegrado
A Dissertation
Submitted to the
Graduate Faculty
of
George Mason University
in Partial Fulfillment of
The Requirements for the Degree
of
Doctor of Philosophy
Psychology

Committee:

_____ Director

_____ Department Chairperson

_____ Program Director

Date: _____ Summer Semester 2024
George Mason University
Fairfax, VA

12th Grade Academic Outcomes Associated with Middle- and High-School Music
Enrollment Among Low-Income, Ethnically Minoritized Students

A Dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy at George Mason University

by

Alenamie Namata Alegrado
Master of Arts
George Mason University, 2021
Bachelor of Science
George Mason University, 2016

Director: Adam Winsler
Department of Psychology

Summer Semester 2024
George Mason University
Fairfax, VA

Copyright © 2024 Alenamie Namata Alegrado
All Rights Reserved

DEDICATION

This dissertation is dedicated to my grandfather Feliciano Alegrado. The memory of your love, wit, and elegance will always inspire me to live, teach, and write with grace.

I also dedicate this dissertation to my family and friends who lovingly indulge my quirks and curiosities. Your kindness, patience, and support have carried me through countless challenges, heartbreak, and grief.

Without you all there would be no me. Thank you. I love you.

ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. Adam Winsler, and Drs. Thalia Goldstein and Tim Curby for supervising and challenging me in my work. Through your guidance, I have learned to seek and question connections at a level that both frightens and excites me. You have shaped me into the researcher and teacher I am today. I will carry the lessons you taught me forever.

I am so blessed to have made such heartfelt connections with my graduate student peers. Thank you for helping me navigate academia, for making me feel seen, valued, and loved. You all taught me to keep a healthy perspective on life beyond work and responsibilities. Thank you for your guidance, for helping me learn, and for the many dear conversations I will always cherish.

I could not have completed this dissertation without the unwavering support of my mom, dad, big sisters and chosen sisters. Thank you for understanding me and always allowing me space to learn and grow. My years in graduate school have also been the most adventurous years of my life and that is all because of you. I am so eager for new laptop-less adventures.

Finally, thank you to my fiancé who has stood by and celebrated every step of my research journey since I was first admitted into the honors psychology program in undergrad. Your steadiness, encouragement, derpiness, and love kept me afloat when I felt like I was drowning. You have embraced every version of me with grace and I am so grateful. Thank you for reminding me that I'm just a human bean even when I feel like a potato.

Not a single step of my journey was made on my own. My success was only possible through the grace and triumphs of my family, friends, and mentors. I could never thank you enough for your support, generosity, patience, and care. Every time I lost confidence in myself, the confidence you have in me carried me through.

My achievements are not my own, they are the culmination of everyone who has contributed to my well-being.

Thank you. We did it.

TABLE OF CONTENTS

	Page
List of Tables	vi
Abstract.....	vii
High school academic outcomes associated with middle- and high-school music enrollment among low-income, ethnically minoritized students.....	2
References.....	67

LIST OF TABLES

Table	Page
Table 1: Full sample and within-music student demographic and academic performance descriptives.....	21
Table 2: Middle (MJ) and High School (HS) Music and Other Arts Enrollment (N = 20,161)	23
Table 3: Research Question 1 - Final Step Summary	31
Table 4: Research Question 2 - Final Step Summary	47
Table 5: Research Question 3 - Final Step Summary	50

ABSTRACT

12TH GRADE ACADEMIC OUTCOMES ASSOCIATED WITH MIDDLE- AND HIGH-SCHOOL MUSIC ENROLLMENT AMONG LOW-INCOME, ETHNICALLY MINORITIZED STUDENTS

Alenamie Namata Alegrado, Ph.D.

George Mason University, 2024

Dissertation Director: Dr. Adam Winsler

Researchers have long studied the relationship between musical training and cognitive and academic outcomes using a variety of theories about why musical experiences might influence non-music outcomes. However, inconsistent findings leave some researchers questioning the existence of strong transfer effects. Because pre-existing socio-economic advantages support both academic performance and selection into music electives, it is challenging to disentangle the possible impact of music from a child's natural and/or privileged trajectory. Researchers interested in the "effects" of in-school music participation who cannot employ random assignment must understand and control for pre-existing differences between music and non-music groups using longitudinal, quasi-experimental methods to examine outcomes. This was the goal of this dissertation.

The current large-scale, 5-cohort, 14-year longitudinal study followed a large (n = 20,161) sample of mostly low-income (80% qualify for free/reduced-price lunch) and ethnically minoritized (59% Hispanic, 34% Black, 7% White/Other) students from preschool through middle and high school (6th-12th grade) in a large metropolitan, public school system. Information on student demographics, music course enrollment, and academic performance were collected from school records/transcripts, and cognitive school readiness was directly assessed at age four.

I examined the relationship between in-school ensemble music elective enrollment (i.e., band, chorus, guitar, orchestra, keyboard, general music, and music theory) and student academic outcomes in 12th grade (non-arts GPA, days absent, suspension, diploma, and high school completion). Importantly, I controlled for selection effects of music enrollment (i.e., race/ethnicity, gender, poverty, special education status, English language learner status, English proficiency, and 8th grade GPA) and enrollment in other arts electives (i.e., dance, drama, & visual arts) to better compare music to non-music students.

I used linear (overall GPA, academic GPA, days absent) and logistic (suspension, graduation) regression. The following research questions were explored: 1) After controlling for selection factors (i.e., gender, race/ethnicity, SES, disability status, early-ELL status, and 8th grade GPA) and enrollment in other arts electives in high school (9th-12th grade), are there differences in high school academic outcomes between music and non-music students? 2) Does earlier 8th grade GPA moderate the relationship between years of music enrollment (0-4 years for high school and 0-7 years for middle and high

school combined) and 12th grade academic outcomes? 3) Does breadth/dosage of music enrollment (i.e., enrollment in multiple types of music vs. staying with the same type of music) matter in predicting high school outcomes related to music participation? Results show that controlling for selection factors, music enrollment, and more years of music throughout middle and high school, were related to significantly lower odds of school suspension in 12th grade, and higher odds of earning a diploma and completing high school. Music enrollment in some models was related to slightly lower 12th grade non-arts GPA. Results were the same regardless of the student's initial 8th grade GPA. Taking multiple types of music courses in secondary school (breadth/dosage) was also related to positive 12th grade outcomes (better attendance, better school completion) both by itself and above and beyond being enrolled in music. It appears that the social experience of being in high school music electives supports positive engagement, persistence, and graduation outcomes in high school and taking multiple types of music further helps.

HIGH SCHOOL ACADEMIC OUTCOMES ASSOCIATED WITH MIDDLE- AND HIGH-SCHOOL MUSIC ENROLLMENT AMONG LOW-INCOME, ETHNICALLY MINORITIZED STUDENTS

Researchers have long studied the relationship between musical training and cognitive and academic outcomes (Corrigall & Trainor, 2011; Gardiner et al., 1996; Schellenberg, 2004; Shaw, 2022), using a variety of theories about why musical experiences might influence non-music outcomes. However, inconsistent findings leave researchers questioning the possibility of far transfer effects (Schellenberg, 2019; Winner & Cooper, 2000). Because music students tend to have pre-existing advantages in academic performance that affect selection into music electives, it is challenging to disentangle the possible impact of music on outcomes from a child's existing natural and/or privileged trajectory. Additionally, differences in type of musical experience, how musical experiences are measured, and method of analysis make it challenging to compare results across studies (Butzlaff, 2000; Draper & Bartolome, 2021; Foster & Marcus Jenkins, 2017; Jaschke et al., 2013).

Many correlational studies have reported positive associations between music and child outcomes (Barrett & Bond, 2015; Brown & Sax, 2013; Cabanac et al., 2013; Carioti et al., 2019; Corrigall & Trainor, 2011; Fasano et al., 2019; Gouzouasis et al., 2007; Helmrich, 2010; Moreno et al., 2011; Roden et al., 2014; Vaughn & Winner, 2000; Wetter et al., 2009; Williams et al., 2015). However, correlational studies are not able to infer a causal relationship between musical experience and outcomes (Foster & Jenkins, 2017; Schellenberg, 2011). Confounding variables that relate to musical experiences and

non-music outcomes may drive observed positive correlations between the two. Experimental studies have reported positive effects (Costa-Giomi, 1999; Gardiner et al., 1996; Holochwost et al., 2017; Moreno et al., 2011; Schellenberg, 2004) but sometimes no effect of music (Costa-Giomi, 1999; 2004). Although experimental designs allow for causal inference, random assignment is not always possible when examining naturally occurring groups (e.g., students who do or do not enroll in in-school music elective courses).

Longitudinal quasi-experimental studies, although not employing random assignment, allow researchers to examine naturally occurring groups (e.g., students who do or do not enroll in in-school music electives) while controlling for pre-existing group differences related to both selection into music and later academic outcomes. Quasi-experimental studies have identified a positive relationship between musical experiences and non-music outcomes (Babo, 2004; Corrigan et al., 2013; Degé et al., 2014; Fasano et al., 2019; Gouzouasis et al., 2007; Guhn et al., 2019; Helmrich, 2010; Herrero & Carriedo, 2018; Kinney, 2008, 2010, 2019; Metsäpelto & Pulkkinen, 2012; Piro & Ortiz, 2009; Roden et al., 2014; Schellenberg, 2006), but they have also suggested mixed (Roden et al., 2014; Shaw, 2022; Todhunter-Reid, 2019; Williams et al., 2015) or no association with outcomes after controlling for selection effects of music enrollment (Elpus, 2013; Foster & Marcus Jenkins, 2017).

Systematic reviews report relatively weak and inconsistent positive correlations between musical experience and child academic and cognitive outcomes (Butzlaff, 2000; Jaschke et al., 2013; Sala & Gobet, 2016). These findings cast doubt on there being

strong causal transfer effects from music to non-music child outcomes, but they certainly invite additional work to be done. Although many individual studies report positive outcomes related to musical experiences, more additional rigorous research designs and uniformity in methodology is needed to better analyze findings across studies.

Music researchers propose two main theories to explain why music may improve a child's performance in school. One theory is the idea that the combination of different executive function skills needed to produce music strengthen executive functions overall which could lead to better performance in academic classes where these same executive function skills are used (Fasano et al., 2019; Guhn et al., 2019; Helmrich, 2010; Herrero & Carriedo, 2018; Holochwost et al., 2017; Moreno et al., 2011; Piro & Ortiz, 2009; Roden et al., 2014). Another theory is that the habits of mind learned and practiced while mastering an instrument are skills and behaviors that are also productive in academic classes (Corrigall et al., 2013; Freer, 2009; Guhn et al., 2019; Hogan & Winner, 2019; Metsäpelto & Pulkkinen, 2012). Both theories suggest far transfer from music training to academic performance might occur. There is more research on the connection between music and executive function skills than habits of mind. However, because the literature on music training and academic outcomes is mixed, doubt is cast on both theories.

Habits of mind are styles of thinking and behaving used to face challenges that have been studied in many different academic domains (i.e., math, science, special education, and visual arts electives) (Hogan & Winner, 2019). It is a framework individuals use to solve problems. Habits of mind tap into discipline (Fasano et al., 2019; Guhn et al., 2019), self-efficacy (Guhn et al., 2019; Metsäpelto & Pulkkinen, 2012),

perseverance (Corrigan & Trainor, 2011; Metsäpelto & Pulkkinen, 2012), cooperation, responsibility (Fasano et al., 2019), mastery orientation (Guhn et al., 2019), motivational and attitudinal changes, bonding, stress reduction (Metsäpelto & Pulkkinen, 2012), and attentional skills (Corrigan & Trainor, 2011). Students learn these methods of thinking and behaving to tackle challenges in school (e.g., mastering a piece or mastering algebra) that then guide their thoughts and behaviors to tackle challenges outside of school (e.g., learning how to change a flat tire).

Researchers have observed eight habits of mind taught and practiced in music electives (Hogan & Winner, 2019) including: evaluate (e.g. tuning a guitar by ear), express (e.g. playing lively during allegro passages), imagine (e.g. picturing tiptoeing when playing pianissimo), listen (e.g. awareness of sound balance in an ensemble), notice (e.g. awareness of bow directions), participate in community (e.g. forming a group to practice together), persist (e.g. mastering a difficult passage), and set goals and be prepared (e.g. practicing for a concert performance). These habits of mind are also practiced in academic classes: evaluate (e.g. fixing grammatical errors), express (e.g. discussing an appropriate interpretation of a poem), imagine (e.g. making a hypothesis for an experiment), listen (e.g. judging arguments in a debate), notice (e.g. focusing on personal and peer expressions when communicating), participate in community (e.g. forming a study group), persist (e.g. committing to solve difficult math problems), and set goals and be prepared (e.g. creating a project timeline and acquiring the resources to complete the project). The practice of habits of mind in music electives train skills that are also vital to academic success.

Studies on the effect of music in early childhood report improvements in children's attention regulation, prosocial and emotion skills, and verbal intelligence (Brown & Sax, 2013; Gardiner et al., 1996; Moreno et al., 2011; Williams et al., 2015). Children with more musical experience show greater growth in prosocial and attention regulation skills (Williams et al., 2015). These skills are essential for children to develop the self-regulation skills needed to become efficient learners. Early and frequent musical experiences give children more time and opportunities to practice these developing skills.

Timing, duration, and child age/developmental context all contribute to how musical experiences may impact child outcomes. Young children are in early stages of their cognitive development. A musical experience during this time acts as an intentional method to train skills that are coming online. Studies on the effect of music in early childhood report improvements in children's attention regulation, prosocial and emotion skills, and verbal intelligence (Brown & Sax, 2013; Gardiner et al., 1996; Moreno et al., 2011; Williams et al., 2015). Children with more frequent musical experience show greater growth in prosocial and attention regulation skills (Williams et al., 2015). These skills are essential for children to develop the self-regulation skills needed to become efficient learners. Early and frequent musical experiences give children more time and opportunities to practice these developing skills.

Research on children between 6 to 11 years old show a similar pattern of performance for children who have musical experiences compared to children who do not. Musically trained children showed greater auditory processing skills and better ability to update and filter information which are needed for learning across domains

(Herrero & Carriedo, 2018; Roden et al., 2014). Children with longer training or participation in musical activities showed greater gains in reading comprehension (Corrigall & Trainor, 2011) and academic performance (Metsäpelto & Pulkkinen, 2012). Children who participated in arts and music activities for two to three years showed better academic attainments and working skills compared to children who did not and those who only participated for one year (Metsäpelto & Pulkkinen, 2012). Musical activities provide opportunities for children to practice more advanced self-regulation skills. Children who engage in frequent musical experiences or stay engaged in musical activities over a long period of time seem to experience the greatest gains (Corrigall & Trainor, 2011; Guhn et al., 2019; Metsäpelto & Pulkkinen, 2012; Shaw, 2022; Williams et al., 2014). Considering these findings, it is interesting to consider how music participation in later childhood and adolescence may relate to academic outcomes.

Music is a means to practice executive function skills in early childhood that relate to skills needed to become an efficient learner (Corrigall & Trainor, 2011). These executive functions may have far transfer effects on academic skills because they improve a child's ability to self-regulate, process information, concentrate, and filter distractions (Herrero & Carriedo, 2018; Roden et al., 2014). When children transition into middle school they enter a period of early adolescent synaptogenesis. This is a developmentally sensitive period for cognitive and social development (Helmrich, 2010; Herrero & Carriedo, 2018; Wang & Eccles, 2012) and may shift the way students engage with musical experiences, specifically music elective experiences.

Extra-curricular activities (ECAs) contribute to school climate and offer more opportunities for students to feel respected and included in schools (Finn, 1989). Social integration and engagement are important pathways when considering dropout prevention (Catterall, 1998; Finn, 1989). Although linking ECAs to dropout is rare, researchers have found that consistent ECA involvement was related to lower odds of dropout (Thouin et al., 2022). Social support found in ECAs helps students deal with stress, but if their peers are not engaged in school, they have a higher risk of dropping out. ECAs that provide social support and positive academic attitudes may reduce student dropout. We see that students with higher GPAs are more likely to enroll in music electives, so there is a significant presence of students in music classes who value and can support academic achievement.

Theoretical Connection Between Music Electives and Academic Outcomes

I propose that there are three major mechanisms through which music electives might influence academic performance – executive function, social bonding, and habits of mind. Interest in music attracts students to music electives where relevant academic behaviors are often practiced. Music electives provide a space where students grow in their musical ability and may contribute to their overall academic experience. The experience of music learning within the context of music electives is a powerful combination. Executive function, social bonds, and habits of mind are all engaged during music making and this combination of mechanisms may improve both musicianship and academic performance. Individual growth in executive function, enhanced social bonds, and practice in habits of mind may contribute to, strengthen, and reinforce each other.

Therefore, it is not only musical experience that might influence academic performance, but the entirety of the music elective experience.

Learning how to play an instrument requires executive function skills for gaining physical and mental mastery of an instrument and for establishing habits of mind that drive the learning process. These executive function skills and habits of mind are valuable characteristics that contribute to a student's overall academic performance. Music students gain mastery in their musicianship because of consistent use of productive mindsets and behaviors they learned and practice for years. These fundamental skills and behaviors for playing an instrument are learned in earlier years of music training and practiced in subsequent years of enrollment. Therefore, once these skills are established, students need only maintain these behaviors to keep up their academic performance. The duration of student enrollment in a music elective influences the level of impact musical electives provide (Shaw, 2022). One year of exposure may not be enough to see academic benefits in middle school when students first begin their lessons (Carioti et al., 2019), but students who sustain music enrollment through high school report higher sense of belonging and better academic outcomes than their non-musical peers (Shaw, 2022).

Typically, high school students are refining the skills and techniques they learned in their middle school music ensemble. Therefore, much of the learning and training of behavior and social bonds influenced by music electives began in middle school. Each year a student is enrolled in a music elective, they are exercising their self-regulation skills and reinforcing productive habits of mind. We may not find as much change or growth over time for outcomes of high school music electives because music students

have been practicing the same skills and behaviors in school that they learned years before such as in middle school.

Additionally, music electives are a setting for students to bond over a shared interest, build relationships, and support each other inside and outside the music room (Adderley et al., 2003; Bartolome, 2013; Morrison, 2001; Parker, 2014; Sachs et al., 2021). Piaget and Vygotsky recognized that social interaction is key for learning (Helmrich, 2010), and high school students learn with their friends and, perhaps more importantly, from their friends in school. Considering Bronfenbrenner's bio-ecological model, music learning is a proximal process and music electives reside in the child's microsystem (Bronfenbrenner & Morris, 2006; Guhn et al., 2019). Adolescent social groups influence behavioral, emotional, and cognitive engagement (Wang & Eccles, 2012) as well as motivation and attitudes toward school (Metsäpelto & Pulkkinen, 2012).

Enrollment in music electives may be particularly beneficial for students who are disengaged academically because they offer an alternative method to participate in school. Enrollment in multiple types of music electives allow students to expand their musical interests and increase their social connections with like-minded peers which allows them to formulate a self-image in-school separate from academics. Although we may not find a strong connection between participation in ECAs to grades, they may encourage school perseverance (Thouin et al., 2022) and resilience (Catterall, 1998) which are also important academic outcomes.

Middle school music electives are the first music training opportunity many students have that demand little to no prior musical experience to receive music

education (McNeal, 1998). Therefore, when considering the relationship between music elective enrollment and high school academic outcomes, it is important to consider these earlier years of experience. Music students are expected to grow in skill and technique with each year of enrollment. For example, students who enroll in a high school intermediate orchestra class are expected to be prepared to further develop their music skills beyond the standard of middle school orchestra (State of Nevada Academic Standards for Music, 2018). Therefore, entry into high-school music electives without previous middle school enrollment is more difficult and uncommon for some music types. If researchers want to understand how music electives relate to students' overall academic experience, it is important to consider whether music enrollment, that begins in middle school and may last through high school, relates to high school student academic performance.

Social connections are formed and shaped by the activities in which students participate (Helmrich, 2010). These social bonds influence what experiences a child has and what they learn in school. Some students choose to enroll in music electives as an expression of their interests, personality (Herrero & Carriedo, 2018), gender identity (Metsäpelto & Pulkkinen, 2012), and interests (Seifried, 2012). Music classes are a place where students of varying academic abilities can mingle outside of academic tracks because of a shared interest. The culture of music electives is likely influenced by the students it attracts (Morrison, 2001; Seifried, 2012). Academic achievement is a predictor of music enrollment, particularly for instrumental music electives (Alegrado & Winsler, 2020; Elpus,

2013; Kinney, 2019). If high-academically-achieving students are more likely to enroll in a music class, then music electives may become environments that value and foster academic achievement.

The decision to enroll in a music elective shapes what social connections students will make. An adolescent's social group influences their behavioral, emotional, and cognitive engagement in (Wang & Eccles, 2012), and their motivational and attitudinal perspective of, school (Metsäpelto & Pulkkinen, 2012). Members of the same music ensemble influence each other's academic identities, values, and experiences. High cognitive skills and academic achievement are predictors of middle school music enrollment (Alegrado & Winsler, 2020). Therefore, music ensembles are a social context that can positively influence a student's academic career by fostering social bonds with high academic performers. The quality of the social bonds and sense of belonging to the music ensemble can reinforce or diminish the influence peers have on each other.

It is important to consider possible enrollment in other arts electives when examining the influence of music enrollment on academic outcomes. Similar to music, dance, drama, and visual arts classes all engage executive function, habits of mind, and social bonding. Therefore, we may expect that all arts forms have a connection to academic performance. However, there is variation in specific skills trained and valued across arts electives which may relate to differences in the relationship between art types and academic performance. If we control for participation in other arts electives, we account for the possibility that non-music students are practicing and gaining similar skills as music students. If music enrollment continues to provide an academic advantage

after enrollment in other arts is in the model, this suggests an academic advantage unique to music rather than an overall arts effect.

We know that selection into music courses is systematic - students who are more advantaged economically and academically early on are more likely to enroll in music electives (Alegrado & Winsler, 2020; Elpus, 2013; Elpus & Abril, 2011; Foster & Marcus Jenkins, 2017; Kinney, 2019). In my previous work, I found that after controlling for demographic (race/ethnicity, gender, poverty, special education status, English language learner status, English proficiency), and early skills (age-4 motor, cognitive, language, and social/behavioral skills), prior academic skills in middle school (5th grade GPA and test scores) were related to greater odds of enrolling in music electives (band, chorus, guitar, and orchestra) in middle school (Alegrado & Winsler, 2020). Because these pre-existing advantages already support academic progress in school, it is important to examine whether the possible effects of music enrollment are stronger among initially less-advantaged students. Thus, researchers interested in the “effects” of in-school music participation who cannot employ random assignment must understand and control for pre-existing differences between music and non-music groups using longitudinal, quasi-experimental methods to examine outcomes. This is precisely what I will do in my dissertation.

Previous Work

In my previous work, I explored predictors of middle school music enrollment, predictors of quitting music in 7th grade, and academic outcomes

related to middle school music enrollment. We found that only 20% of students took a music elective in middle school. Gender, ethnicity, poverty, special education, early-ELL status, 5th grade English proficiency, prior academic performance (5th grade GPA, standardized math and reading test scores) and initial school readiness skills (social, behavioral, cognitive, language, and motor skills) at age four were significant predictors of middle school music enrollment (Alegrado & Winsler, 2020). This is consistent with previous literature that found selection effects related to middle school music electives (Elpus, 2013; Kinney 2019). We also found that approximately half (53%) of 6th grade students who enrolled in a music elective did not continue enrollment in 7th grade. Being male and greater 5th grade GPA and reading scores were related to lower odds of quitting music (Alegrado & Winsler, in review). In my next study, significant predictors of enrollment and enrollment in other arts electives were included as covariates when exploring differences in academic outcomes between music and non-music middle school students (Alegrado & Winsler, in review). I found that higher GPA, math and reading test scores, fewer days absent, and lower odds of suspension in 8th grade were related to middle school music enrollment. I also found that more years of enrollment were related to better academic outcomes and that initial academic performance moderated the effect of years of enrollment (stronger effects of music for those initially lower in 5th-grade GPA). In addition to exploring factors and academic outcomes related to music enrollment broadly, I found variance in the strength of connection between enrollment and academic outcomes for individual music electives (band, chorus, guitar, orchestra, and keyboard). Enrollment was related to greater 8th grade GPA for chorus, guitar, and

orchestra; greater 8th grade reading scores for band, chorus, guitar, and orchestra; greater 8th grade math scores for band, guitar, and orchestra; fewer days absent in 8th grade for band and orchestra; and lower odds of suspension in 8th grade for band. We did not find a connection between keyboard course enrollment and 8th-grade academic outcomes.

The Current Study

This dissertation expands upon my master's thesis in three main ways: 1) I am expanding my dataset to include middle and high school enrollment and academic performance. 2) I assess 12th grade academic outcomes (rather than 8th grade). 3) I measure the influence of breadth/dosage of music enrollment. This project makes multiple contributions to the literature. I examine whether there is a broad connection between music enrollment (yes/no) and academic outcomes, if the number of years enrolled influences outcomes, and whether early academic performance moderates the influence of years of music enrollment on academic outcomes. Importantly, when assessing student GPA, I consider academic performance not including performance in music/arts and non-academic course grades. Exclusively examining academic course grades allows me to assess how students are performing academically removing the possibility that less academically rigorous electives (such as music and the arts) inflate overall GPA. The large longitudinal dataset I am using is composed of low-income and predominantly racially/ethnically minoritized students. My sample provides valuable information on students who are typically underrepresented in research and allows me to compare historically minoritized groups to each other rather than to a White majority

group. I include selection effects of music enrollment as covariates (i.e., race/ethnicity, gender, poverty, special education status, English language learner status, English proficiency, age-4 cognitive skills, 5th grade GPA) when exploring the relationship between academic performance and music enrollment to more fairly compare music and non-music students. I also account for the impact of enrolling in other arts electives (i.e., dance, drama, visual arts) that are often thought to similarly boost academic skills (Batdi & Batdi, 2015; Gara & Winsler, 2019; Sheridan, 2011). Further, I take into account previous music enrollment in middle school when exploring specifically high school music enrollment and academic outcomes. Finally, I explore whether enrollment in one or multiple types of music electives differentially relates to academic outcomes.

It is possible that it takes a certain number of years for students to learn, practice, and reinforce these skills and behaviors before one can observe a robust connection between music enrollment and academic outcomes. Because I am interested in cumulative years of music enrollment, I examine academic performance at the end of high school in 12th grade. I am interested in student course performance (i.e., overall GPA, academic GPA), engagement in school (i.e., days absent, suspension), and whether they eventually go on to graduate.

Beyond considering differences in academic performance based on years of music enrollment, I consider breadth/dosage of music enrollment. A measure on diversity of music enrollment allows me to explore if dedication and focus on a single type of music elective or diverse engagement across music types in high school are differentially related to academic outcomes. By exploring diversity of enrollment, we can understand if there

is a relationship between enrollment and academic outcomes that suggests it is more academically productive to enroll in multiple years of just one or multiple types of music electives.

It is unclear whether diversity of music enrollment would relate to better academic outcomes compared to dedication to a single type of music elective in high school. Diversity of enrollment may be positively related to 12th grade GPA if it signifies high interest and engagement with music practices that support academic performance. Diverse music enrollment allows students to apply their executive function skills and productive habits of mind to multiple domains which demands flexibility of these skills and behaviors and engagement with a wider group of peers. However, diversity of enrollment may be negatively related to GPA if it signifies interests and priorities outside of academic courses and less intense musical skill development.

In addition to GPA, graduating high school is a significant academic outcome. Researchers have found that poor academics and lack of social engagement in school are related to dropout (Finn, 1989), but there is a lot of mobility into and out of performance-based risk related to dropout (Catterall, 1998). If students do not have a strong academic self-image, then they may develop negative attitudes towards and disengage from school (Hess & Copeland, 2001). Perhaps breadth/dosage of music enrollment is most beneficial to students who are disengaged academically but feel connected to school through their music electives. Positive experiences in music electives may motivate students to avoid missing school (e.g., absences, suspension) and continuous enrollment may be protective against dropout (Thouin et al., 2022). The following research questions were explored:

1) After controlling for selection factors (i.e., gender, race/ethnicity, SES, disability status, early-ELL status, age 4 cognitive skills, and 8th grade GPA) and enrollment in other arts electives in high school (9th-12th grade), are there differences in high school academic outcomes (i.e., 12th grade overall GPA, academic GPA, days absent, suspension, & graduation rates) between high school music and non-music students? 2) Does earlier 8th grade GPA moderate the relationship between years of music enrollment (0-4 years for high school and 0-7 years for middle and high school combined) and 12th grade academic outcomes? 3) Does breadth/dosage of music enrollment (i.e., enrollment in multiple types of music vs. staying with the same type of music) matter in predicting high school outcomes related to music participation?

Method

Participants

Participants of this study are children from the Miami School Readiness Project (MSRP; Winsler et al., 2008), a large-scale, prospective longitudinal study that followed five cohorts of children who attended either community-based childcare with subsidies or public-school pre-K programs at age four between the 2002-2007 in Miami Florida. I examined middle and high school enrollment data between the 2009-2010 and the 2019-2020 academic years, giving us complete on-time middle and high school grade progression data (grades 6 through 12) across all five of our cohorts. The sample consisted of 20,161 students who had complete end-of-year grades from 6th through 12th grade and did not repeat or skip a grade between 6th through 11th grade. If a student was retained or skipped a grade in elementary school, but did not skip or repeat a grade in middle or high

school, they were eligible to be in the sample. If a student repeated 12th grade, they were included but academic outcomes were taken from their first attempt at 12th grade. This inclusion criteria were particularly important for capturing years of enrollment but particularly breadth of music enrollment to ensure students had the same years of opportunity to enroll in music courses.

There were 23,744 students who had 12th grade academic outcome data in the MSRP. Due to my inclusion criteria, I lost 3,583 students who either repeated a grade in middle or high school or did not have complete end-of-year data between 6th and 12th grade. Students who were excluded from my final sample were statistically different from those who were in the sample for all five 12th grade academic outcomes (non-arts GPA ($t(4,664) = 11.03, p < .001$), absences ($t(4,167) = -16.88, p < .001$), suspension ($\chi^2(1, N = 23,744) = 7.27, p < .01$), diploma ($\chi^2(1, N = 23,744) = 457.04, p < .001$), complete high school ($\chi^2(1, N = 23,744) = 268.89, p < .001$)), and for music enrollment across middle and high school (Y/N) ($\chi^2(1, N = 23,744) = 80.36, p < .001$). Students who did not meet the inclusion criteria and were therefore excluded from my final analyses had significantly lower 12th grade non-arts GPA ($M = 2.93; SD = .68$) and more days absent ($M = 21.62; SD = 19.82$) than students in my final sample (non-arts GPA: $M = 3.06; SD = .61$; absences: $M = 21.62; SD = 19.82$). Students excluded from the final sample had higher rates of suspension (excluded = 6%; included = 5%), lower rates of earning a diploma (excluded = 85%; included = 95%), lower rates of completing high school (excluded = 90%; included = 97%), and lower rates of music enrollment across middle and high school (excluded = 37%; included = 45%).

It is important to note that due to my inclusion criteria, the lower range of performance on 12th grade academic outcomes was missing. Additionally, the MSRP is a longitudinal dataset that is subject to attrition related to higher academic performance – high academic performing students are more likely to leave the Miami-Dade county public school system which results in termination from the study. Therefore the upper range of performance on 12th grade academic outcomes was also likely restricted/not included. These limitations on the lower and upper range of academic performance are important to keep in mind when interpreting the results of this study.

Procedure

School system student records were collected for each child from K through 12th grade. Administrative school records of student demographic information (e.g., student gender, ethnicity) were collected with consent, and with appropriate de-identification procedures as approved by the institutions' IRB procedures. Table 1 shows descriptive demographic and academic performance information for the full sample and for students who enrolled in a music elective at least once between 6th and 12th grade.

Table 1: Full sample and within-music student demographic and academic performance descriptives

	Total sample		Enrolled in MJ/HS						
	N = 20,161		N = 9,156						
	<i>n</i>	%	<i>n</i>	%					
Selection Factors									
<i>Gender</i>	Missing : <i>n</i> = 0		Missing : <i>n</i> = 0						
Female	9,833	48.80%	4,629	50.6%					
Male	10,328	51.20%	4,527	49.4%					
<i>Race/Ethnicity</i>	Missing : <i>n</i> = 0		Missing : <i>n</i> = 0						
Hispanic/Latino	12,947	64.20%	5,679	62.0%					
Black	5,875	29.10%	2,901	31.7%					
White/Other	1,339	6.60%	576	6.3%					
<i>FRPL Status</i>	Missing : <i>n</i> = 12		Missing : <i>n</i> = 5						
No FRL	4,125	20.50%	1,834	20.0%					
Reduced-Priced Lunch	1,849	9.20%	845	9.2%					
Free Lunch	14,175	70.30%	6,472	70.7%					
<i>Disability Status</i>	Missing : <i>n</i> = 0		Missing : <i>n</i> = 0						
None	17,887	88.70%	8,239	90.0%					
Has disability	2,274	11.30%	917	10.0%					
<i>ELL Status</i>	Missing : <i>n</i> = 2		Missing : <i>n</i> = 1						
Not ELL	7,714	38.30%	3,603	39.4%					
ELL	12,445	61.70%	5,552	60.6%					
Outcomes									
<i>Suspension</i>	Missing : <i>n</i> = 0		Missing : <i>n</i> = 0						
Not Suspended	19,178	95.10%	8,762	95.7%					
Suspended	983	4.90%	394	4.3%					
<i>Diploma</i>	Missing : <i>n</i> = 0		Missing : <i>n</i> = 0						
No Diploma	1,118	5.50%	466	5.1%					
Received Diploma	19,043	94.50%	8,690	94.9%					
<i>HS Complete</i>	Missing : <i>n</i> = 0		Missing : <i>n</i> = 0						
Did not complete	701	3.50%	301	3.3%					
Completed	19,460	96.50%	8,855	96.7%					
	Full Sample		Not Enrolled in HS Music		Enrolled in HS Music			Cohen's <i>d</i>	
	<i>M</i>	(<i>SD</i>)	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>		<i>SD</i>
Selection Factors	Missing : <i>n</i> = 0								
<i>8th Grade GPA</i>	2.94	(-0.62)	14,759	2.97	(-0.62)	5,402	2.86	(0.62)	0.17
Outcomes	Missing : <i>n</i> = 0								
<i>Non-Arts GPA</i>	3.06	(-0.61)	14,759	3.09	(0.60)	5,402	2.98	(0.62)	-0.17
<i>Days Absent</i>	Missing : <i>n</i> = 34								
	15.81	(13.24)	14,735	15.68	(12.97)	5,392	16.17	(13.95)	0.04

Measures

Music and Other Arts Enrollment. Administrative data collected each year on each student for 6th-12th grade included all course subjects taken and appearing on the end-of-year transcript (e.g., math, social studies, science, band). In-school arts electives (i.e., dance, drama, visual arts, music) are course options students elect to take. Using whether a child's transcript included an arts elective in a given grade, I created the following variables denoting when (i.e., the grade the arts elective appeared on the student's transcript), whether (i.e., Y/N - if the student transcript included an arts elective), and which music (i.e., band, chorus, guitar, orchestra, keyboard, theory, general music) or other arts electives (dance, drama, visual arts) students took in middle and high school. In order to ensure students were present enough in school to receive music instruction, I only included students who attended school for at least half the academic year (> 90 days out of the 180 school days). No 6th -9th grade music students were affected by this criteria. There were two 10th grade, three 11th grade, and three 12th grade students enrolled in a music elective that were not present for more than half the academic year. Table 2 shows descriptive enrollment information for music enrollment in middle and high school and other arts elective enrollment in high school. The table displays middle through high school music enrollment, high school music enrollment, high school other arts enrollment, and middle school music enrollment. The proportion of students who ever enrolled in music and the number of years of enrollment is included in the table.

Table 2: Middle (MJ) and High School (HS) Music and Other Arts Enrollment (N = 20,161)

	MJHS Music		HS Music		HS Other Arts		MJ Music	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
<i>Ever Enrolled</i>	9,156	45.4%	5,402	26.8%	12,245	60.7%	5,837	29.0%
<i>Years Enrolled</i>								
1	4,633	50.6%	3,362	62.2%	6,873	56.1%	3,343	57.3%
2	2,108	23.0%	1,057	19.6%	3,360	27.4%	1,388	23.8%
3	1,318	14.4%	504	9.3%	1,431	11.7%	1,106	18.9%
4	495	5.4%	479	8.9%	581	4.7%		
5	237	2.6%						
6	182	2.0%						
7	183	2.0%						
<i>Types of Music Enrolled</i>								
1	6,561	71.7%	4,104	76.0%				
2	1,989	21.7%	1,004	18.6%				
3	494	5.4%	232	4.3%				
4	92	1.0%	54	1.0%				
5	17	0.2%	7	0.1%				
6	3	0.0%	1	0.0%				
7	0	0.0%	0	0.0%				
<i>Music Breadth</i>								
	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>(SD)</i>				
<i>Full Sample</i>								
MJHS	0	14	0.99	(1.63)				
HS	0	11	0.51	(1.14)				
<i>W/i Music Students</i>								
MJHS	1	14	2.61	(2.14)				
HS	1	11	1.89	(1.49)				

Middle School Music. I created variables denoting when, whether, and which music courses (i.e., band, chorus, guitar, orchestra, keyboard, general music, music theory) students enrolled in middle school. These grade-level enrollment variables were aggregated across all middle school grades (6th, 7th, and 8th) to make a total years of music enrollment in middle school variable (0-3 years). Nearly one-third ($n = 5,837$) of the sample enrolled in a middle school music elective. Within students who took a music class in middle school, 57% enrolled for one year, 24% enrolled for two years, and nearly 19% enrolled for three years.

High School Music. Similar to middle school, I created grade-level variables denoting when, whether, and which music courses (band, chorus, guitar, orchestra) students enrolled in high school. These variables were aggregated across all high school grades (9th, 10th, 11th, and 12th) to make a total years of music enrollment in high school variable (0-4 years). I also created a variable that denotes whether a student ever enrolled in a music elective in high school (Y/N). Nearly one-third ($n = 5,402$) of the sample enrolled in a high school music elective. Within students who took a music class in high school, 62% enrolled for one year, 20% enrolled for two years, 9% enrolled for three years, and 9% enrolled for four years.

Middle and High School. Using the middle school and high school grade-level enrollment variables, I created a variable that captures total grades a student enrolled in music electives (i.e., band, chorus, guitar, orchestra, keyboard, general music, music theory) from 6th through 12th grade (0-7 years). Slightly less than half of students (45%; $n = 9,156$) enrolled in a music class in middle and/or high school. Half of students who

enrolled in a music class only enrolled for one year, 23% enrolled for two years, 14% enrolled for three years, 5% enrolled for four years, 3% enrolled for five years, 2% enrolled for six years, and 2% enrolled for seven years.

High School Other Arts. Similar to the music enrollment variables, I created variables denoting when, whether, and which other arts electives (dance, drama, visual arts) students enrolled in high school. These variables were aggregated across all high school grades (9th, 10th, 11th, and 12th) to make a total years of other arts enrollment in high school variable (0-4 years). I also created a variable that denotes if a student ever enrolled in non-music arts elective in high school (Y/N). Two-thirds of students enrolled in a non-music arts elective in high school, and of those, 56% of students were enrolled for one year, 27% were enrolled for two years, 12% were enrolled for three years, and 5% were enrolled for four years.

Breadth of Music. I created a continuous breadth/dosage measure of music enrollment that summed the total music types taken per year (e.g., a student who enrolled in band for four years would receive a “4” and a student who enrolled in chorus, guitar, orchestra, and keyboard for one year also received a “4”). Band, chorus, guitar, orchestra, keyboard, general music, and music theory were all included in the breadth of music variable. Theoretically, a student who enrolled in every music elective in every grade would have a 28 for high school breadth and a 49 for middle through high school breadth. In reality, the range of high school breadth was 0-11 and the range of middle through high school breadth was 0-14.

Child-Level Predictors.

Gender. Males were coded as ‘0’ and females were given a ‘1’ using school record data. Our sample was almost evenly split between female (49% female; 51% male).

Race/Ethnicity. Child race/ethnicity was collected by the school district and coded into four categories: “Hispanic” (includes individuals who identified as Hispanic/Latino; “Black” includes individuals who identified as African American/Black/Caribbean, or Black and some other racial group; “Other” includes individuals who identified as White or a mixture of other racial groups, and “Asian/Pacific Islander.” More than half of our sample was Hispanic/Latino (64%), a third (29%) of our sample was Black, and 7% of our sample was categorized as Other.

Poverty Status. Children’s poverty status is based on student eligibility for free or reduced lunch (FRL) in 9th grade. Eligibility is determined at the beginning of the year by the family meal application completed by the child’s primary caregiver. Children 130% of the federal poverty line qualify for free lunch, and those who are 185% of the poverty line qualify for reduced-price lunch. One-fifth of students did not receive free- or reduced-price lunch, 9% of students received reduced-priced lunch, and 70% of students received free lunch.

Special Education Status. Special education status in 9th grade was collected from administrative records in the form of the student’s primary exceptionality code. Students who had a code in 9th grade received a ‘1’ for special education, and others received a ‘0.’ Disability types included: intellectual disability, speech/language disorder, or visually impaired, deaf or hard of hearing, specific learning disabled, dual-sensory

impaired, autistic, emotionally disabled, traumatic brain injured, or other health impaired. Only 10% of students received a disability code.

ELL Status in Kindergarten. English language learner status was determined by schools at kindergarten entry from parent-reported home language use. Those who reported speaking another language at home were considered ELLs in kindergarten by the school system. Students identified as early-ELL were received a '1' and students not identified as early-ELL received a '0.' Because the students are now in high school, and ELL status was determined at school entry in kindergarten of 1st grade, this variable is really a former ELL status (now bilingual) indicator as all students by the time they get to 9th grade are proficient in English. Two-thirds of the sample were coded as ELL students.

8th Grade Grade Point Average (GPA). GPA was calculated using end-of-year grades for a given grade across all subjects. Grades were based on a 5-point, A-F scale, where grades were based on a 5-point, A-F scale, where 4.0 = A, 3.0 = B, 2.0 = C, 1.0 = D, and 0.0 = F.

Academic Outcomes.

Consistent with the structure of my thesis, where I explored end of middle school (8th grade) academic outcomes, I explored end of high school (12th grade) academic outcomes. I analyzed data related to music elective enrollment between 6th and 12th grade and 12th grade academic outcomes.

12th Grade Non-Arts Grade Point Average (GPA). 12th grade GPA was calculated using end-of-year grades in 12th grade across all subjects excluding all arts electives (e.g., ballet, drawing, theatre, orchestra). Math (e.g., calculus, geometry,

statistics, trigonometry), science and technology (e.g., aerospace engineering, biology, physics, robotic systems) English (e.g., classical literature, creative writing, English, journalism), humanities (e.g., anthropology, global studies, U.S. history, sociology), foreign language (American sign language, German, Greek, Japanese) and non-academic (e.g., agriculture, cosmetology, physical therapy, weightlifting) course grades were included. Grades were based on a 5-point, A-F scale, where 4.0 = A, 3.0 = B, 2.0 = C, 1.0 = D, and 0.0 = F. This non-arts GPA measure provided a clearer picture of how students are performing in school outside of their arts classrooms. It is worth noting that the GPA variable used here does not take into account advanced courses that might be weighted differently, so this GPA measure is not the same as the student's official GPA at graduation. Students in weighted courses may earn equal or lower end-of-year course grades than students in non-weighted courses but may have completed more rigorous course work at a higher caliber of performance that is not captured in this measure. Also, this GPA is not cumulative – it is just 12th grade non-academic GPA.

12th Grade Days Absent. We received administrative records of student attendance each academic year. Teachers report child attendance, absences, and unexcused absences to school administration. Our attendance measure represents the total of student excused and unexcused absences. 12th grade attendance data was used to calculate the total number of days missed.

12th Grade Suspension. We received administrative records of student in- and out-of-school suspension each academic year. A student is flagged as suspended if they receive one or more suspensions within a given year. I used 12th grade suspension data to

flag students as ever having been suspended ('0' = never suspended and '1' = suspended) in 12th grade.

12th Grade High School Completion. We received administrative records of student graduation data each academic year. At the end of the student's first attempt at 12th grade, students are designated a graduation code and type. If a student received a graduation code or type that indicated they earned a diploma or certificate of completion, they were coded as '1' completed high school. Students who finished 12th grade with a record of end-of-course grades but did not receive a graduation completion code were coded as '0' for having not completed high school.

12th Grade High School Diploma. The 12th grade high school diploma variable is a stricter version of the 12th grade high school completion variable. Students who received a graduation completion code and type that did not explicitly include a diploma were coded as a '0' for high school diploma.

Results

Research Question 1

I used a series of multivariate linear and logistic regression models to explore whether music enrollment (HS Y/N, HS 0-4 years, HS 1-4 years, MJHS 0-7 years, MJHS 1-7 years) was related to academic outcomes (12th grade: non-arts GPA, absences, suspension, diploma, high school completion) after controlling for selection factors related to music enrollment (gender, race/ethnicity, FRPL status, disability status, early-ELL status, 8th grade GPA). Step 1 covariates included selection factors and music

enrollment. Enrollment in other arts electives in high school was entered in step 2. When exploring high school music enrollment (9th-12th grade), middle school music enrollment was entered in step 2a and high school other arts enrollment was entered in step 2b to examine the impact of the covariates on the model separately. Middle school music and high school other arts enrollment were examined together in step 3 of the high school music enrollment models. When exploring enrollment across middle and high school, middle school music enrollment was not included as a covariate because it was accounted for in the enrollment measure.

Continuous outcomes (i.e., non-arts GPA, days absent) were explored using linear regression and dichotomous outcomes (i.e., suspension, diploma, high school completion) were explored using logistic regression. Table 3 summarizes the final step in the regression results for the five academic outcomes and the five corresponding regression models used to explore music enrollment measures. The selection factor covariates listed in the table relate specifically to model 1 regression analyses that examined HS Y/N music enrollment. The pattern of significance for selection and enrollment covariates did not change much across models. To analyze the third ethnicity contrast (Other/Black) and the third lunch status contrast (no FRPL/Reduced PL) I ran another regression model flipping the reference group from Hispanic to Black students and Free PL to Reduced PL status. I will first give a detailed description of my analysis strategy and the results for model 1 analyses for the first academic outcome – non-arts GPA, then provide a brief description of results for models 2, 3, 4, and 5. Because of the large sample size and the large number of models run, I used a more conservative alpha level at $p < .01$ level.

Table 3: Research Question 1 - Final Step Summary

	Non-Arts GPA		Days Absent		Suspension		Diploma		HS Complete	
	Final Step		Final Step		Final Step		Final Step		Final Step	
	<i>B</i>	<i>(SE)</i>	<i>B</i>	<i>(SE)</i>	<i>OR</i>	<i>(SE)</i>	<i>OR</i>	<i>(SE)</i>	<i>OR</i>	<i>(SE)</i>
<i>Selection Factors (Model 1)</i>										
Female/Male	.141***	.008	2.358***	.185	.609***	.070	1.192**	.067	1.344***	.083
Black/Hispanic	.008	.011	-2.094***	.262	.396***	.108	.937	.091	.958	.112
Other/Hispanic	.031	.016	.544	.392	.989	.145	1.009	.167	1.092	.208
Other/Black	.023	.017	2.663***	.409	2.497***	.159	1.077	.166	1.14	.208
No FRPL/Reduced PL	.021	.015	.897	.358	.666**	.128	1.012	.162	1.153	.194
No FRPL/Free PL	.058***	.010	-2.146***	.239	1.501**	.128	.989	.162	.867	.194
Reduced PL/Free PL	.038**	.013	-3.06***	.316	1.156	.095	.675***	.104	.653**	.130
Special Education Status	.022	.012	-.999**	.287	.820	.103	.491***	.080	.483***	.095
ELL Status	.028**	.010	-.668**	.239	.970	.090	1.223	.087	1.137	.107
8th Grade GPA	.420***	.007	-5.845***	.155	.462***	.054	4.042***	.053	3.305***	.063
<i>Enrollment Covariates per Model</i>										
Model 1: HS Y/N										
<i>High School Music</i>	-.052***	.009	.016	.205	.750***	.080	1.305***	.074	1.327**	.092
Middle School Music	-.027**	.008	.168**	.200	.964	.075	1.072	.075	.954	.090
High School Other Arts	-.036***	.008	.507	.185	.997	.068	1.182	.066	1.18	.081
Model 2: HS (0-4 years)										
<i>High School Music</i>	-.028***	.004	-.194	.104	.876**	.044	1.231***	.045	1.26***	.056
Middle School Music	-.009	.005	.025	.110	.942	.044	1.067	.047	.968	.054
High School Other Arts	-.015***	.004	.076	.086	.956	.033	1.159***	.034	1.102	.041
Model 3: HS (1-4 years)										
<i>High School Music</i>	-.021	.008	-.561**	.199	.918	.080	1.377***	.089	1.444**	.114
Middle School Music	-.007	.008	-.012	.196	1.106	.075	1.063	.082	.966	.096
High School Other Arts	-.023	.007	.235	.175	.975	.069	1.175	.067	1.109	.081
Model 4: MJHS (0-7 years)										
<i>High School Music</i>	-.019***	.003	-.089	.066	.908**	.028	1.152***	.030	1.109**	.035
High School Other Arts	-.015***	.004	.075	.086	.955	.033	1.16***	.034	1.104	.041
Model 5: (1-7 years)										
<i>High School Music</i>	-.014**	.005	-.283	.118	.941	.042	1.212***	.048	1.165**	.057
High School Other Arts	-.023**	.007	.237	.175	.929	.053	1.153**	.052	1.068	.061

Notes. **p<.01, ***p<.001. Model selection and enrollment covariates reflect the ever enrolled in music (0/1) regression models; To analyze the third ethnicity contrast (Other/Black) and the third lunch status contrast (no FRPL/Reduced PL) we ran another regression model flipping the reference group from Hispanic to Black students and Free PL to Reduced PL status.

Model 1: High School Music Enrollment (yes/no)

This measure of music enrollment allowed me to compare music and non-music students. This was the least precise measure of music enrollment – students enrolled in music for one year are treated the same as students who enrolled in music for 4 years. This measure examined possible broad connections between music enrollment and academic outcomes. In Table 3, the first section under the enrollment covariates per model refers to Model 1: HS Y/N.

Non-arts GPA. The first column in Table 3 shows the final step of regression results for predicting 12th grade non-arts GPA. The non-arts GPA includes all courses students completed in 12th grade except for music, dance, drama, and visual arts courses.

Step 1. Step 1 of regression model 1 included selection factors for music enrollment and a dichotomous high school music enrollment measure. Predicted 12th grade GPA was higher for females compared to males, higher for students who did not receive free- or reduced-priced and for students who received reduced-priced lunch compared to free lunch, and higher for former ELL students than non-ELL students. Higher 8th grade GPA was related to higher 12th grade GPA. I did not find predictive differences related to race/ethnicity or special education status in step 1 of this model. Of relevance to the research question, while controlling for selection factors related to music enrollment, enrolling in high school music was related to slightly lower 12th grade GPA.

Step 2a. A dichotomous yes/no middle school (6th-8th grade) music enrollment measure was entered in step 2a of regression model 1 and was also related to lower 12th grade non-arts GPA. The pattern of significance for selection factors remained consistent

after introducing this covariate. High school music enrollment remained negatively related to 12th grade non-arts GPA after middle school music enrollment was entered into the model.

Step 2b. A dichotomous yes/no high school other arts enrollment measure was entered in step 2b of regression model 1. All significant covariates from step 1 remained significant in step 2b. After controlling for enrollment in other arts electives in high school, students who received disability services had a slightly greater 12th grade non-arts GPA compared to students who did not receive disability services. High school music enrollment remained negatively related to 12th grade non-arts GPA after including other arts enrollment in the model

Step 3. The dichotomous middle school music and high school other arts enrollment measures were entered together in step 3 of regression model 1. The pattern of significance from step 1 for selection effects remained in step 3 of the model. Above and beyond selection factors, middle school music enrollment, and other arts enrollment in high school, high school music enrollment was related to slightly lower 12th grade non-arts GPA.

Absences. The second column in Table 3 shows the final step of regression results for predicting the number of days students missed in 12th grade.

Step 1. Predicted days absent in 12th grade was greater for female students compared to males, greater for racially/ethnically “Other” students than Black students, and greater for students who did not receive free- or reduced-priced lunch compared to those who received reduced-priced lunch. Days absent in 12th grade was lower for Black

students compared to Hispanic/Latine students, lower for students who did not receive either free- or reduced-priced lunch, and lower for students who received reduced priced lunch compared to students who received free lunch, and lower for former ELL students than non-ELL students. Higher 8th grade GPA, was related to fewer days absent in 12th grade. High school music enrollment was not related to absences in 12th grade.

Step 2a. Middle school music enrollment did not significantly contribute to predicted 12th grade absences or change the pattern of covariate significance when added to the model. High school music enrollment remained non-significant in step 2a.

Step 2b. High school other arts enrollment was related to slightly more predicted days absent in 12th grade and did not change the pattern of covariate significance when added to the model. High school music enrollment remained non-significant in step 2b.

Step 3. The pattern of covariate significance remained constant from step 1 to step 3. Enrollment in other arts electives in high school remained significantly related to greater days absent when selection factors and middle school music was also included in the model. High school music enrollment Y/N was still not related to 12th grade absences.

Suspension. The third column of Table 3 shows the final step of regression results for predicting the odds of being suspended in 12th grade.

Step 1. The odds of being suspended in 12th grade were two times greater for “Other” students than Black students, and greater for students who did not receive free- or reduced priced lunch compared to students who received free lunch. The odds of being suspended were lower for female compared to male students, lower for Black students compared to Hispanic/Latine students, and lower for students not in poverty compared to

students who received free lunch. Higher 8th grade GPA was related to lower odds of being suspended in 12th grade. While controlling for selection factors related to music, importantly, enrolling in high school music electives was related to a 25% decrease in the odds of being suspended in 12th grade.

Step 2a. When controlling for selection factors and high school music enrollment, middle school music enrollment was not related to the odds of being suspended in 12th grade. High school music enrollment remained related to lower odds of suspension after accounting for middle school music enrollment.

Step 2b. Enrolling in other arts electives in high school did not contribute to odds of being suspended in 12th grade. High school music enrollment remained related to lower odds of suspension after accounting for high school other arts enrollment in the model.

Step 3. The pattern of significant covariates in step 1 remained in step 3 after controlling for middle school music and high school other arts enrollment. High school music enrollment remained related to lower odds of being suspended after controlling for middle school music enrollment and enrollment in other arts electives in high school.

Diploma receipt. The fourth column in Table 3 shows the final step of regression results for predicting the odds of earning a diploma the first-time students completed 12th grade.

Step 1. The odds of earning a diploma were greater for female compared to male students and greater for former ELL students than non-ELL students. Higher 8th grade GPA was related to a 400% increase in the odds of earning a diploma. While controlling

for selection factors related to music enrollment, students who enrolled in music in high school had 30% greater odds of earning a diploma than students who did not enroll in music.

Step 2a. Middle school music enrollment was not related to the odds of earning a diploma in 12th grade when added to the model. High school music enrollment remained related to higher odds of earning a diploma after accounting for middle school music enrollment in the model.

Step 2b. Enrollment in other arts electives in high school was not related to earning a diploma in 12th grade when added to the model. High school music enrollment remained related to higher odds of earning a diploma after accounting for other arts enrollment.

Step 3. The pattern of covariate significance remained from step 1 to step 3 of the model. Above and beyond selection factors of enrollment, middle school music and other arts enrollment, high school music enrollment was still related to greater odds of earning a diploma.

Complete High School. The fifth column in Table 3 shows the final step of regression results for predicting the odds of completing high school the first-time students reached 12th grade. Students who completed high school earned either a diploma or a certificate of completion.

Step 1. The odds of completing high school were greater for female compared to male students. Students who received special education services had lower odds of completing high school at their first attempt than students who did not. Higher 8th grade

GPA was related to a 300% increase in the odds of completing high school. After controlling for selection factors related to enrollment, high school music enrollment was related to about 32% greater odds of completing high school. Race/ethnicity, FRPL status, and early-ELL status were not related to the odds of completing high school in 12th grade.

Step 2a. Middle school music enrollment was not related to the odds of completing high school above and beyond selection effects for and enrollment in high school music. The positive effect of taking high school music was still present after adding middle school enrollment.

Step 2b. Enrollment in other arts electives in high school was unrelated to odds of completing high school. After other arts enrollment was entered in the model, students who received reduced-priced lunch had lower odds of completing high school than students who received free-priced lunch. The positive effect of taking high school music was still present after adding other arts high school enrollment.

Step 3. After controlling for selection factors, middle school music enrollment and enrollment in other arts electives in high school, high school music enrollment was still related to greater odds of completing high school.

Model 2: High School Enrollment (0-4 years)

The high school 0-4 years of enrollment measure examined whether more years of music taking in high school were related to differences in academic achievement. Controlling for middle school music enrollment while exploring high school music enrollment allowed me to track whether students had previous experience learning and

practicing skills and behaviors in music electives that may support later academic outcomes. This was important to consider given that students who never enrolled in music in high school may have had up to three years of music training in middle school. In Table 3, the second section under the enrollment covariates refers to Model 2 and lists the effect for years of high school music and the covariates of other arts enrollment as well as years of middle school music enrollment. Given that the pattern of covariate significance remains stable across steps, I will now only report a summary of the final step of the regression models.

Non-arts GPA. The pattern of significance for selection covariates in model 2 mirrors model 1. Unlike model 1, years of middle school music enrollment was not a significant predictor of 12th grade non-arts GPA. Every year of enrollment in other arts electives in high school was related to a small decrease in 12th grade non-arts GPA. After controlling for selection factors, middle school music enrollment, and other arts enrollment in high school, every year of high school music enrollment was related to a small *decrease* in 12th grade non-arts GPA.

Absences. The pattern of significance for selection covariates in model 1 remained consistent in model 2. Similar to model 1, middle school music enrollment, other arts enrollment in high school, and music enrollment in high school did not significantly predict 12th grade absences. Years of high school music enrollment was not associated with days absent in 12th grade.

Suspension. The pattern of significance remained similar from model 1 to model 2. Consistent with model 1, years of middle school music and high school other arts

enrollment did not significantly contribute to odds of 12th grade suspension. After controlling for selection factors, middle school music, and other arts enrollment in high school, each year of music enrollment in high school was linked to 13% fewer odds of being suspended in 12th grade. Since this is multiplicative, this means that a student who took music all 4 years in high school had 52% (.13 X 4) fewer odds of being suspended in their final year of high school.

Diploma. The pattern of significance for selection factors and enrollment in model 1 was mirrored in model 2. Years of middle school music was not related to the odds of earning a diploma in 12th grade, but each year of high school other arts enrollment was related to 16% greater odds of earning a diploma. After controlling for selection factors, middle school music, and other arts enrollment in high school, each year of music enrollment was related to an even greater odds 23% of earning a diploma. Thus, a student who took music all 4 years in high school had almost double the odds (92%) of graduating from high school with a diploma.

Complete High School. The pattern of significance for selection factors and enrollment in model 1 carried forward in model 2. Years of middle school music did not significantly predict the odds of completing high school, but each year of enrollment in other arts electives in high school was related to greater odds of completing high school. After controlling for selection factors, middle school music, and other arts enrollment in high school each year of music enrollment was related to a 26% increase in the odds of completing high school.

Model 3: High School Enrollment (1-4 years)

I did additional analyses looking just within students who enrolled in at least one high school music elective. This helped me explore whether a relationship between greater years of music enrollment and academic outcomes exists beyond possible overall group differences between music and non-music students. In Table 3, the third section under the enrollment covariates refers to Model 3 and lists the effects for years of high school music and other arts enrollment as well as years of middle school music enrollment for students who enrolled in at least 1 music class in high school.

Non-arts GPA. Unlike model 1, I did not find group differences between students who received reduced-priced lunch compared to free lunch when predicting 12th grade non-arts GPA, and early-ELL status was not a significant predictor in model 3. Years of middle school music enrollment was not a significant predictor of 12th grade non-arts GPA, but each year of enrollment in other arts electives was related to a small *decrease* in 12th grade non-arts GPA. In the final step of model 3, years of music enrollment for music students was unrelated to 12th grade non-arts GPA.

Absences. When limited to just those who took at least one music class in high school, I did not find group differences related to poverty or receipt of special education services. However, I did find that absences were greater for racially/ethnically ‘Other’ students compared to Hispanic/Latine students. Middle school music enrollment and enrollment in other arts electives were not related to days absent in 12th grade. After controlling for selection factors and enrollment in middle school music and other arts enrollment in high school, each additional year of music enrollment for music students was related to missing about a half of a day less of school (.56 fewer days absent per

year) in 12th grade. Thus, a student who took music all four years missed a full 2 days fewer school days on average in 12th grade.

Suspension. Again, poverty was unrelated to suspension among just music students. Middle school music and high school other arts enrollment were not related to the odds of being suspended in 12th grade. Unlike model 1 and 2, each additional year of music enrollment for just music students was not significantly related to the odds of being suspended in 12th grade given our chosen conservative alpha level of $p < .01$.

Diploma. For just music students, there was no difference in the odds of earning a diploma in 12th grade by gender, poverty, or early-ELL status. Middle school music enrollment and enrollment in other arts electives in high school were not related to the odds of earning a diploma. Similar to models 1, and 2, each additional year of music enrollment for music students was related to 38% higher odds of earning a diploma in 12th grade in the final step of model 3.

Complete High School. For just music students, no selection factors of enrolling in music were related to the odds of completing high school in 12th grade in model 3. Middle school music enrollment and years of other arts enrollment in high school were not related to the odds of completing high school. Each additional year of music enrollment was related to 44% higher odds of completing high school for students that took at least one music class. Thus, a music student who took music all four years had almost double the odds of completing high school compared to taking only one year of music.

Model 4: Middle and High School Enrollment (0-7 years)

This measure examined whether total years of music enrollment from middle school through high school was related to differences in 12th grade outcomes. This expanded range of years of enrollment allowed for better examination of the possible influence of long-term music enrollment on academic outcomes. In Table 3, the fourth section under the enrollment covariates per model refers to Model 4, and lists the effects for years of high school music and other arts enrollment. Because middle school was already accounted for in this middle through high school years of enrollment measure, there is no separate covariate for middle school music enrollment in model 4.

Non-arts GPA. The pattern of significance for both selection and enrollment covariates from model 1 was reflected in model 4. Enrollment in other arts electives was related to a small decrease in 12th grade non-arts GPA. While controlling for selection factors of enrollment and enrollment in other arts electives in high school, every year of music enrollment in middle school and high school still related to a small decrease in 12th grade non-arts GPA.

Absences. The same pattern of significant selection covariates in model 1 was present in model 4. Similar to model 1, years of music enrollment was not significantly related to 12th grade absences. Unlike model 1, enrollment in other arts electives was not a significant predictor in 12th grade absences in model 4. Similar to models 1 and 2, overall years of music enrollment in secondary school was not related to absences in 12th grade.

Suspension. Significant selection covariates in model 1 were similarly reflected in model 4. Enrollment in other arts electives in high school was not related to the odds of

12th grade suspension. After controlling for selection factors and enrollment in other arts electives, each year of music enrollment in secondary school was related to 10% lower odds of suspension in 12th grade. Again, this estimate is multiplicative, so a student enrolled in music for all 7 years of middle and high school would have 70% less odds of being suspended in 12th grade compared to a student who never took music. It is worth noting that this effect including the middle school years is weaker than that for years of high school enrollment, suggesting that the effects of music classes on 12th grade suspension is stronger in high school than in middle school music taking.

Diploma. The pattern of significance for both selection and enrollment covariates in model 1 was also reflected in model 4. Each year of enrollment in other arts electives was related to an increase in the odds of earning a diploma in 12th grade. Similar to all previous models, each year of music enrollment was related to 15% increased odds of earning a diploma in 12th grade in. Again, this effect is stronger for just high school than when including both high school and middle school.

Complete High School. The pattern of significance for both selection and enrollment covariates in model 1 was reflected again in model 4. Each year of enrollment in other arts electives was related greater odds of completing high school. Similar to all previous models, each year of music enrollment in secondary school was related to increased odds of earning a diploma in 12th grade, The effect size including middle school was much smaller (11%) than that for years of music in high school (26%).

Model 5: Middle and High School Enrollment (1-7 years)

Years of music enrollment across middle and high school within music students was the final measure used when exploring the relationship between music enrollment and 12th grade academic outcomes. In table 3, the final section under the enrollment covariates per model refers to Model 5, and lists the effects for years of high school music and other arts enrollment within music students. Because middle school was already accounted for in this middle through high school years of enrollment measure, there was no separate covariate for middle school music enrollment in model 5.

Non-arts GPA. For just music students in model 5, there was no difference in the effect of years of music on 12th grade GPA by poverty or early-ELL status. Years of enrollment in other arts electives in high school was related to slightly lower 12th grade non-arts GPA. Similar to all previous models, each additional year of music enrollment was related to a slightly lower 12th grade non-arts GPA.

Absences. The pattern of significant selection covariates in model 1 was similar to model 5. For just music students, absences in 12th grade were greater for racially ‘Other’ students compared to Hispanic/Latine students. Enrollment in other arts electives was related to greater days absent in 12th grade. Similar to model 1, 2, and 4, when looking within students who took a music class at least once in middle and/or high school, additional years of enrollment was not related to absences in 12th grade.

Suspension. For just students who took at least one music class, FRPL status did not contribute to predicted odds of suspension in 12th grade in model 5. Further, unlike model 1, students who received special education had lower odds of being suspended in 12th grade than students who did not. Years of enrollment in other arts electives was not

related to the odds of 12th grade suspension. Years of other arts enrollment were not related to the odds of being suspended in 12th grade. Similar to model 3, additional years of music enrollment was not related to the odds of being suspended in 12th grade in model 5 for music students.

Diploma. For just music students, none of the demographic variables predicted diploma receipts. Years of other arts enrollment was related to greater odds of earning a diploma in 12th grade. Similar to all previous models, after controlling for selection factors related to music enrollment, each additional year of music (for those who took at least one year) was related to 21% greater odds of earning a diploma in 12th grade.

Complete High School. For just music students, gender, and poverty status were unrelated to completing high school. Further unlike model 1, years of enrollment in other arts electives was not related to the odds of completing high school. Consistent with all previous models, after controlling for selection factors and enrollment in other arts electives, each additional year of middle and high school music enrollment was related to greater odds of completing high school in 12th grade.

Research Question 2

I used a similar series of linear and logistic regression models to explore whether the influence of years of music enrollment on 12th grade academic outcomes was moderated by the student's prior, 8th grade GPA. The structure of regression models for research question 2 mirrored the structure of research question 1 with the addition of the relevant interaction term by 8th grade GPA in step 1. Entering the interaction term in step 1 of the model allowed me to see if adding middle school music or high school other arts

enrollment in later steps affected the interaction. These analyses examined whether the relationship between years of enrollment and academic outcomes was different for initially low and high-performing 8th grade students. I explored this from two perspectives – within high school and across middle through high school.

Table 4 summarizes the final step in the regression results for the five academic outcomes and four corresponding regression models used to examine the effect of this interaction when predicting 12th grade academic outcomes. Like Table 3, there are 5 columns of information relating to each of the academic outcomes. The selection factor covariates listed in the table relate specifically to model 1 regression analyses that examined HS 0-4 years of music enrollment. Importantly, there was minimal change for selection and enrollment covariates across model steps. Because research question 2 builds upon what was found in research question 1, I only report here the results of the interaction term. There was never a significant interaction between 8th grade GPA and years of music enrollment for any of the academic outcomes in any of the four ways enrollment was examined. The effects of music enrollment on high school on 12th grade performance reported above were the same for students who entered high school with weak and strong GPAs. Thus my hypothesis was not supported.

T

Table 4: Research Question 2 - Final Step Summary

	Non-arts GPA		Days Absent		Suspension		Diploma		HS Complete	
	B	(SE)	B	(SE)	OR	(SE)	OR	(SE)	OR	(SE)
<i>Selection Factors (Model 1)</i>										
Male/Female	.143***	.008	2.372***	.185	.613***	.070	1.18	.067	1.337***	.083
Black/Hispanic	.004	.011	-2.073***	.261	.39***	.108	.942	.091	.958	.112
Other/Hispanic	.030	.016	.537	.392	.990	.145	.997	.167	1.079	.208
Other/Black	.025	.017	2.635***	.409	2.539***	.159	1.058	.167	1.126	.208
No FRPL/Reduced PL	.022	.015	.904	.358	.671**	.128	1.003	.162	1.149	.194
No FRPL/Free PL	.060***	.010	-2.149***	.239	1.491**	.128	.997	.162	.871	.194
Reduced PL/Free PL	.038**	.013	-3.071***	.316	1.149	.095	.68***	.104	.656**	.13
Special Education Status	.023	.012	-.988**	.287	.821	.103	.488***	.080	.482***	.095
ELL Status	.026**	.010	-.664**	.239	.965	.090	1.224	.087	1.133	.107
8th Grade GPA	.425***	.007	-5.914***	.170	.459***	.059	4.15***	.058	3.379***	.069
<i>Enrollment and Interaction Covariates</i>										
Model 1: HS Enrollment (0-4 Years)										
8th Grade GPA * Music Enrollment	-.007	.007	.094	.168	1.055	.067	.901	.066	.919	.081
High School Music Enrollment	-.008	.022	-.473	.512	.757	.190	1.588**	.170	1.552	.21
Middle School Music Enrollment	-.009	.005	.020	.110	.939	.044	1.073	.047	.972	.054
High School Other Arts Enrollment	-.015***	.004	.078	.086	.957	.033	1.157***	.034	1.1	.041
Model 2: HS Enrollment (1-4 Years)										
8th Grade GPA * Music Enrollment	.012	.013	.647	.318	.937	.120	.927	.128	.852	.159
High School Music Enrollment	-.056	.04	-2.49	.969	1.099	.340	1.664	.333	2.172	.429
Middle School Music Enrollment	-.007	.008	-.042	.197	1.11	.075	1.067	.082	.974	.097
High School Other Arts Enrollment	-.023***	.007	.239	.175	.974	.069	1.174	.067	1.108	.081
Model 3: MJHS Enrollment (0-7 Years)										
8th Grade GPA * Music Enrollment	.007	.005	.049	.114	1.025	.045	.992	.046	1.012	.054
High School Music Enrollment	-.041**	.015	-.240	.357	.847	.130	1.174	.121	1.077	.142
High School Other Arts Enrollment	-.015***	.004	.077	.086	.956	.033	1.16***	.034	1.105	.041
Model 4: MJHS Enrollment (1-7 Years)										
8th Grade GPA * Music Enrollment	.013	.007	.194	.178	.968	.070	1.040	.076	.996	.087
High School Music Enrollment	-.051	.023	-.904	.557	1.033	.204	1.096	.199	1.176	.233
High School Other Arts Enrollment	-.021***	.006	.211	.132	.929	.053	1.153**	.052	1.068	.061

Notes. **p<.01, ***p<.001. Model selection and enrollment covariates reflect the ever enrolled in music (0/1) regression models; To analyze the third ethnicity contrast (Other/Black) and the third lunch status contrast (no FRPL/Reduced PL) we ran another regression model flipping the reference group from Hispanic to Black students and Free PL to Reduced PL status.

Research Question 3

I explored the relationship between breadth of music enrollment and 12th grade academic outcomes by using a similar strategy as research question 2. Instead of inputting an interaction term in step 1 of the models, I included the breadth/dosage of music enrollment measure. I examined breadth for middle school through high school and just within high school. These analyses explored if breadth of music enrollment (i.e., the sum of the total number of years a student enrolled in each type of music elective) influenced 12th grade academic outcomes in general, and over and above having enrolled in music electives. This allowed me to consider students who enrolled in multiple types of music classes and account for the length of time they enrolled in each type. Therefore, beyond comparing music and non-music students, this measure was an attempt to capture diverse interest and/or depth of music engagement. Table 2 includes descriptive information on the number of years a student enrolled in a music elective (overall), the number of types of music classes students took, and the means and standard deviations of breadth of enrollment in high school and across middle and high school for the full sample and within music students. The highest level of breadth in high school was 11 and the highest breadth level of breadth across middle and high school was 14.

Table 5 summarizes the final step in the regression results for each academic outcome and regression model used to examine breadth/dosage effects of music enrollment when predicting 12th grade academic outcomes. The layout of Table 5 is similar to Tables 3 and 4 – there is one column for each academic outcome, the selection factor covariates relate to model 1 regression analyses that examined breadth of music

enrollment in high school across the full sample. Again, because research question 3 builds upon what was already reported, I only report the effects of breadth.

Table 5: Research Question 3 - Final Step Summary

	Non-Arts GPA		Days Absent		Suspension		Diploma		Complete HS	
	<i>B</i>	<i>(SE)</i>	<i>B</i>	<i>(SE)</i>	<i>OR</i>	<i>SE(B)</i>	<i>OR</i>	<i>SE(B)</i>	<i>OR</i>	<i>SE(B)</i>
<i>Selection Factors (Model 1)</i>										
Male/Female	.143***	.008	2.366***	.185	.61***	.07	1.188	.067	1.34***	.083
Black/Hispanic	.005	.011	-2.12***	.262	.395***	.108	.943	.091	.964	.112
Other/Hispanic	.029	.016	.551	.392	.991	.145	.994	.167	1.073	.208
Other/Black	.024	.017	2.696***	.409	2.509***	.159	1.054	.167	1.112	.209
No FRPL/Reduced PL	.022	.015	.92**	.358	.667**	.128	1.006	.162	1.145	.194
No FRPL/Free PL	.059***	.01	-2.12***	.239	1.499**	.128	.994	.162	.873	.194
Reduced PL/Free PL	.037**	.013	-3.058***	.316	1.154	.095	.679***	.104	.658**	.13
Special Education Status	.022	.012	-.993**	.287	.821	.103	.49***	.08	.482***	.095
ELL Status	.027**	.01	-.673**	.239	.969	.09	1.224	.087	1.137	.107
8th Grade GPA	.419***	.007	-5.826***	.155	.463***	.054	4.017***	.053	3.281***	.063
<i>Music Breadth and Enrollment Covariates</i>										
Model 1: HS										
<i>HS Breadth of Music Enrollment</i>	-.011	.005	-.395**	.118	.944	.054	1.302***	.07	1.377**	.093
Middle School Music Enrollment	-.025**	.009	.256	.201	.831	.124	1.042	.075	.924	.09
High School Other Arts Enrollment	-.037***	.008	.466	.185	.972	.075	1.192**	.066	1.192	.081
High School Music Enrollment	-.031	.013	.755	.301	.993	.069	.862	.127	.808	.16
Model 2: HS (w/i music students)										
<i>HS Breadth of Music Enrollment</i>	-.013	.005	-.338**	.128	.922	.055	1.314***	.07	1.39***	.093
Middle School Music Enrollment	-.005	.016	-.04	.393	1.291	.147	1.034	.142	.939	.174
High School Other Arts Enrollment	-.057***	.016	.879	.378	1.144	.147	1.226	.131	1.147	.163
Model 3: MJHS										
<i>MJHS Breadth of Music Enrollment</i>	-.009**	.003	-.238**	.074	.954	.033	1.185***	.042	1.161**	.049
High School Other Arts Enrollment	-.037***	.008	.456	.185	.991	.069	1.196**	.066	1.195	.081
High School Music Enrollment	-.032**	.01	.765**	.242	.864	.095	.891	.097	.862	.116
Model 4: MJHS (w/i music students)										
<i>MJHS Breadth of Music Enrollment</i>	-.009**	.003	-.224**	.077	.95	.034	1.189***	.042	1.161**	.049
High School Other Arts Enrollment	-.052***	.012	.759**	.283	1.006	.108	1.229	.101	1.098	.124

Notes. **p<.01, ***p<.001. Model selection and enrollment covariates reflect the ever enrolled in music (0/1) regression models; To analyze the third ethnicity contrast (Other/Black) and the third lunch status contrast (no FRPL/Reduced PL) we ran another regression model flipping the reference group from Hispanic to Black students and Free PL to Reduced PL status.

Model 1: Breadth/Dosage of High School Music Enrollment

This model included the high school music breadth/dosage measure focused on 9th and 12th grade. In Table 5, the first section under music breadth and enrollment covariates refers to model 1 and lists the effects for music breadth in high school (0-11), middle school music enrollment (Y/N), other arts enrollment in high school (Y/N), and high school music enrollment (Y/N).

Non-arts GPA. While controlling for only selection factors of enrollment in step 1, overall breadth of music enrollment in high school was related to a decrease in predicted 12th grade non-arts GPA . In step 2a, middle school music enrollment was entered into the model and breadth of music enrollment in high school remained significant. In step 2b, high school other arts enrollment was entered into the model and breadth of music enrollment remained significant. In step 2c, however, high school music enrollment was entered into the model, and in this ‘above and beyond’ model, breadth of music enrollment was not significantly related to GPA in 12th grade. Thus, in the final step (tabled), above and beyond middle school music enrollment, other arts enrollment in high school, and high school Y/N music enrollment, how many different types of music types enrolled in throughout high school did not matter for 12th grade GPA.

Absences. While controlling for only selection factors in step 1, breadth of music enrollment in high school was not related to 12th grade absences. When middle school music, and other arts enrollment in high school were added in steps 2 , breadth of music still didn’t matter. However, when high school music enrollment was entered in the final step, breadth of music enrollment was related to significantly fewer absences in 12th

grade. In the final step of model 1, music breadth was related to fewer days absent above and beyond Y/N middle and high school music and other arts enrollment in high school.

Suspension. While controlling for selection factors of enrollment, breadth of music enrollment was related to lower odds of being suspended in 12th grade. When middle school music enrollment were entered into the model, breadth of music enrollment was no longer significant. When enrollment in other arts electives in high school and music enrollment in high school were entered into the model breadth of music enrollment remained significant. In the final step of the model, breadth of music enrollment was not a significant predictor of 12th grade suspension.

Diploma. While controlling for only selection factors of enrollment, breadth of music enrollment was related to greater odds of earning a diploma in 12th grade and remained significant across all steps of the model. Thus, breadth of music enrollment was a significant predictor of greater odds of earning a diploma above and beyond Y/N middle and high school music and other arts enrollment in high school.

Complete High School. While controlling for selection factors of enrollment, breadth of music enrollment was related to greater odds of completing high school in 12th grade and remained significant across all steps of the model. Similar to diploma status, breadth of music enrollment was a significant predictor of greater odds of completing high school above and beyond Y/N middle and high school music and other arts enrollment in high school.

Model 2: Breadth/Dosage of High School Music Enrollment Within High School Music Students

This model included the same high school breadth measure as model 1 but just examined breadth within music students. In table 5, the second section under music breadth and enrollment covariates refers to model 1 and lists the covariates for music breadth in high school (1-11), middle school music enrollment (Y/N), and other arts enrollment in high school (Y/N).

Non-arts GPA. Breadth in music enrollment was not a significant predictor of 12th grade non-arts GPA within music students across all steps of model 2.

Absences. Breadth of music enrollment was a significant predictor of fewer 12th grade absences within music students across all steps of model 2.

Suspension. Breadth of music enrollment was not a significant predictor of suspension in 12th grade within music students across all steps of model 2.

Diploma. Breadth of music enrollment was a significant predictor of earning a diploma in 12th grade within music students across all steps of model 2.

Complete High School. Breadth of music enrollment was a significant positive predictor of completing high school in 12th grade within music students across all steps of model 2.

Model 3: Breadth of Music Enrollment Across Middle and High School

This model included a breadth measure focused on the number of types of music electives and the number of years students enrolled in each of their music electives between 6th and 12th grade. In table 5, the third section under music breadth and enrollment covariates refers to model 3 and lists the covariates for music breadth in

middle through high school (0-14), other arts enrollment in high school (Y/N), and high school music enrollment (Y/N).

Non-arts GPA. While controlling for only selection factors, breadth of music enrollment across middle and high school was related to lower 12th grade non-arts GPA. Breadth of music enrollment remained significant when other arts enrollment in high school was entered into the model. Music breadth was no longer significant when high school music enrollment was entered into the model. In the final step of model 3, music breadth was related to slightly lower 12th grade GPA.

Absences. Breadth of music enrollment across middle and high school was not related to absences in 12th grade in step 1. Music breadth remained non-significant when high school other arts enrollment was entered into the model. When high school music enrollment was entered into the model, breadth of music enrollment was related to fewer days absent in 12th grade. In the final step of the model, breadth remained related to fewer days absent in 12th grade.

Suspension. While controlling for selection factors, breadth of music enrollment across middle and high school was related to lower odds of being suspended in 12th grade. Breadth of music enrollment remained significant when high school other arts enrollment was entered into the model. After including high school music enrollment in the model, breadth of music was no longer a significant predictor of 12th grade suspension.

Diploma. Breadth of music enrollment across middle and high school was related to higher odds of earning a diploma across all steps of model 3.

Complete High School. Breadth of music enrollment across middle and high school was related to higher odds of completing high school across all steps of model 3.

Model 4: Breadth/Dosage of Music Enrollment Across Middle and High School Within Music Students

This model included the same high school breadth measure as model 3 but just examined breadth within music students. In Table 5, the fourth section under music breadth and enrollment covariates refers to model 4 and lists the covariates for music breadth in middle through high school (1-14) and other arts enrollment in high school (Y/N).

Non-arts GPA. While controlling for selection factors, breadth of music enrollment was not related to 12th grade non-arts GPA within music students. After accounting for other arts enrollment, breadth of music enrollment became related to slightly lower 12th grade non-arts GPA.

Absences. While controlling for selection factors, breadth of music enrollment was related to fewer absences in 12th grade within music students. After controlling for both selection and other arts enrollment, breadth of music enrollment remained related to fewer days absent in 12th grade.

Suspension. Breadth of music enrollment was not a significant predictor of 12th grade suspension within music students.

Diploma. While controlling for selection, breadth of music enrollment was related to higher odds of earning a diploma in 12th grade. After controlling for selection

and enrollment in other arts electives, breadth of music enrollment remained related to greater odds of earning a diploma in 12th grade within music students.

Complete High School. While controlling for selection, breadth of music enrollment was related to higher odds of completing high school in 12th grade. After controlling for selection and enrollment in other arts electives, breadth of music enrollment remained related to greater odds of completing high school in 12th grade within music students.

Discussion

Researchers have explored possible connections between music and non-music outcomes for decades (Corrigall & Trainor, 2011; Gardiner et al., 1996; Schellenberg, 2004; Shaw, 2022). However, there is limited rigorous support for far transfer effects or positive correlations beyond early childhood (Schellenberg, 2006; Todhunter-Reid, 2019). This leaves researchers questioning what developmental and/or performance outcomes may be related to musical experiences and if there is a critical time period of exposure (Helmrich, 2010) or dosage of experience (Shaw, 2022) needed to observe transfer effects.

Prior research that also employed quasi-experimental design when exploring in-school elective enrollment and academic outcomes has found positive (Alegrado & Winsler, 2024; Guhn et al., 2019), null (Elpus, 2013), and mixed (Shaw, 2022) relationships between music and non-music outcomes. Similar to these studies, I controlled for multiple factors related to both selection into music enrollment and academic outcomes in my research design. However, unlike these samples, I did not

explore a nationally representative sample and instead examined how music enrollment relates to predominantly low-income and ethnically minoritized students. Additionally, unlike these previous studies, I controlled for student enrollment in other arts electives that may provide a similar developmental context. Although dosage of music enrollment has been studied, my analyses of the effect of breadth of enrollment above and beyond just enrolling in music provides new insight into the value of diverse participation in music programs.

The goal of this dissertation was to examine the relationship between music enrollment and 12th grade academic outcomes while controlling for selection factors of enrollment and other arts elective experiences. This was achieved using school transcript data on course enrollment and academic performance between 6th and 12th grade. Music enrollment was measured in multiple ways to examine possible connections from multiple perspectives. I looked at possible broad connections (yes/no music enrollment) between music and 12th grade outcomes, how years of enrollment may influence the connection (MJHS 0-7 years of enrollment; HS 0-4 years of enrollment), and what the connection looks like when focusing on music students themselves (MJHS 1-7 years of enrollment; HS 1-4 years of enrollment).

I looked at length of enrollment from two perspectives - across middle school and high school and just within high school, so I could examine music enrollment cumulatively across seven years and control for previous music enrollment when focusing on high school enrollment. By examining music enrollment across the full sample and within music students themselves, I gained a better picture of whether

additional years of enrollment was impactful beyond the contrast we find between music and non-music students. Focusing within music students also lessened the issue of selection because all students in this analysis are students who selected into music at least once. There were some differences between models examining years of enrollment across the full sample and models examining within music students – particularly for suspension and days absent. Of course, the child's individual background still plays into their academic performance, so maintaining demographic and previous academic performance as covariates in the model was important.

Both overall (Y/N enrollment) and years of enrollment (HS 0-4 years, MJHS 0-7 years) was related to higher odds of earning a diploma and completing high school in 12th grade. This relationship was found even when looking within music students themselves (HS 1-4 years; MJHS 1-7 years). Previous research focused on elective music taking in high school did not include measures of high school graduation, but researchers have suggested that extracurriculars help support student engagement in school and may protect against dropout (Catterall, 1981; Finn, 1989; Thouin et al., 2022). These findings support this theory of extracurricular engagement. Notably, music enrollment is related to better graduation outcomes above and beyond controlling for enrollment in other arts electives.

Music enrollment overall (Y/N HS enrollment) and years of enrollment (HS 0-4 years, MJHS 0-7 years) were also related to lower odds of suspension. However, when looking within music students, additional years of enrollment (HS 1-4 years, MJHS 1-7 years) were not related to lower odds of suspension in 12th grade. This suggests that

knowing the number of years a student enrolled in music does not provide much more information about the odds of being suspended than simply knowing a student ever enrolled in a music elective. Previous research on high school music course taking has not examined suspension as a behavioral academic outcome, but behavioral outcomes like suspension and absences are practical measures of student performance in school. Music enrollment was related to fewer days absent when looking at years of enrollment within high school (HS 1-4 years). It is possible that persistence in high school music electives is a sign of school engagement and these students are more likely to show up to school.

Previous research that explored the relationship between high school music enrollment and academic outcomes focused on standardized test scores (Elpus, 2013; Shaw, 2022) and subject exam scores in high school (Guhn et al., 2019). I used a GPA measure that reflects students course grades across all subjects (except arts electives) to assess academic achievement in 12th grade. This GPA measure removed possible inflation in students' overall GPA related to arts enrollment and is a practical representation of in-school academic performance. The negative relationship found between music enrollment and non-arts GPA contrasts with similar previous research that found no (Elpus, 2013; Shaw, 2022) or a positive relationship (Guhn et al., 2019) between music and academic outcomes. However, the inclusion of 8th grade GPA as a model covariate critically impacted my ability to detect a relationship between 12th grade GPA and music enrollment. The statistical variance attributed to music enrollment when predicting 12th grade GPA was the remaining variance after controlling for GPA

differences a few years prior in 8th grade. It is possible that differences in GPA related to music enrollment are more pronounced in middle school than high school.

Developmentally, this suggests that middle school is a critical time for students to enroll in music electives because it places them in a productive academic context where they can learn and practice new important skills with their classmates and then foster these skills, behaviors, and friendships as they move forward in high school.

The relationship between music enrollment and non-arts GPA was almost always negative, and small, and persisted even after controlling for enrollment in other arts electives. I ran similar models in robustness checks substituting 12th grade non-arts GPA with 12th grade overall GPA (including arts) and 12th grade just academic GPA to further explore the relationship and found similar slightly negative results. However, in practical interpretation of the effect size, the reduction in GPA was never more than one-tenth of a letter grade. In previous research, opposite to these results, I found that middle school music enrollment was related to higher 8th grade GPA. This may be related to differences in course rigor, academic priorities and opportunities, and developmental cognitive, behavioral, and social skills growth in middle versus high school. For example, high school students have the opportunity to enroll in advanced college-level courses, take on after-school jobs, and have more choice in socializing. All these factors influence academic performance in ways that are not present in middle school.

In my previous research, I found that 5th grade GPA moderated the connection between years of music enrollment and 8th grade GPA and suspension (Alegrado & Winsler, in review). Both low and high initial academic performers showed a positive

relationship between years of music enrollment and academic outcomes, but the relationship was stronger for initially low compared to high academic performers. Students who already have effective habits of mind, strong cognitive skills, and good behavior regulation already practice the positive characteristics related to high academic achievement that music ensembles encourage. Therefore, it is reasonable that the relationship between music enrollment and academic outcomes was not as large for students with strong early academic performance. Given this finding, I sought to further explore this interaction in high school in this dissertation. However, I did not find any differences in academic performance between high and low initial academic performers related to years of enrollment when adding this interaction term to the regression models. It is likely that there are more factors that impact student outcomes beyond music enrollment in high school that are not present or are less impactful in middle school – after-school jobs, more extracurricular opportunities. Alternatively, there may be a ceiling on the relationship between music enrollment and academic outcomes that students reach before high school or musical experiences and training are more developmentally and academically impactful in childhood (Southgate & Roscigno, 2009; Todhunter-Reid, 2019) and early-adolescence (Helmrich, 2010). Therefore, depending on the timing and type of exposure, musical experiences may be a catalyst for the development of certain skills and behaviors that are also related to academic achievement.

I found that breadth of music enrollment was positively related to 12th grade behavioral outcomes and somewhat negatively related to lower 12th grade academic

outcomes. Previous research has examined dosage of music enrollment by measuring years of enrollment (Guhn et al., 2019; Schellenberg, 2006; Shaw, 2022) and by sum of enrollment credits (Elpus, 2013). However, this study provides novel contribution to the literature by examining the relationship between breadth of music enrollment on academic outcomes independently and above and beyond participation in other arts electives and above and beyond music enrollment itself. Similar to previous studies (Alegrado & Winsler, in review; Guhn et al., 2019; Helmrich, 2010; Schellenberg, 2006), I found critical dosage effects not only related to greater years of enrollment but greater breadth of enrollment.

Similar to music enrollment, breadth of music enrollment was positively related to the odds of earning a diploma and completing high school across all models. Again, similar to music enrollment, I found that breadth of music enrollment was related to lower odds of suspension but not when looking within music students. It was not surprising that music enrollment and breadth of music enrollment models had similar relationships with 12th grade behavioral outcomes. The breadth of enrollment measure is an extension of the music enrollment measure. What is important to note is enrollment in multiple types of music classes had an additional connection to academic outcomes above and beyond accounting for music enrollment. This finding is a unique contribution to the literature.

Interestingly, greater breadth of enrollment was related to fewer days absent across all models while music enrollment was only related to fewer days absent when looking within high school music enrollment. Considering that breadth of enrollment was

related to lower days absent and higher odds of earning a diploma and completing high school, it seems that the more music classes a student takes, the more likely they are to show up and complete their academic requirements to graduate and complete high school. This suggests that music electives support school engagement which relates to previous research linking extracurricular engagement with lower odds of dropout (Thouin et al., 2022). Music electives help students integrate into the school community which may be protective against school dropout (Catterall, 1998| Finn, 1989).

Implications and Recommendations

Music is an activity that engages important executive function skills, but it may be less important to pin down a direct link between learning music and developmental outcomes than valuing and enhancing the musical experience as a whole to support child outcomes. The physical, social, and behavioral aspects of music training all intertwine to influence a child's development. It is possible that the importance of each of these aspects changes as children grow up. In previous work, we found a positive association between music enrollment in GPA in middle school but in high school that relationship was minimal and sometimes reversed. Developmentally, executive function skills practiced, and productive academic behaviors learned in music classes may be more impactful in school at a younger age (Brown & Sax, 2013; Gardiner et al., 1996; Moreno et al., 2011; Williams et al., 2015). As students get older and enter high school, they have already had years to practice these skills, so we may no longer see a relationship between music and academics at the end of high school. However social skills and experiences tied to music classes may be more impactful in these later years that are particularly

important for social development (Wang & Eccles, 2012). This may also be why we see a positive connection between GPA and music enrollment in middle school but not high school, but we still see positive behavioral outcomes in high school. Parents, teachers, and advocates should support students' interest in music and foster school engagement through music programs without adding an expectation for related academic gains.

Limitations

This study has multiple strengths – large sample size, rigorous quasi-experimental design, large number of control variables: selection factors, earlier music elective experiences, alternative arts experiences, longitudinal data, multiple measures of music enrollment, and unique non-arts GPA, but there were also limitations to the study design. This sample was subject to both positive attrition and exclusion of lower academic performers due to inclusion criteria. This resulted in a restricted range of academic performance within our sample. The restricted range may have specifically impacted my ability to detect an interaction between years of music enrollment and 8th grade GPA – a relationship identified in previous work. Although I was able to account for many confounding variables in my analysis strategy, I did not control for possible nesting effects. However, in previous work we found that only 10% of variance in similar analyses of this sample was attributed to school-level difference. Given our large sample, adjusting for standard errors for nesting makes seldom difference in our results. All of the 108 schools in the study offered at least one music elective. However, all schools may not have offered all seven types of music electives. This variance in music enrollment

opportunity across schools may be particularly impactful when exploring dosage effects of music enrollment and should be accounted for in future exploration.

Transcript data allowed me to examine student enrollment in electives and academic performance across grade levels, but I did not have access to information about student's other extra-curricular activities, (e.g., private music lessons, sports training) and therefore could not control for those experiences.

Future Directions

The breadth/dosage measure captured a form of diversity in music enrollment, but I did not explore possible differences in academic performance related to specific types and combinations of music electives. I have found some differences in academic performance within music types when examining middle school music enrollment, and it would be interesting to see if these differences persist, widen, or disappear in high school. Not all music types showed the same relationship between enrollment and academic outcomes. For example, middle school music enrollment was related to greater 8th grade math scores, but this relationship was driven mostly by guitar, orchestra, and band enrollment. This relationship was not present for keyboard or chorus. Although the non-arts 12th grade GPA outcome variable provided insight into how students performed at the end of high school, a cumulative GPA measure would provide insight into student's overall academic performance throughout high school. Further, an academic GPA that includes math, science and technology, English, humanities and social sciences, and foreign language courses and excludes both arts and other elective courses (e.g.,

agriculture, cosmetology, physical therapy) would give a more focused measure of academic classroom performance.

REFERENCES

- Adderley, C., Kennedy, M., & Berz, W. (2003). "A home away from home": the world of the high school music classroom. *Journal of Research in Music Education*, 51(3), 190–205. <https://doi.org/10.2307/3345373>
- Alegrado, A., & Winsler, A. (2020). Predictors of taking elective music courses in middle school among low-ses, ethnically diverse students in Miami. *Journal of Research in Music Education*, 68(1), 5–30. <https://doi.org/10.1177/0022429420908282>
- Arnaud.Cabanac, Perlovsky, L., Bonniot-Cabanac, M.-C., & Cabanac, M. (2013). Music and academic performance. *Behavioural Brain Research*, 256, 257–260. <https://doi.org/10.1016/j.bbr.2013.08.023>
- Babo, G. D. (2004). The relationship between instrumental music participation and standardized assessment achievement of middle school students. *Research Studies in Music Education*, 22(1), 14–27. <https://doi.org/10.1177/1321103X040220010301>
- Barrett, M. S., & Bond, N. (2015). Connecting through music: The contribution of a music programme to fostering positive youth development. *Research Studies in Music Education*, 37(1), 37–54. <https://doi.org/10.1177/1321103X14560320>
- Bartolome, S. J. (2013). "It's like a whole bunch of me!": the perceived values and benefits of the seattle girls' choir experience. *Journal of Research in Music Education*, 60(4), 395–418. <https://doi.org/10.1177/0022429412464054>

- Bronfenbrenner, U., & Morris, P. A. (n.d.). *The Bioecological Model of Human Development*. 36.
- Brown, E. D., & Sax, K. L. (2013). Arts enrichment and preschool emotions for low-income children at risk. *Early Childhood Research Quarterly*, 28(2), 337–346. <https://doi.org/10.1016/j.ecresq.2012.08.002>
- Carioti, D., Danelli, L., Guasti, M. T., Gallucci, M., Perugini, M., Steca, P., Stucchi, N. A., Maffezzoli, A., Majno, M., Berlingeri, M., & Paulesu, E. (2019). Music education at school: too little and too late? Evidence from a longitudinal study on music training in preadolescents. *Frontiers in Psychology*, 10, 2704. <https://doi.org/10.3389/fpsyg.2019.02704>
- Catterall, J. S. (1998). Risk and resilience in student transitions to high school. *American Journal of Education*, 106(2), 302–333. <https://doi.org/10.1086/444184>
- Corrigall, K. A., Schellenberg, E. G., & Misura, N. M. (2013). Music training, cognition, and personality. *Frontiers in Psychology*, 4. <https://doi.org/10.3389/fpsyg.2013.00222>
- Corrigall, K. A., & Trainor, L. J. (2011). Associations Between Length of Music Training and Reading Skills in Children. *Music Perception: An Interdisciplinary Journal*, 29(2), 147–155. <https://doi.org/10.1525/mp.2011.29.2.147>
- Costa-Giomi, E. (1999). The effects of three years of piano instruction on children's cognitive development. *Journal of Research in Music Education*, 47(3), 198–212. <https://doi.org/10.2307/3345779>

- Costa-Giomi, E. (2004). Effects of three years of piano instruction on children's academic achievement, school performance and self-esteem. *Psychology of Music, 32*(2), 139–152. <https://doi.org/10.1177/0305735604041491>
- Degé, F., Wehrum, S., Stark, R., & Schwarzer, G. (2014). Music lessons and academic self-concept in 12- to 14-year-old children. *Musicae Scientiae, 18*(2), 203–215. <https://doi.org/10.1177/1029864914523283>
- Elpus, K. (2013). Is it the music or is it selection bias? A nationwide analysis of music and non-music students' sat scores. *Journal of Research in Music Education, 61*(2), 175–194. <https://doi.org/10.1177/0022429413485601>
- Fasano, M. C., Semeraro, C., Cassibba, R., Kringelbach, M. L., Monacis, L., de Palo, V., Vuust, P., & Brattico, E. (2019). Short-term orchestral music training modulates hyperactivity and inhibitory control in school-age children: a longitudinal behavioural study. *Frontiers in Psychology, 10*, 750. <https://doi.org/10.3389/fpsyg.2019.00750>
- Foster, E. M., & Marcus Jenkins, J. V. (2017). Does participation in music and performing arts influence child development? *American Educational Research Journal, 54*(3), 399–443. <https://doi.org/10.3102/0002831217701830>
- Gara, T. V., & Winsler, A. (2019). Selection into, and academic benefits from, middle school dance elective courses among urban youth. *Psychology of Aesthetics, Creativity, and the Arts. https://doi.org/10.1037/aca0000250*

- Gardiner, M. F., Fox, A., Knowles, F., & Jeffrey, D. (1996). Learning improved by arts training. *Nature; London*, 381(6580), 284.
<http://dx.doi.org.mutex.gmu.edu/10.1038/381284a0>
- Gouzouasis, P., Guhn, M., & Kishor, N. (2007). The predictive relationship between achievement and participation in music and achievement in core Grade 12 academic subjects. *Music Education Research*, 9(1), 81–92.
<https://doi.org/10.1080/14613800601127569>
- Guhn, M., Emerson, S. D., & Gouzouasis, P. (2019). A population-level analysis of associations between school music participation and academic achievement. *Journal of Educational Psychology*. <https://doi.org/10.1037/edu0000376>
- Helmrich, B. H. (2010). Window of opportunity? Adolescence, music, and algebra. *Journal of Adolescent Research*, 25(4), 557–577.
<https://doi.org/10.1177/0743558410366594>
- Herrero, L., & Carriedo, N. (2018). Differences in updating processes between musicians and non-musicians from late childhood to adolescence. *Learning and Individual Differences*, 61, 188–195. <https://doi.org/10.1016/j.lindif.2017.12.006>
- Hess, R. S., & Copeland, E. P. (2001). Students' stress, coping strategies, and school completion: A longitudinal perspective. *School Psychology Quarterly*, 16(4), 389–405. <https://doi.org/10.1521/scpq.16.4.389.19899>
- Holochwost, S. J., Propper, C. B., Wolf, D. P., Willoughby, M. T., Fisher, K. R., Kolacz, J., Volpe, V. V., & Jaffee, S. R. (2017). Music education, academic achievement,

- and executive functions. *Psychology of Aesthetics, Creativity, and the Arts*, 11(2), 147–166. <https://doi.org/10.1037/aca0000112>
- Kinney, D. W. (2008). Selected demographic variables, school music participation, and achievement test scores of urban middle school students. *Journal of Research in Music Education*, 56(2), 145–161. <https://doi.org/10.1177/0022429408322530>
- Kinney, D. W. (2010). Selected nonmusic predictors of urban students' decisions to enroll and persist in middle school band programs. *Journal of Research in Music Education*, 57(4), 334–350. <https://doi.org/10.1177/0022429409350086>
- Kinney, D. W. (2019). Selected nonmusic predictors of urban students' decisions to enroll and persist in middle and high school music ensemble electives. *Journal of Research in Music Education*, 67(1), 23–44. <https://doi.org/10.1177/0022429418809972>
- McCabe, J., Dupéré, V., Dion, E., Thouin, É., Archambault, I., Dufour, S., Denault, A.-S., Leventhal, T., & Crosnoe, R. (2020). Why do extracurricular activities prevent dropout more effectively in some high schools than in others? A mixed-method examination of organizational dynamics. *Applied Developmental Science*, 24(4), 323–338. <https://doi.org/10.1080/10888691.2018.1484746>
- Metsäpelto, R.-L., & Pulkkinen, L. (2012). Socioemotional behavior and school achievement in relation to extracurricular activity participation in middle childhood. *Scandinavian Journal of Educational Research*, 56(2), 167–182. <https://doi.org/10.1080/00313831.2011.581681>

- Moreno, S., Bialystok, E., Barac, R., Schellenberg, E. G., Cepeda, N. J., & Chau, T. (2011). Short-term music training enhances verbal intelligence and executive function. *Psychological Science, 22*(11), 1425–1433. <https://doi.org/10.1177/0956797611416999>
- Morrison, S. J. (2001). The school ensemble: a culture of our own: school ensembles are not just classes or performance groups, but guardians of their own specific culture, a culture that informs and enriches the lives of their members. *Music Educators Journal, 88*(2), 24–28. <https://doi.org/10.2307/3399738>
- Parker, E. C. (2014). The process of social identity development in adolescent high school choral singers: a grounded theory. *Journal of Research in Music Education, 62*(1), 18–32. <https://doi.org/10.1177/0022429413520009>
- Piro, J. M., & Ortiz, C. (2009). The effect of piano lessons on the vocabulary and verbal sequencing skills of primary grade students. *Psychology of Music, 37*(3), 325–347. <https://doi.org/10.1177/0305735608097248>
- Roden, I., Grube, D., Bongard, S., & Kreutz, G. (2014). Does music training enhance working memory performance? Findings from a quasi-experimental longitudinal study. *Psychology of Music, 42*(2), 284–298. <https://doi.org/10.1177/0305735612471239>
- Sachs, M. E., FeldmanHall, O., & Tamir, D. I. (2021). Clarifying the link between music and social bonding by measuring prosociality in context. *Behavioral and Brain Sciences, 44*, e90. <https://doi.org/10.1017/S0140525X2000117X>

- Schellenberg, E. G. (2004). Music lessons enhance IQ. *Psychological Science, 15*(8), 511–514. <https://doi.org/10.1111/j.0956-7976.2004.00711.x>
- Seifried, S. A. (2012). Why “guitar kids” are different: attracting new students to school instrumental programs. *American String Teacher, 62*(2), 34–36. <https://doi.org/10.1177/000313131206200207>
- Shaw, B. P. (2022). A national analysis of music coursetaking, social-emotional learning, and academic achievement using propensity scores. *Journal of Research in Music Education, 69*(4), 382–401. <https://doi.org/10.1177/00224294211006415>
- Thouin, É., Dupéré, V., Dion, E., McCabe, J., Denault, A.-S., Archambault, I., Brière, F. N., Leventhal, T., & Crosnoe, R. (2022). School-based extracurricular activity involvement and high school dropout among at-risk students: Consistency matters. *Applied Developmental Science, 26*(2), 303–316. <https://doi.org/10.1080/10888691.2020.1796665>
- Todhunter-Reid, A. (2019). In-school arts education and academic achievement: A child fixed effects approach. *Arts Education Policy Review, 120*(2), 112–119. <https://doi.org/10.1080/10632913.2018.1423595>
- Vaughn, K., & Winner, E. (2000). SAT scores of students who study the arts: What we can and cannot conclude about the association. *Journal of Aesthetic Education; Champaign, 34*(3/4), 77.
- Wang, M.-T., & Eccles, J. S. (2012). Social support matters: longitudinal effects of social support on three dimensions of school engagement from middle to high school:

social support. *Child Development*, 83(3), 877–895.

<https://doi.org/10.1111/j.1467-8624.2012.01745.x>

Wetter, O. E., Koerner, F., & Schwaninger, A. (2009). Does musical training improve school performance? *Instructional Science*, 37(4), 365–374.

<https://doi.org/10.1007/s11251-008-9052-y>

Williams, K. E., Barrett, M. S., Welch, G. F., Abad, V., & Broughton, M. (2015).

Associations between early shared music activities in the home and later child outcomes: Findings from the Longitudinal Study of Australian Children. *Early Childhood Research Quarterly*, 31, 113–124.

<https://doi.org/10.1016/j.ecresq.2015.01.004>

BIOGRAPHY

Alenamie Namata Alegrado received her Bachelor of Science in Psychology from George Mason University in 2016 and continued at George Mason University to receive her Master of Arts in Psychology in 2021 and Doctor of Philosophy in Psychology in 2024. Her research focused on predictors of and academic outcomes related to in-school music enrollment and related arts electives.