Relationships Among High School Students' Large Music Ensemble Enrollment and Academic Performance in Rural Public-School Systems in South Georgia

by

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Abstract

The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. The research questions were: (a) RQ1: Is there a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement?; (b) Is there a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement?; (c) RQ3: Is there a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model? I used an original, student-level dataset comprised of anonymized secondary data from eleven rural schools in South Georgia. The dataset included every student in those eleven schools (N = 2,981). High school large music ensemble (band and/or choir) enrollment was operationalized binarily (yes=1, no=0) for RQ1 and RQ3. High school large music ensemble (band and/or choir) enrollment was operationalized continuously as years of enrollment for RQ2. Academic performance was operationalized as GPA, ACT score, EOC grade, EOC American literature score, and EOC level. The results showed consistent statistically significant and positive relationships between enrollment in band and enrollment in both band and choir and academic performance. The results for enrollment in choir but not band were less consistent, with some statistically insignificant results, some statistically significant negative associations, and some statistically

significant positive associations with academic performance. Practically, the results demonstrate that high school large music ensembles, specifically band, are associated with improved academic performance and could potentially be considered fundamental to general education in rural high schools in Georgia. Future research should account for omitted covariates such as previous music learning experience, nature of high school program variable bias and simultaneity bias.

Artificial Intelligence (AI) Use Disclosure Statement

In preparing this dissertation manuscript, the following artificial intelligence (AI) tool was used: Grammarly. This tool was used primarily to check grammar, syntax, and use of passive voice. The author acknowledges full responsibility for the intellectual content of this work and has ensured that all AI-assisted sections have been reviewed and revised for accuracy and appropriate academic style. All AI-generated content was reviewed and validated for relevance, appropriateness, and accuracy before incorporation into the final document to maintain the scholarly integrity of this study.

Digital Accessibility Use Disclosure Statement

In the preparation of this dissertation manuscript, the following digital accessibility tools were used to ensure this document complies with federal requirements: Microsoft Word and Adobe Acrobat. The author acknowledges full responsibility for the intellectual content of this work and has made a good faith effort to comply with digital accessibility requirements in publishing, wherein the nature of the content does not significantly change in order to do so. Furthermore, all content has been reviewed and revised to meet these requirements prior to final publication.

Acknowledgments

I chose this topic because I spent my career teaching in rural area public school systems. Throughout my time in various school systems, I have witnessed programs being cut or completely dismantled by policymakers and school leaders who lacked a whole-child mindset for rural education. My mission was to shed light on the relationship between academic schoolwork and large group music ensembles. Although I am no longer in the classroom, I have been able to use my current platform as a school principal to hire quality music educators and promote rural area school development across South Georgia.

This dissertation is dedicated to my amazing wife, Dr. Monica McGee, for her support and constant encouragement during this journey. She was the rock of our family and provided me with moral support, allowing me to focus on earning this degree. This was a team effort that included our awesome children: Kadien (11), Khloee (9), and KaMonie (1). This team also includes my parents, Mary and Dr. James McGee, and my in-laws, Martha and Booker Owens, who took time with the kids when Monica and I were working on our doctoral degrees. However, completing the degree became a challenge for me with the death of my mother-in-law, Martha Owens, on December 22, 2023. She would always encourage me to strive for excellence and never give up.

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Chapter 1

Introduction

Music is an integral part of the human experience, providing physical and mental health benefits, including increased coordination, creativity, and social ties (Liddell, 2022; Venter & Panebianco, 2022). Music has been part of education across many cultures and historical periods. Since the beginnings of educational practice and philosophy, music has played a role in individuals' ability to interact and articulate ideals (Adams et al., 2023). Ancient Greek civilizations integrated music into the seven liberal arts: grammar, logic, rhetoric, arithmetic, geometry, music, and astronomy.

Music continues to play a vital role in education in the United States (Liddell, 2022). Music education can support students' cognitive, social, emotional, and physical needs (Adams et al., 2023; Guhn et al., 2020; Marino & Chinn, 2023; Thapa & Rodriguez-Quiles, 2023; Thorpe & McPhail, 2022; Venter & Panebianco, 2022). It has been associated with the development of language and reading skills, social and emotional skills, self-esteem, and the ability to integrate socially with peers (Ellis, 2021; Jo, 2023; Venter & Panebianco, 2022). Music education has also been positively associated with academic performance (Adams et al., 2023; Gorbunova & Plotnikov, 2019).

Scholars recommend incorporating music education into school curricula due to its long-standing association with student development (Marino & Chinn, 2023; Venter & Panebianco, 2022). However, decreasing school budgets can lead to the cancellation of large music ensembles and other music classes. School budgets that retain large music ensembles allocate fewer funds to them than to general education classes (e.g., math,

English, science), especially in rural areas (Major, 2013; Venter & Panebianco, 2022; Wang & Haris, 2025). A statistical study of the relationship between student enrollment in large music ensembles and academic performance may help to improve the budgetary situations of large school music ensembles and, in turn, academic performance in rural areas (Wang & Haris, 2025).

Purpose of the Study

The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. The results of this study contribute to the literature about the statistical relationships between school music enrollment and academic performance in rural public schools. The results can be used by educators, school administrators, and public policymakers to potentially assist with academic performance in rural public schools.

Research Questions and Hypotheses

RQ1 Is there a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement?

H_1 There is a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement.

H_0 There is not a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement.

RQ2 Is there a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement?

H_1 There is a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement.

H_0 There is not a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement.

RQ3 Is there a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model?

H_1 There is a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model.

H_0 There is not a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model.

Delimitations

This study had several delimitations. The sample was delimited to represent a specific region and type of school setting in rural Georgia. Regions outside this area

were not included. The included schools are located south of I-16 and were designated as rural by the Georgia Governor's Office of Student Achievement. I did not account for the differences in the quality, type, or pedagogical approach of music programs, instruction, and learning experiences available among large high school ensembles in rural communities; and other types of school music enrollment, such as elementary and middle school music classes, or other high school music classes. I also did not include previous music experience such as piano lessons, community music, and church music. Although some school systems offer music courses in piano, music technology, music theory, music appreciation, guitar, jazz band, and other small ensembles, I delimited the research to focus only on band and choir, which are considered large music ensembles. The third type of high school large music ensemble, orchestra, was excluded because this type of high school large music ensemble was not offered in public schools in rural Georgia for the years of data included in this study. As such, other potentially valuable covariates were not included in this dissertation. The data were further delimited to the following:

- Student Large Music Ensemble Enrollment
    - Enrollment in Band and/or Choir.
    - Years of Enrollment in Band and/or Choir.
- Student Academic Achievement
    - ACT Total Scores (English, Reading, and Non-Math Scores)
    - End of Course (EOC) Overall Scores
    - EOC Level
    - American Literature EOC Scores

- Grade Point Average (GPA)

A final noted delimitation is that due to the nature of the data set, information about individual students' non-school music experiences, such as private lessons and church music, was not accounted for in the study.

Limitations

Several limitations exist in this study. The first limitation was the possibility of unknown biases in the data collection source. Bias or inconsistencies in grading could have influenced the student's ACT total reading component score (the combined English and Reading) and ACT overall scores in Reading, Math, and Science. The precise grading methodological practices of teachers were not known. Another limitation was that the study did not account for differences in grading approaches between teachers, the protocol for grading in schools, and the protocol for grading in the district. Due to the nature of the data set, information about individual students' non-school music experiences, such as private lessons and church music, was not accounted for in the study. A third limitation includes the threats to internal validity posed by the history and maturation effects due to the cross-sectional nature of the dataset. A fourth limitation is that the probabilistic generalizability of the results is limited to the census of schools included in the dataset. A fifth limitation is the nature and quality of instruction in the different choral and band programs based on factors such as course scheduling, funding, and qualifications of an instructor. Further, and in terms of limitations, it must be considered that some rural choral programs are more informal often with a teacher who may not have formal training.

Assumptions

The first assumption was that students' academic records, received from the various school districts, were accurately recorded for the 2023 school year. Another assumption was that the data files were not manipulated. It was not possible to test either of these assumptions.

Definition of Terms

- **Academic Achievement:** Academic achievement is the overall measure of a student's proficiency in activities such as exams, assignments, and class enrollment (Conway, 2020). In this study, academic achievement was measured by the ACT overall score, EOC overall score, EOC American literature score, EOC level, and GPA.
- **Grade Point Average (GPA):** A grade point average is a numerical representation of a student's academic performance, calculated by assigning point values to different grades and averaging them (Pitdsats, 2019).
- **Grading:** The grading process occurs as students participate in assessments, course evaluations, and performance tasks, all of which are evaluated against predetermined criteria (Conway, 2020).
- **High School:** A secondary educational institution typically attended by students between 14 and 18 in preparation for higher education or employment (Hess, 2019).
- **Music Education:** The formal instruction and learning experiences focused on studying music, including theory, composition, performance, and appreciation (Pitts, 2019). School music enrollment was delimited to band and/or choir for

public high school students in rural Georgia for this study.

- **Students:** Individuals engaged in learning and receiving education, typically attending schools or educational institutions (McCoy & Lind, 2022).

Summary

The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. This study may contribute to the understanding of potential relationships between school music enrollment and student academic achievement in rural public schools. The results of this study could inform music educators, administrators, and policymakers and contribute to the literature on the relationships between high school large ensemble enrollment and academic achievement in rural schools.

Chapter 2

Literature Review

Introduction

I used the Education Resources Information Center (ERIC), Google Scholar, Scopus, and Web of Science databases to locate studies on the relationships between school music enrollment and students' achievement in other academic areas. I selected these databases due to their relevance and the comprehensive literature they contain. When searching these databases, I entered the following keywords and phrases: *Music, education, high school, performance, achievement, academic, and development.* Boolean logic was employed to connect these keywords and phrases, thereby narrowing the scope of the search results. I used the following criteria to select literature: studies published within the past five years in a scholarly, peer-reviewed journal in the English language. A minimum of 85% of the sources included in this review were published within the past five years, while the remainder were included based on their information being seminal to the problem and purpose of this study.

Chapter Two provides a comprehensive review of the literature on the critical components of music education and their impact on student development and academic achievement. Notably, it draws on findings from Abeles et al. (2021), Adams et al. (2023), and Venter and Panebianco (2022) to underscore the importance of music education within the broader educational landscape. The chapter begins by examining emerging themes from recent research, including the cognitive, emotional, and social benefits of music education. It highlights how participation in music programs not only fosters creativity and critical thinking but also enhances self-discipline and teamwork

skills among students. Furthermore, it highlights the positive correlation between music education and improved academic outcomes, suggesting that students involved in music often achieve better results in subjects such as mathematics and language arts.

Additionally, this section highlights notable gaps in the existing literature, including the scarcity of studies evaluating the extent to which band and/or choir enrollment is statistically associated with academic performance in rural public high schools. It highlights the need for further research to explore these areas in greater depth, providing a solid rationale for the current study. The following sections synthesize seminal evidence demonstrating the intricate relationship between music education and various aspects of high school students' development. Citing works by Kim and Kwon (2022), Park (2022), and Welch (2022), I discussed how music education is linked to personal growth and academic success, thereby reinforcing the value of integrating the arts into the standard curriculum. Finally, I summarized the key findings in the related literature and reinforced the importance of continued exploration in this field, setting the stage for the subsequent chapters of the current study.

Integrated Arts Education

Researchers have demonstrated a correlation between arts education and academic achievement (Guhn et al., 2020; Incognito et al., 2022; Thopre & McPhail, 2022). Guhn et al. (2020) found participation in arts programs to be associated with improved academic outcomes, including higher grades and standardized test scores. Additionally, programs that integrate the arts are linked to enhanced cognitive abilities (Daubney & Fautley, 2020). Researchers suggest that engaging in performing arts education plays an important role in enhancing various cognitive and emotional skills,

including spatial-temporal abilities, creativity, and critical thinking (Fautley & Daubney, 2022; Guhn et al., 2020; Ulger, 2019). Furthermore, participation in musical arts programs is closely linked to the social and emotional development of students, enabling them to navigate complex interpersonal relationships and express their feelings (Barbeau et al., 2023; Siljamaki & Kanellopoulos, 2020).

In addition to these benefits, involvement in performing arts also boosts self-esteem, empowering students to feel more confident in their abilities and worth (Gorbunova & Plotnikov, 2019). The collaborative nature of these programs fosters empathy among participants, encouraging them to understand and share the emotions of others (Cho, 2021; Park, 2021c). Ultimately, performing arts education fosters an environment where collaboration and cooperation thrive, as students learn to work together toward shared goals (Adams et al., 2023).

Emotional Expression

Artistic education also serves as a secure outlet for emotional expression (Elpus & Abril, 2019; Gorbunova & Plotnikov, 2019; Wesolowski et al., 2022). Art and music can help students express and understand their emotions, leading to improved emotional regulation and resilience (Kinney, 2019; Regier, 2022). Kinney (2019) stated that arts education programs can foster positive self-concept and self-efficacy, especially in at-risk adolescents. Similarly, creating art or performing can be intrinsically satisfying and enriching, enhancing overall happiness and life satisfaction (White, 2021). This intrinsic satisfaction can enhance motivation for education by making it more self-determined, thereby increasing academic performance and achievement over time (Welch, 2022).

Performing arts programs expose students to artistic traditions and cultural practices, thereby nurturing cultural awareness and appreciation (Khasanova, 2020; Prest & Goble, 2021). These benefits can be contingent upon the quality and implementation of the programs (Abeles et al., 2021; Bowen & Kisida, 2019; Hong & Chu, 2021). The performing arts play a significant role in helping students express and understand their emotions. Arts education provides a safe and constructive outlet for emotional expression (Gonzalez Ben, 2022). Moreover, it enables students to comprehend and interpret the emotions conveyed through different art forms, thereby enhancing their emotional intelligence (Prest & Goble, 2021; White, 2021).

One advantage of performing arts programs is they nurture students' holistic growth (Langley, 2022; Park, 2022; Thorpe & McPhail, 2022). However, while performing arts programs may foster social, emotional, and physical development, these outcomes can depend on several variables. For example, the quality of the program, the type of program, and the level of student engagement can all influence the extent to which performing arts programs foster social, emotional, and physical development (Hong & Chu, 2021; Marino & Chinn, 2023).

The literature emphasizes the importance of music education in public schools and highlights the need for stronger advocacy, policy support, and research to sustain and expand music programs. The National Association for Music Education (NAfME) stressed the importance of using public awareness campaigns to highlight the benefits of music education in public school districts (Vaughan-Marra & Baumgartner, 2022). Kang and Kang (2021) argued policymakers must comprehend the value of music education and its impact on student development. There are great recommendations for

incorporating music education into the standard curriculum (Hong & Chu, 2021; Jung, 2023; Venter & Panebianco, 2022). Venter and Panebianco (2022) revealed schools with music programs have higher graduation rates and standardized test scores. According to Venter and Panebianco (2022), music education is integral to the school curriculum. Although Kang and Kang (2021) provided evidence of the value of music education by demonstrating how students benefited from it, there remains a need to enhance knowledge and bridge the gap between policy and practice. The literature calls for more rigorous research and advocacy to preserve and promote music education in high schools.

The performing arts can contribute to the enhancement of emotional intelligence, which is an increasingly recognized and essential component of general intelligence, linked to a wide range of societal outcomes, including employability and leadership (Bae, 2021; Gorbunova & Plotnikov, 2019; Kim, 2022). The arts offer a unique platform for emotional expression and understanding, thereby enhancing students' emotional intelligence (Elpus & Abril, 2019). The performing arts can also have a positive societal impact, such as enhancing cultural understanding (Gorbunova & Plotnikov, 2019). Arts enrollment can expose students to diverse cultures and perspectives, fostering cultural understanding and empathy (Kim, 2022). A lack of cultural competence and empathy is associated with reduced student achievement, lower college readiness, and limited employability (Gonzalez Ben, 2022; Gorbunova & Plotnikov, 2019; Kim, 2022).

Community engagement is also enhanced through the performing arts in various ways (Incognito et al., 2022; Prest & Goble, 2021). The arts often involve public performances or exhibitions that encourage students to engage with their community

(Wong et al., 2023). Furthermore, experiences with the arts contribute to the development of marketable skills among students (Massy & Sembiante, 2022). The skills developed through arts education, such as creativity, collaboration, and communication, are highly valued in the job market. Therefore, arts education can prepare students for careers outside the arts (Robison et al., 2021). As a result, students have greater opportunities to explore various career paths (Venter & Panebianco, 2022). Arts education can help students identify their interests and abilities, enabling them to explore potential career paths in the arts and beyond (Tucker & Winsler, 2023). This skill is often overlooked when students are taught to focus solely on core subjects.

Students can encounter various artistic traditions and cultural practices, thereby nurturing cultural awareness and appreciation, through music education (Gonzalez Ben, 2022; Khasanova, 2020). In increasingly diverse societies, cultural competency can contribute to social cohesion and mutual respect (Bennett & Sena Moore, 2023; Khasanova, 2020). However, performing arts programs may lead to comprehensive benefits. The outcomes can vary depending on several factors, such as the program's quality, the art forms involved, and the student's level of engagement and interest (Kim, 2023). Exposure to the performing arts may provide students with a rich context for holistic development. Such exposure should be considered a part of a broader, more well-rounded educational program (Yoon, 2020). The following subsection contains a review of the literature on the relationships between enrollment in the performing arts.

Enrollment in the Performing Arts

Skills developed through the arts, such as creativity, problem-solving, and collaboration, are essential for college success (Siljamaki & Kanellopoulos, 2020). Siljamaki and Kanellopoulos (2020) found arts-engaged students were more likely to attend and graduate from college. There is speculation that enrollment in performing arts programs has a positive impact on students' academic achievement (Kim, 2023). However, it is essential to note arts program quality and student engagement can impact student achievement outcomes (Calderon-Garrido & Gustems-Carnicer, 2021; Fautney & Daubney, 2022; Kim, 2023). There is a need for high-quality arts education programs that engage students and integrate arts education into the broader curriculum (Bowen & Kisida, 2019; Calderon-Garrido & Gustems-Carnicer, 2021; Fautley & Daubney, 2022).

Enrollment in performing arts programs has been shown to positively co-vary with academic achievement (Elpus & Abril, 2019; Kwon & Jung, 2022; Springer & Silvey). Students participating in such programs tend to perform better on standardized tests and earn higher grades than their non-participating counterparts (Kim & Kwon, 2022). Additionally, students who participate in arts programs generally demonstrate a higher level of engagement in school than their peers, which usually translates to higher levels of student achievement (Springer & Silvey, 2022). Program quality and student engagement are statistically related, potentially indicating a need for high-quality arts education programs that engage students and integrate arts education into the broader curriculum.

Education in the performing arts generally has a positive relationship with high school students' academic performance (Adams et al., 2023; Guhn et al., 2020; Montemayor et al., 2023). Abeles et al. (2012) and Rolandson and Conn (2022) found a strong correlation between musical enrollment and improved academic performance, as evidenced by grade point averages and standardized test scores. Additionally, music training can improve mathematical and spatial-temporal abilities, language abilities, executive functions, graduation rates, and school engagement (Siljamaki & Kanellopoulos, 2020). Despite the positive relationships between performing arts education and enrollment, the outcomes of music education depend significantly on the quality and nature of the music program, individual factors associated with students, socioeconomic factors, and the quality of educators within the institutions in which the programs are delivered to students (Rolandson & Conn, 2022). The following section discusses gaps in the literature and the need for future research on the relationships between music education and academic performance among high school students.

Large Music Ensemble and Academic Achievement

A positive correlation exists between students who participate in music education and higher cognitive development (Marino & Chinn, 2023; Thorpe & McPhail, 2022; Venter & Panebianco, 2022). Jo (2023) found music training to augment language and reading skills. Additionally, Barbeau et al. (2023) argued music participation enhances cognitive abilities that support academic performance. Music education also plays an essential role in students' social and emotional development (Guhn et al., 2020). Guhn et al. (2020) demonstrated that participation in music classes helps students' self-

esteem and social skills. Ellis (2021) indicated that music improves coordination and collaboration.

Music has a similar relationship with academic performance as other performing arts classes (Bennett & Sena Moore, 2023; Fautley & Daubney, 2022; Rolandson & Conn, 2022). Music education has been linked to the academic achievement of secondary school students (Gonzalez Ben, 2022; Fautley & Daubney, 2022; Tucker & Winsler, 2023). Studies show a positive correlation between musical enrollment and improved academic performance (Gonzalez Ben, 2022; Springer & Silvey, 2022; Tucker & Winsler, 2023). Tucker and Winsler (2023) discovered that enrollment in music was associated with higher grades and improved performance on standardized assessments. Some researchers have found no statistically significant correlation between participation in large music ensembles and academic achievement. Shaw's (2025) use of propensity score weighting for multiple regression analysis elicited no statistically significant results between participation in choir and/or orchestra and academic achievement. However, Shaw (2025) concluded these results do not falsify the theoretical proposition of a relationship between music participation and academic achievement, due to the limitations and delimitations of his study.

Learning to perform a musical instrument is associated with mathematical and spatial-temporal abilities (Abeles et al., 2021). Gonzalez Ben (2022) revealed a correlation between music education and mathematical achievement. Abeles et al. (2021) discovered musical training improved children's spatial-temporal reasoning. Additionally, music education can enhance language abilities (Hietanen et al., 2022). Hietanen et al. (2022) noted musical training improved children's verbal intelligence.

Their discovery may be due to the cognitive processes shared by music and language, such as auditory sequencing and aural focus.

Music training is theorized to impact executive functions, which include problem-solving, planning, and concentration (Abeles et al., 2021; Daubney & Fautley, 2020; Gonzalez Ben, 2022). According to a study by Daubney and Fautley (2020), musical training may improve adolescents' verbal memory, attention, and executive functions. As a result, music enrollment has been found to have a positive impact on graduation rates and school engagement (Choi & Seo, 2022; Daubney & Fautley, 2020). Students who participate in music programs are often more engaged in school, which can lead to improved academic outcomes (Choi & Seo, 2022). Daubney and Fautley (2020) discovered schools with music programs had substantially higher graduation rates than those without.

Researchers have indicated a relationship between fostering reflective and creative thinking through programs such as music or the arts, which can lead to improved academic achievement among some students. Welch et al. (2020) highlighted the lack of objective and quantifiable knowledge regarding the impact of music on academic outcomes. According to Welch et al. (2020), data regarding the potential impact on well-being stemming from music enrollment, which is crucial for developing cognitive behavior and skills in adolescence, is available. However, it remains to be determined whether there is a statistically significant relationship between music participation and academic achievement. Akpur (2020) investigated the potential efficacy of music enrollment and its relationship to academic achievement. The research study included a sample of 227 students from a state university, comprising

56% male and 44% female participants. Students demonstrated critical, reflective, and creative thinking dispositions throughout the data collection process. Academic achievement, as well as overall grades by institution for the fall term, were taken into consideration. Structural equation modeling identified critical thinking, creative thinking, and reflective thinking to be positively associated with improving academic achievement. Akpur (2020) and Welch et al. (2020) argued that such factors are related to music-based enrollment, as they foster the development of reflective, creative, and academic achievement outcomes. However, the limitation is a lack of focus on music ensembles and insufficient consideration of data from individuals at the higher education level, rather than the high school level.

Some researchers presented conflicting findings regarding the relationship between music enrollment and students' academic achievement scores. Guhn et al. (2020) investigated potential relationships between academic achievement and participation in school music programs. The study included 112,916 students in grades 7 through 12 across the province of British Columbia. The aim was to determine if a relationship existed between music education, mathematics, science achievements, and English proficiency. Student language and cultural background were controlling factors, while concepts such as enrollment type, engagement level, and music achievement were also examined in the study. The results indicated higher levels of music engagement to be associated with higher exam scores in all subjects. Sala and Gobet (2020) examined academic outcomes specific to music training with children using a multi-level meta-analysis of 6,984 studies. The studies included design quality and overall effect size, which were considered detrimental to the quality of examined

programs. Furthermore, no statistically significant differences were identified regarding music training programs and their overall effect on academic outcomes. These two results present controversial findings and further emphasize the importance of understanding student-level data, particularly considering the large population size and significant confounding variables, such as those considered in this study.

Some literature addresses music enrollment from a statistical perspective. Hash (2021) explored the importance of music education, enrollment, and engagement, with a focus on student achievement. A survey of 462 directors was conducted to assess the importance of music engagement, changes in school bands during the COVID-19 pandemic, and the potential impact on student outcomes. According to survey directors, music enrollment is ideal for promoting student achievement, engagement, and enrollment. However, as Hash's (2021) results focused on study material from a perspective rather than quantifiable data, it is unclear whether a statistical relationship exists. Bauer (2020) argued available data regarding the potential relationship between enrollment and student achievement to be based mainly on perceptions without consideration of statistical knowledge. Bauer (2020) also recommended further exploration of this gap, focusing on topics such as music ensembles. Such recommendations emphasize the importance of expanding upon the gap in the literature between high school large music ensemble enrollment and academic performance.

Influence on Cognitive Development of High School Students

Several aspects of cognitive development have also been linked to enrollment in music (Incognito et al., 2022; Massy & Sembiante, 2022; Montemayor et al., 2023). Music education can foster critical thinking and problem-solving abilities (Incognito et

al., 2022; Montemayor et al., 2023; Venter & Panebianco, 2022). Students must make decisions, evaluate possibilities, and think creatively when creating or interpreting art (Fautley & Daubney, 2022). Ulger (2019) finds music education to enhance critical thinking abilities, including observational, interpretive, and reasoning based on visual evidence. Learning to perform a musical instrument can also improve spatial-temporal abilities (Abeles et al., 2021; Asztalos, 2022; Pendergast & Robinson, 2020). According to Pendergast and Robinson (2020), music training has been shown to improve spatial-temporal reasoning in young infants, and this improvement may be long-lasting. Furthermore, an arts education can enhance memory and focus (Bowen & Kisida, 2019; Prest & Goble, 2021).

Studies have demonstrated a correlation between music education and improved language abilities (Daubney & Fautley, 2020; Gorbunova & Plotnikov, 2019). Paananen (2022) found musical training to improve children's verbal intelligence, potentially due to cognitive processes shared by music and language, such as auditory sequencing and aural focus. Additionally, music education was found to enhance mathematical abilities (Incognito et al., 2022; White, 2021). White (2021) revealed a significant correlation between music education and mathematical achievement. Music and mathematics entail pattern recognition and sequential processing.

Researchers have further noted music education to be associated with improved academic achievement among elementary school students (Abeles et al., 2021; Daubney & Fautley, 2020; Lim, 2020). These studies indicated a positive relationship between music and improved academic achievement. Researchers have also demonstrated students involved in some form of music training tended to perform better

on standardized assessments overall (Bowen & Kisida, 2019; Hong & Chu, 2021; Lage-Gomez & Cremades-Andreu, 2019). Several researchers have argued arts education is related to a variety of cognitive abilities, including critical thinking, spatial-temporal skills, memory and attention, language skills, and mathematical abilities (Asztalos, 2022; Gonzalez Ben, 2022; Gorbunova & Plotnikov, 2019). These cognitive benefits can enhance academic performance and lifelong learning skills (Incognito et al., 2022). Furthermore, enrollment in the arts can facilitate the development of social skills such as collaboration, communication, and empathy (Prest & Goble, 2021; Winsler et al., 2020).

Music enrollment is also related to emotional health by facilitating self-expression, boosting self-esteem, and reducing anxiety and tension (Bae, 2021). Cho (2021) found low-income students who participated in the arts had a more positive self-concept and were more engaged in school than their classmates who did not participate in the arts. Therefore, participating in the arts may help fill educational gaps among students who perform below their grade level, those with lower socioeconomic status, or those with limited resources to engage in extracurricular programs. Enrollment in the arts also fosters personal development (Robinson et al., 2021; Tucker & Winsler, 2023). One example was the improved self-confidence, and self-esteem can result from enrollment in music education classes (Cho, J.E., 2021). Learning and mastering an art form can give students a sense of accomplishment, boosting their self-esteem and confidence (Massy & Sembiante, 2022). Enrollment in the performing arts can facilitate increased resilience (Kinney, 2019; Yoo, 2021). The arts often involve critique and

iterative improvement, teaching students how to manage setbacks and criticism, which can increase their resilience (Kinney, 2019).

Enrollment and Student Academic Performance in High School

Students participating in arts programs are often more engaged in their studies. Positive engagement is associated with improvements in academic outcomes, according to evidence from the field of education (Adams et al., 2023; Gorbunova & Plotnikov, 2019). Park (2021b) found students from low socioeconomic backgrounds who participated in the arts to be more likely to remain in school from one year to the next, demonstrate higher levels of academic performance and achievement, and were also more likely to graduate than their peers who did not participate in any of the performing arts in their education careers. Retention and persistence are two critical components of success in high school, and music can help promote these outcomes (Gorbunova & Plotnikov, 2019).

High school music education can be associated with academic performance. Researchers have noted a positive relationship between music education and academic achievement (Abeles et al., 2021; Guan & Matsunobu, 2022; Massy & Sembiante, 2022). Abeles et al. (2021) found music enrollment is associated with higher grades and test scores. Guan and Matsunobu (2022) found schools with music programs to have significantly higher graduation rates than those without.

Multiple cognitive abilities are associated with music education (Bowen & Kisida, 2019; Bong et al., 2021; Fautley & Daubney, 2022). For instance, playing an instrument has been associated with enhanced mathematical skills, language proficiency, and spatial-temporal abilities (Choi & Seo, 2021; Gorbunova & Plotnikov, 2019; Yi, 2022).

Music training has also been linked to improvements in executive functions, including problem-solving, planning, and attention (Bae, 2021; Gorbunova & Plotnikov, 2019). According to a qualitative case study of self-reported music appreciation reports, student reflections, and self-reported emotion charts, 83.78% of students reported improved verbal memory, attention, and executive functions (Bae, 2021).

Participating in a band or orchestra can foster students' social connection, teamwork, discipline, and respect for others (Incognito et al., 2022; Marino & Chinn, 2023). Marino and Chinn (2023) reported participating in an ensemble to enhance their social skills and provided them with a sense of belonging. Furthermore, the emotional release provided by music can assist students in expressing and managing their emotions (Gonzalez Ben, 2022). Additionally, it can boost self-esteem and provide a sense of accomplishment (Lage-Gomez & Cremades-Andreu, 2019). Gorbunova and Plotnikov (2019) found school-based music programs to be potentially associated with improved emotional health among students.

Playing an instrument is related to improved fine motor skills and hand-eye coordination (Guhn et al., 2020; Venter & Panebianco, 2022). Fine motor skills are not commonly taught at the high school level, but they are crucial for optimal physical and psychological development (Guhn et al., 2020). According to Venter and Panebianco (2022), children who played musical instruments had superior motor skills compared with those who did not. Therefore, music offers not only artistic and creative benefits, but also physical benefits. While music education can have these benefits, it was essential to consider that the outcomes can depend on many factors, such as the quality, type, and pedagogical approach of the music program, the student's level of

engagement with the material, individual factors, and the school and community's level of support (Bowen & Kisida, 2019; Philpott, 2022). Therefore, to maximize the benefits, researchers generally agree music education should be thoughtfully implemented in school buildings and adequately supported by stakeholders (Bennett & Sena Moore, 2023; Pendergast & Robinson, 2020; Rolandson & Conn, 2022). The following subsection contains a summary of the literature related to possible outcomes of student enrollment in high school performing arts.

A relationship may exist between secondary school students' music education and academic achievement (Adams et al., 2023; Calderon-Garrido & Gustems-Carnicer, 2021; Guhn et al., 2020). Secondary students participating in music education tend to perform better on standardized tests and earn higher grades (Calderon-Garrido & Gustems-Carnicer, 2021; Robison et al., 2021; Rolandson & Conn, 2022). Performing arts education can enhance cognitive skills, social abilities, emotional health, physical fitness, and college readiness (Nasritdinova, 2021). Music education may help students prepare for college and careers, as well as cultivate cultural awareness and appreciation (Robison et al., 2021). Enrollment in music education, as well as other arts, can have various relationships between high school students, depending on the program's caliber, the art forms involved, and the student's level of engagement and interest (Calderon-Garrido & Gustems-Carnicer, 2021).

Music education, mainly active and immersive, is related to positive academic outcomes for secondary school students, including higher grades and test scores, as well as higher graduation rates, compared to those without music education (Gorbunova & Plotnikov, 2019). Philpott (2022) found a correlation between music education and

enhanced cognitive abilities, executive functions, social connection, collaboration, discipline, and respect for others (Philpott, 2022). Enrollment in a music education course can cultivate social interaction, teamwork, self-control, and regard for others (Zhou, 2022). Participation in music education can improve a student's self-esteem and mental health as well as their physical capabilities. For example, playing an instrument can enhance fine motor skills and hand-eye coordination along with increasing attention to details (Hong & Chu, 2021).

Music Enrollment and Other Outcomes

Music education is also related to social and emotional benefits for high school students' lives, including citizenship, health, and school satisfaction (Cho, 2021; Park, 2021c; Guhn et al., 2020). Enrollment in school music programs often involves community performances, which can foster a sense of social responsibility and community engagement (Adams et al., 2023). Through their performances, students learn the importance of giving back to the community (Prest & Goble, 2021). Music education can introduce students to diverse cultures and perspectives, fostering cultural understanding, empathy, and tolerance (Petress, 2005). These characteristics are essential for citizenship.

Music can serve as an outlet for emotional expression, which is beneficial for emotional health (Nogai, 2020). Additionally, it can serve as a source of relaxation and tension relief, thereby contributing to overall well-being (Yun, 2021). Music enrollment can also benefit cognitive health (Montemayor et al., 2023). Playing a musical instrument, for instance, has been shown to improve cognitive functions such as memory and attention, which are vital to mental health (Hong & Chu, 2021).

Music education can positively impact students' perceptions of school, such as increasing engagement and fostering a sense of belonging (Calderon-Garrido & Gustems-Carnicer, 2021; Daubney & Fautley, 2020). Students involved in music programs often demonstrate increased engagement with school (Guan & Matsunobu, 2022). Enrollment in music ensembles can increase a student's overall school satisfaction, according to Hong and Chu (2021). As discussed in this review, music education can enhance academic performance and contribute to students' school satisfaction (Montemayor et al., 2023). Students are more likely to have a positive attitude toward school if they perceive themselves as academically successful (Bang, 2022).

The abilities developed through music, such as discipline, perseverance, and creativity, are highly valued in college and career settings (Gorbunova & Plotnikov, 2019; Rolandson & Conn, 2022). Bath et al. (2020) found arts-engaged pupils to be more likely to enroll in and complete college. However, although these findings suggest that music education is related to academic achievement, the outcomes can be contingent on the quality and nature of the music program, the student's level of engagement, and the school and community's level of support (Barbeau et al., 2023; Elpus & Abril, 2019; Kwon & Jung, 2022). Therefore, it is essential to ensure that music education is of high quality and well-integrated into the broader curriculum (Fautley & Daubney, 2022). The following sub-section summarizes the literature on the outcomes of enrollment in the performing arts on students' academic performance in high school.

Summary

This chapter presented a literature review of critical constructs and variables associated with music education and relationships with students' development and academic performance (Adams et al., 2023; Springer & Silvey, 2022; Thapa & Rodriguez-Quiles, 2023). First, the strategy for searching the literature was discussed. The literature review on emerging themes from pertinent research was then presented. This review focused on three major themes: the role of enrollment in the performing arts in the development of high school students, the effects of enrollment in the performing arts on high school students, and the impact of enrollment in the performing arts on high school students' academic performance.

Studies showing results related to increase in student enrollment showed that performing arts were an educational strategy that integrates various forms of arts education into a single course of study (Liddell, 2022). Studies have demonstrated music programs can enhance cognitive development; however, the quality of the program and student engagement can influence outcomes (Daubney & Fautley, 2020; Liddell, 2022; Montemayor et al., 2023). Enrollment in the performing arts contributes to the development of secondary school students in numerous ways (Daubney & Fautley, 2020). The second theme relates to the effects of a performing arts education that includes music, visual arts, theater, and dance, which were generally positive and significant when applied longitudinally (Lim, 2022). Additionally, students who participate in the arts tend to demonstrate higher levels of academic performance and higher test scores (Daubney & Fautley, 2020). Persistent music and arts education is associated with significant improvements in cognitive skills, social development,

emotional health, physical fitness, and readiness to transition to college as well (Elpus & Abril, 2019; Guhn et al., 2020; Thorpe & McPhail, 2022). Music education can have significant long-term effects on high school students, including improvements in test scores and grade point averages, which can increase students' likelihood of graduating (Thorpe & McPhail, 2022). Music has a similar impact on academic performance as other arts; however, some aspects are unique to this discipline (Jung, 2023). However, the outcomes can be contingent upon the quality and nature of the program, the student's level of engagement, and the level of support from the school and community.

More research is needed to determine how to design and implement performing arts programs to maximize potential benefits, especially in rural school settings. It has been demonstrated that the performing arts have a positive impact on the development of secondary school students (Winsler et al., 2020). As indicated previously, the benefits of performing arts on these outcomes were moderated and mediated by a range of factors such as the program's quality, the performing arts being applied and the underlying pedagogical approach involved, and students' sense of engagement and interest (Cho, 2022; Paananen, 2022; Winsler et al., 2020).

Enrollment in music programs has been linked to higher cognitive development. Art education, along with music education, can improve critical thinking, problem-solving, spatial-temporal reasoning, memory, concentration, language, and mathematical skills (Fautley & Daubney, 2022; Regier, 2022). Music programs can improve cognitive development, but it is crucial to note that program quality and student engagement can influence outcomes (Adams et al., 2023; Montemayor et al., 2023; Siljamaki & Kanellopoulos, 2020). Enrollment in the performing arts contributes to the

development of high school students in numerous ways (Guhn et al., 2020; Marino & Chinn, 2023). Such research has included positive impacts from music education with numerous studies focused on how music itself impacts student's academic performance. However, gaps in current research continue to warrant attention (Daubney & Fautley, 2020; Gonzalez Ben, 2022; Springer & Silvey, 2022). Further research is needed to investigate the impact of music enrollment on the academic performance of secondary school students. Quantitative studies are necessary to understand the mechanisms by which music enrollment is related to academic performance.

Location and socioeconomic status are contextual factors that should also be examined. It should be determined through research how the duration of enrollment in a music education program relates to student academic achievement. There is a need for additional research on the relationships between high school large ensemble music enrollment and academic performance among diverse populations, such as students in rural settings where funding and access to music education may be limited compared to other settings. The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. Chapter Three presents the methodology to achieve this study´s aims and objectives.

Chapter 3

Methods and Procedures

In Chapter Three, I describe the quantitative methods and procedures applied in this study. The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. Specifically, the study examined how the type of large music ensemble (i.e., band and/or choir) and the duration of students' participation in these programs during high school were related with selected operationalizations of academic performance. The data used in this study were anonymized, secondary data at the student level of analysis. The statistical methods used to test the hypotheses included both parametric and nonparametric methods.

Research Design

The research design was non-experimental, and quantitative. The design was non-experimental because the study was not focused on estimating the change in a dependent variable over time, before and after the implementation of an intervention or treatment (Fitzmaurice et al., 2018). The design was quantitative because it used numerical data to analyze the statistical relationships among two or more variables (Fitzmaurice et al., 2018). The anonymized secondary dataset used in this study reflected these three design features. There were data for multiple years for each student. There were no data for an intervention or a treatment variable. All of the data in the dataset were numeric rather than string values.

Validity

Validity concerns are related to both the internal and external aspects of the study's design (Andrade, 2018). Internal validity is tied to the study's research design, specifically the extent to which the design accounts for the threats to making a causal claim (i.e., the threats to internal validity) upon the results of statistical analysis (Andrade, 2018). External validity refers to the extent to which the findings can be generalized probabilistically to other contexts (Andrade, 2018).

The threats to internal validity that the dataset accounted for were maturation and history. Maturation was accounted for by the longitudinal nature of the dataset. History was accounted for by the inclusion in the dataset of students who participated in neither band nor choir. Selection remained a threat to internal validity because enrollment in a band and/or choir was not randomly assigned. Statistical regression was not a threat because enrollment was not assigned to students based on a cut-off. Testing and instrumentation were not threats because no data were collected directly from human subjects (Tabachnick et al., 2013). Social response bias was not a threat because the data were academic performance measures rather than self-reports or teacher reports of academic performance (Tabachnick et al., 2013). Omitted variable bias was a threat due to the delimitation of the study to include variables just for high school large music ensemble enrollment, to the exclusion of data for other variables that are known to be statistically associated with academic performance (Tabachnick et al., 2013).

The results of the hypothesis testing were externally valid for the target population because the secondary dataset included every student in that population. The results of the study were not generalizable beyond the target population due to

students outside the target population having a zero percent chance of being included in the dataset.

Participants

The target population for this study was high school students attending eleven rural high schools in Georgia. The anonymized, secondary data for the study "participants" were collected prior to the current study through routine school record keeping (N = 2,981). The research protocol for the cleaning, coding, and analysis of the dataset was determined to be "non-human subjects research" by the Auburn University Institutional Review Board (IRB) because the secondary data had been de-identified (see Appendix B). I employed a census strategy that included the entire population because the dataset included every student in the target population (Verma & Abdel-Salam, 2019). A G*Power a priori power analysis was conducted for the bivariate analyses (for RQ1/H_1 and RQ2/H_1), which elicited a minimum N of 210. Another G*Power a priori power analysis was conducted for the multivariate analyses (for RQ3/H_1), which elicited a minimum N of 119. Both tests were conducted for an alpha level of 0.05, power of .80, and effect size f = 0.25 (moderate effect size). The results are presented in Appendix C.

Data Collection and Variables

The dataset was an anonymized, secondary dataset at the student level of analysis. Authorization to use the data was received before the study commenced. The operationalization of each variable is presented in this section, organized by research question and alternative hypothesis. ACT score was operationally defined as the student's reported ACT composite score. The ACT composite score is reported on a 1-

to-36 scale and reflects the average of the student's English, mathematics, and reading scores, rounded to the nearest whole number (ACT, n.d.). EOC overall score was operationally defined as the student's reported overall Georgia Milestones End-of-Course assessment score. Georgia Milestones measures how well students have learned the state-adopted content standards in tested subject areas (Georgia Department of Education, n.d.). American Literature EOC score was operationally defined as the student's reported score on the American Literature and Composition EOC assessment, which is a criterion-referenced assessment of mastery of the course content standards (Georgia Department of Education, 2020). EOC level was operationally defined as the student's categorical achievement level on the EOC assessment, reported as one of four Georgia Milestones performance levels: Beginning Learner, Developing Learner, Proficient Learner, or Distinguished Learner (Georgia Department of Education, 2020). GPA was operationally defined as the student's cumulative grade point average, which served as a school-based measure of academic performance (Beatty et al., 2015).

RQ1/H_1

The first research question (RQ1) was "Is there a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement?" The alternative hypothesis (H_1) for RQ1 was "There is a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement." This hypothesis was tested using two operationalizations of the independent variable and five operationalizations of the dependent variable. The

independent variable was operationalized using five, mutually exclusive binary variables (yes=1, no=0): (1) enrollment in band regardless if also enrolled in choir (*Band enrollment* in Table 1), (2) enrollment in choir regardless if also enrolled in band (*Choir enrollment* in Table 1. The reference group for RQ1/$H_1$was students enrolled in neither band nor choir. The dependent variable for RQ1/H_1 was academic achievement. The different operationalizations of the dependent variable for RQ1/H_1 were ACT score, EOC overall score, American literature EOC score, EOC level, and GPA.[1]

Table 1

Research Question 1: Operationalizations of the Independent Variable

Variable name	Operationalization (yes=1)	Reference group (no=0)	Reasoning
Band enrollment	The student enrolled in band only, or in both band and choir	The student enrolled in choir only, or in neither band nor choir	To estimate the statistical association of any type of band enrollment (i.e., with or without choir enrollment) with academic achievement
Choir enrollment	The student enrolled in choir only, or in both band and choir	The student enrolled in band only, or in neither band nor choir	To estimate the statistical association of any type of choir enrollment (i.e., with or without band enrollment) with academic achievement

[1] EOC Level is an ordinal variable based on Georgia Milestones performance levels.

RQ2/H1

The second research question (RQ2) was “Is there a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement?” H_1 for RQ2 was “There is a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement.” This hypothesis was tested using six operationalizations of the independent variable and five operationalizations of the dependent variable. The independent variable was operationalized using five ratio-level variables: (1) the number of years of enrollment in band regardless of the number of years also enrolled in choir (*Band enrollment years* in Table 2), (2) the number of years of enrollment in choir regardless of the number of years also enrolled in band (*Choir enrollment years* in Table 2, (3) the number of years of enrollment in band for students never enrolled in choir (*Band enrollment only years* in Table 2), (4) the number of years of enrollment in choir for students never enrolled in band (*Choir enrollment only years* in Table 2), (5) the number of years of enrollment in either band or choir for students enrolled in band only or choir only (*Band or choir years* in Table 2), and (6) the number of years of enrollment in both band and choir, (*Band and choir years* in Table 2). The reference group for RQ2/H_1 was students who never participated in band or choir and therefore have zero years of participation in each type of large high school music ensemble. The dependent variable for RQ2/H_1 was academic achievement. The different operationalizations of the dependent variable for RQ2/H_1 were ACT score, EOC overall score, American literature EOC score, EOC level, and GPA.

Table 2

Research Question 2: Operationalizations of the Independent Variable

Variable name	Operationalization (#years ≥ 1)	Reference group (#years = 0)	Reasoning
Band enrollment years	The number of years a student was enrolled in band, for students who were enrolled in band only, and for students who were enrolled in both band and choir	Students enrolled in band for 0 years, including students enrolled in choir only, and students who never enrolled in band or choir	To estimate the statistical association of the number of years of band enrollment of any type (i.e., band-only, band and choir) with academic achievement
Choir enrollment years	The number of years a student was enrolled in choir, for students who were enrolled in choir only, and for students who were enrolled in both band and choir	Students enrolled in choir for 0 years, including students enrolled in band only, and students who never enrolled in band or choir	To estimate the association of the number of years of choir enrollment of any type (i.e., choir-only, band and choir) with academic achievement
Band enrollment only years	The number of years a student was enrolled in band, for students who were enrolled in band only	Students enrolled in band for 1 or more years who were also enrolled in choir for 1 or more years, and students enrolled in band for 0 years, including students enrolled in choir only, and students who never enrolled in band or choir	To estimate the statistical association of the number of years of band-only enrollment (i.e., excluding the number of years of band enrollment for students enrolled in band and choir) with academic achievement
Choir enrollment only years	The number of years a student was enrolled in choir, for students	Students enrolled in choir for 1 or more years who were also enrolled in band for 1 or more	To estimate the statistical association of the number of years of any singular type of

Variable name	Operationalization (#years ≥ 1)	Reference group (#years = 0)	Reasoning
	who were enrolled in choir only	years, and students enrolled in choir for 0 years, including students enrolled in band only, and students who never enrolled in band or choir	large high school music ensemble participation (i.e., band-only, choir-only, excluding enrollment in both band and choir) with academic achievement
Band or choir years	The number of years a student was enrolled in band, for students who were enrolled in band only, or the number of years a student was enrolled in choir, for students who were enrolled in choir only	Students enrolled in choir for 1 or more years who were also enrolled in band for 1 or more years, and students who never enrolled in band or choir	To estimate the effect of each year of (i.e., excluding the number of years of choir enrollment for students enrolled in band and choir) on academic achievement
Band and choir years	The number of years a student was enrolled in both band and choir	Students enrolled in band only for 1 or more years, students enrolled in choir only for one or more years, and students who never enrolled in band or choir	To estimate the statistical association of the number of years of dual enrollment in a large high school music ensemble participation (i.e., both band and choir) with academic achievement

RQ3/H_1

The third research question (RQ3) was “Is there a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model?” *H_1* for RQ3 was “There is a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model.” This hypothesis was tested using ten operationalizations (five binary and five years of enrollment) of the independent variable and five operationalizations of the dependent variable. The independent variables for the multivariate hypothesis test for RQ3/*H_1* were all of the binary variables except *Band or choir enrollment* and *Band and/or choir enrollment.* The former was excluded due to singularity with *Band only enrollment* and *Choir only enrollment*. The latter was excluded due to singularity with *Band enrollment* and *Choir enrollment*. The reference group for RQ3/*H_1* was students not enrolled in band or choir. The dependent variable for RQ3/*H_1* was academic achievement. The different operationalizations of the dependent variable for RQ3/*H_1* were ACT score, EOC overall score, American literature EOC score, EOC level, and GPA.

Summary of Data Collection and Variables

Table 3 summarizes the independent variables and reference groups for RQ1/*H_1*, RQ2/*H_1*, and RQ3/*H_1*. The quantitative models for RQ1/*H_1* and RQ2/*H_1* are bivariate; the quantitative model for RQ3/*H_1* is multivariate. If a subgroup of the study sample was included in the reference group, the cell includes an “X” in the table. If a subgroup of the study sample was not included in the reference group, the cell is blank in the table.

Table 3

Summary of Independent Variables and Reference Groups for RQ1/H1, RQ2/H1, and RQ3/H3

Research question and hypothesis	Independent variables	Subgroups (X = included in the reference group)			
		Students enrolled in choir only	Students enrolled in band only	Students enrolled in both band and choir	Students never enrolled in either band or choir
RQ1/H_1 and RQ2/H_1	*Band enrollment* (regardless of choir enrollment) (RQ1/H_1) and *Band enrollment years* (RQ2/H_1)	X			X
RQ1/H_1 and RQ2/H_1	*Choir enrollment* (regardless of band enrollment) (RQ1/H_1) and *Choir enrollment years* (RQ2/H_1)		X		X
RQ2/H_1	*Band only enrollment years* (RQ2/H_1)	X		X	X
RQ2/H_1	*Choir only enrollment years* (RQ2/H_1)		X	X	X
RQ2/H_1	*Band or choir enrollment*			X	X

Research question and hypothesis	Independent variables	Subgroups (X = included in the reference group)			
		Students enrolled in choir only	Students enrolled in band only	Students enrolled in both band and choir	Students never enrolled in either band or choir
	(RQ1/H_1) and *Band or choir only enrollment years* (RQ2/H_1)				
RQ2/H_1	*Band and choir only enrollment years* (RQ2/H_1)	X	X		X
RQ2/H_1	*Band and/or choir only enrollment years* (RQ2/H_1)				X
RQ3/H_1 (binary independent variables)	*Band only enrollment*, *Choir only enrollment*, and *Band and choir enrollment*				X
RQ3/H_1 (continuous independent variables)	*Band only enrollment years*, *Choir only enrollment years*, and *Band and choir enrollment years*				X

Data Ethics

I did not collect identifiable human subject data. The dataset was anonymized before I was authorized to access it. I stored the dataset on an encrypted USB file for which only I know the password. I have stored the encrypted USB file in a locked file cabinet in my home office. I will clean and destroy the encrypted USB file five years after the graduation date on the title page of this manuscript.

Statistical Description of the Variables

Descriptive statistics included percentages for categorical variables, as well as measures of central tendency and variability for continuous variables. The mean, standard deviation, skewness, and kurtosis were reported for the continuous variables to describe the data's central tendency, variability, and posterior distribution. The mean was reported to support estimating the central value among cases for specific values, while the standard deviation supported my understanding of the dispersion of values among cases (Tabachnik & Fidell, 2018). The skewness and kurtosis values helped me to understand the distribution of values for individual cases within the sample, regarding the shape of the data. Specifically, the skewness statistic supported my understanding of whether and to what extent the value was positive or negative (Tabatchnick & Fidell, 2018). The kurtosis statistic supported my understanding of whether there was a platykurtic or leptokurtic distribution of the data and to what extent a platykurtic or leptokurtic distribution exists (Tabatchnick & Fidell 2018). The descriptive statistics also included the coefficient of variance ($CV = \sigma/m$).

The *CV* value was included to delineate the standard deviation ratio, providing a percentage representation of variation from the mean (Tabachnick & Fidell, 2018). These statistics are presented and interpreted in Chapter 4.

Statistical Assumptions Tests

The variables included in the study were tested, when appropriate, for linearity, normality of residuals, multicollinearity, and heterogeneity. Linearity was tested using scatterplots with fitted regression lines and Lowess smoothers (see Appendix D). The normality of residuals was assessed by creating histogram models for the Shapiro-Wilk test using the residuals from the regression models tested for each hypothesis. If the result was $p \leq .05$, then the null hypothesis concerning the normal distribution of the data was rejected, and the alternative was accepted. The null hypothesis was that the distribution was normally distributed; the alternative hypothesis was that the distribution was not normally distributed. If the result was not $p \leq .05$, then it was assumed that there was no normal distribution of the residuals (Verma & Abdel-Salam, 2019). After each analysis of variance test, Levene's test for heterogeneity was conducted to assess the equality of variances across groups. This procedure evaluated whether the assumption of equal variances was met for each dependent variable. When Levene's test was significant ($p \leq .05$), indicating heteroskedasticity, the results were interpreted using nonparametric alternatives or supported by additional robustness checks. Multicollinearity was assessed using a variance inflation factor (VIF), with a threshold of 10 as the cutoff for acceptable multicollinearity in the dataset (Verma & Abdel-Salam, 2019). The assumption of heterogeneity was tested using the Breusch-Pagan test where the null hypothesis is that residuals have constant variance. If $p \leq .05$, the assumption of heterogeneity was rejected (Verma & Abdel-Salam, 2019), whereas $p > .05$ indicates heterogeneity. If the assumptions were violated, potential considerations would include reporting the assumption violation as a limitation in Chapter 5, applying a

transformation or a log to the data, or selecting an alternative non-parametric test. The results of these tests are presented in Chapter 4.

Hypothesis Tests

All Shapiro-Wilk tests were statistically significant ($p \leq .05$), indicating that the dependent variables were non-normally distributed. Therefore, the Kruskal–Wallis H test was used for RQ1/H_1, the research question and alternative hypothesis for the binary operationalizations of enrollment in high school large music ensembles (see Table 1 above). The Kruskal–Wallis test, a rank-based nonparametric alternative to one-way ANOVA, was used because it does not assume normality or equality of variances and provides a valid test of distributional differences between groups when data violate parametric assumptions (Field, 2018). The Kruskal–Wallis test is also appropriate for ordinal dependent variables such as EOC Level because it compares ranked outcomes across groups without assuming equal intervals between achievement categories (Conover, 1999).[2]

For RQ2/H_1, in which high school large music ensemble participation was operationalized as the number of years enrolled, ordinary least squares (OLS) regression analysis with heteroskedasticity-robust standard errors was used. OLS

[2] Log-transformed versions of the dependent variables were also examined to determine whether the transformation corrected for non-normality. However, the Shapiro–Wilk tests on the transformed variables remained statistically significant, indicating that normality was not achieved. Consequently, the raw dependent variables were retained for the Kruskal–Wallis analyses to preserve interpretability and consistency across models.

regression with heteroskedasticity-robust standard errors retains the OLS coefficient estimates but adjusts the estimated variance used for statistical inference (Wooldridge, 2020). OLS regression with heteroskedasticity-robust standard errors is not the same as robust regression, which uses a different estimation procedure designed to reduce the influence of outliers (Woolridge, 2019). In contrast, OLS regression with heteroskedasticity-robust standard errors does not change the OLS estimator itself. Instead, it adjusts the estimated standard errors to produce valid inferences when the assumption of constant error variance is violated (UCLA Statistical Consulting Group, n.d.). OLS with heteroskedasticity-robust standard errors was used instead of robust regression because the primary concern was heteroskedasticity rather than the presence of influential outliers that would require an alternative estimation method like robust regression (UCLA Statistical Consulting Group, n.d.; Woolridge, 2019). Although the dependent variables were non-normal, the large sample size (N > 1,000) invoked the Central Limit Theorem, ensuring that coefficient estimates were unbiased and approximately normally distributed.

The EOC Level variable was categorical and ordinal; therefore, an ordered logistic regression model was used for that dependent variable rather than OLS regression analysis (Woolridge, 2019). Georgia Milestones EOC performance levels constitute an ordinal categorical variable because they classify student performance into discrete categories that have a meaningful order but not a known or equal distance between them. Specifically, EOC scores are reported as four achievement levels: Beginning Learner, Developing Learner, Proficient Learner, and Distinguished Learner. These categories clearly represent increasing levels of mastery of course standards,

which establishes an ordered ranking. However, the difference between adjacent levels (e.g., between Developing to Proficient and Proficient to Distinguished) does not represent a uniform or measurable interval, meaning the variable cannot be treated as continuous. Because the dependent variable consists of ordered categories rather than continuous values, an ordered logit model is appropriate (Woolridge, 2019). Ordered logit regression is designed for dependent variables that are categorical but ranked, allowing the analysis to estimate how independent variables influence the probability that an observation falls at or above a given category while respecting the ordinal structure of the outcome (Wooldridge, 2019).

The third research question and hypothesis (RQ3/H_1) constituted a multivariate version of RQ1/H_1. Each of the binary independent variables from RQ1/H_1 was specified in a multivariate quantitative model for RQ3/H_3. The reference group for *RQ3/H_1* was distinct from that for *RQ1/H_1* because it consisted exclusively of students who were not enrolled in any music ensemble in the dataset (see Table 3 above). Multivariate regression analysis was used due to the five independent variables. Specifically, OLS regression with heteroscedasticity-robust standard errors was used for the same reasons as specified for RQ2/H_1. Ordered logistic regression was used for the categorical ordinal dependent variable (i.e., EOC Level) for the same reasons as for RQ2/H_1.

Chapter 4

Results

Chapter Four of this quantitative dissertation includes the analysis of primary data. The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. This study involved public school system data from high school students from rural areas in the state of Georgia as the unit of observation. Primary existing data were used to examine student membership status and duration of membership for the school band and choir. The results of this study suggest a positive association between large ensemble enrollment and student academic performance, based on the strength, direction, and significance of the statistical findings. Chapter Four includes three sections: outlier removal and descriptive statistics, tests for normality, tests for heterogeneity and linearity, tests for multicollinearity, and hypothesis tests.

Outlier Removal and Descriptive Statistics

The descriptive statistics summarized the distribution and variability of key academic performance variables (Table 4). The dataset included 2,981 observations. Skewness levels were determined using the conventional absolute skewness value thresholds described by Kim (2013) and Doane and Seward (2011), whereby values less than 0.5 indicated approximately symmetric or mildly skewed distributions, values between 0.5 and 1.0 indicated moderate skewness, and values greater than 1.0 indicated high or strong skewness. ACT scores had a mean of 20.06 (*SD* = 5.45), with values ranging from 6.00 to 36.00, with moderate positive skew (0.68) and leptokurtosis

(3.64). The EOC overall score had a mean of 510.29 (*SD* = 49.65), spanning from 330.00 to 871.00, with an approximately symmetric distribution (skewness = 0.05) and a leptokurtic distribution (4.56), evidence of a peaked distribution. GPA demonstrated a lower mean of 2.96 (*SD* = 0.63), with a range from 1.14 to 4.00 and slight negative skewness (-0.13). The GPA distribution was slightly skewed toward higher values.

Table 4

Statistical Description of the Dependent Variables

Variable	Mean	*SD*	*n*	*%*	Min	Max	Kurtosis	Skewness	*CV*
ACT score			1,111						
	20.06	5.45		37	6.00	36.00	3.64	0.68	0.27
EOC overall score			2,981						
	510.29	49.65		100	330.00	871.00	4.56	0.05	0.10
EOC American literature			2,981						
	75.22	10.58		100	33.00	100.00	3.30	-0.6	0.14
EOC level			2,981						
	2.25	0.85		100	1.00	4.00	2.20	0.02	0.38
GPA			2,981						
	2.96	0.63		100	1.14	4.00	2.16	-0.13	0.21

Descriptive statistics were also calculated for the binary enrollment variables which included dummy variables (Table 5). The descriptive statistics included an overview of enrollment in musical ensembles, including band and choir, as well as the duration of enrollment. Twenty-seven percent (*n* = 796) of observations in the dataset were enrolled in band, while 73% were not (*n* = 2,151). Eighteen percent of the observations (*n* = 548) were enrolled in choir, while 82% (*n* = 2433) were not. Only 4% of students were enrolled in both band and choir (*n* = 118). The years of any ensemble enrollment averaged 1.30 (*SD* = 1.84), with a right-skewed distribution (skewness = 1.15), suggesting that most students participated for a shorter duration. Choir enrollment years showed the strongest skew (2.52) and high kurtosis (8.19). The highest kurtosis was observed for enrollment years among students involved in both band and choir (29.91), demonstrating an extreme concentration of short durations.

Table 5

Shapiro–Wilk W Test for Normal Data

Variable	Mean	*SD*	*n*	%	Min	Max	Kurtosis	Skew.	*CV*
Band enrollment (dummy)	--	--	796	27	--	--	--	--	--
Choir enrollment (dummy)	--	--	548	18	--	--	--	--	--
Band enrollment only (dummy)	--	--	676	23	--	--	--	--	--
Choir enrollment only (dummy)	--	--	429	14	--	--	--	--	--
Band or Choir enrollment (dummy)	--	--	1,105	37	--	--	--	--	--
Band and Choir enrollment (dummy)	--	--	119	4	--	--	--	--	--
Band and/or choir enrollment (dummy)	--	--	1,224	41	--	--	--	--	--
Band or choir years	1.08	1.84	2,981	--	< .001	8.00	3.30	1.15	1.41
Band enrollment years	0.88	1.55	2,981	--	< .001	4.00	2.96	1.34	1.77
Choir enrollment years	0.43	1.04	2,981	--	< .001	4.00	8.19	2.52	2.45
Band only years	0.75	1.47	2,981	--	< .001	4.00	3.68	1.59	1.97
Choir only years	0.33	0.93	2,981	--	< .001	4.00	11.23	3.03	2.84
Band and choir years	0.22	1.15	2,981	--	< .001	8.00	29.91	5.24	5.11
Band and/or choir years	1.31	1.84	2,981	--	< .001	8.00	3.30	1.15	1.41

Normality Tests

All dependent variables were examined for normality using the Shapiro-Wilk *W* test (Table 6). Logarithmic transformations were then applied to reduce potential skew. However, the transformed variables also remained non-normally distributed (Table 7).

Table 6

Shapiro–Wilk W Test for Normal Data

Variable	*n*	*W*	*V*	*z*	*p*-value
ACT score	1,111	0.96	24.98	8.00	<.001
GPA	2,981	0.99	23.75	8.17	<.001
EOC American Literature Score	2,981	0.99	18.22	7.49	<.001
EOC Grade	2,981	0.98	39.08	9.46	<.001

Table 7

Shapiro–Wilk W Test for Normal Data (Log-Transformed Variables)

Variable	*n*	*W*	*V*	*z*	*p*-value
ACT score	1,111	0.98	11.31	6.03	<.001
GPA	2,981	0.97	49.69	10.08	<.001
EOC American Literature Score	2,981	0.98	28.21	8.62	<.001
EOC Grade	2,981	0.97	108.02	12.08	<.001

The Shapiro-Wilk test results for both the raw and log-transformed dependent variables confirmed that all dependent variables significantly deviated from normality ($p < .001$ for all). Therefore, for models with binary independent variables (i.e., for Research Question 1), Kruskal–Wallis *H* tests were used to assess group differences in academic outcomes. As a rank-based nonparametric procedure, Kruskal–Wallis does

not rely on normality or equality of variances and provides a robust alternative to one-way ANOVA when comparing two or more independent groups (Woolridge, 2019).

For models in which the independent variables were measured continuously as the number of years of ensemble enrollment (i.e., for RQ2/H_1), OLS regression with heteroskedasticity-robust standard errors was used. Although the Shapiro–Wilk tests indicated that the dependent variables were non-normally distributed, this does not invalidate the use of ordinary least squares (OLS) regression. The Shapiro–Wilk test assesses the normality of the data, not the sampling distribution of the regression estimates. According to the Central Limit Theorem, in sufficiently large samples the sampling distribution of the estimated coefficients approaches normality even when the underlying data or residuals are skewed. Because the models in this study included large sample sizes (N > 1,000), unbiased and consistent parameter estimates were obtained. Heteroskedasticity-robust standard errors (Huber–White estimators) were applied to correct for unequal error variances, ensuring valid inference under conditions of non-normality. A generalized linear model (GLM) approach was not used because the dependent variables were continuous and expressed on natural, interpretable scales (e.g., GPA points and test scores), for which OLS provides direct and easily interpretable estimates of change in academic outcomes per unit increase in years of participation (Wooldridge, 2020).

Homogeneity Tests

Levene's tests were run following each of the hypothesis tests presented in the next section. Across the Levene's tests, homogeneity held for some but not all comparisons. For GPA, variances were unequal for band participation regardless of

choir enrollment, band-only, band-and-choir, and band-and/or-choir (all $p \leq .001$), but equal for choir participation regardless of band enrollment and choir-only (both $p > .05$). For ACT, heteroskedasticity appeared for band participation regardless of choir enrollment, band-only, and band-and/or-choir (all $p \leq .001$), whereas choir regardless of band enrollment, choir-only, and band-and-choir were homoscedastic (all $p > .05$). For EOC Grade, band participation regardless of choir enrollment, band-only, and band-and-choir showed unequal variances ($p = .045$), while choir regardless of band enrollment, choir-only, and band-and/or-choir were homoscedastic (all $p = .08$). For EOC American Literature, all tested contrasts were homoscedastic (all $p = .06$). For EOC Level, variances were unequal for choir participation regardless of band enrollment and band-and/or-choir ($p = .007$), and equal for band regardless of choir participation, band-only, choir-only, and band-and-choir (all $p = .28$). Accordingly, Kruskal–Wallis remained the primary inference method both where variances were unequal (strengthening the case for a distribution-free test) and where variances were equal (given the pervasive non-normality and, for EOC Level, ordinality).

Multicollinearity Tests

Multicollinearity Diagnostics for Binary Independent Variables

Multicollinearity is only a potential issue for the hypothesis tests for RQ3/H_1, which were multivariate hypothesis tests. The hypothesis tests for RQ1/H_1 and RQ2/H_1 were bivariate; multicollinearity was not a concern. Variance Inflation Factor analysis was conducted to assess multicollinearity among the binary ensemble participation variables used in the regression models (Table 7). The results indicated substantial multicollinearity among several predictors, with VIF values far exceeding the common

threshold of 10, suggesting strong linear dependence among the dummy-coded ensemble participation variables. The extremely high VIFs for band participation regardless of choir enrollment (VIF = 54.90) and band-only participation (VIF = 584.81) indicate near redundancy, meaning these variables overlap substantially in the information they provide. Similarly, band-and/or-choir (VIF = 181.25), band-and-choir (VIF = 144.27), choir participation regardless of band enrollment (VIF = 88.43), and choir-only participation (VIF = 93.43) also exhibited multicollinearity well above acceptable limits.

Multicollinearity Diagnostics for Continuous Independent Variables

Variance inflation factor analysis was conducted to assess multicollinearity among the continuous ensemble participation variables used in the regression models. The results indicated severe multicollinearity across several predictors, with VIF values well above the commonly accepted threshold of 10. The highest VIF was observed for band-and/or-choir participation (VIF = 626.35), followed by band participation regardless of choir enrollment (VIF = 432.32), band-only participation (VIF = 402.98), band-and-choir participation (VIF = 253.38), choir-only participation (VIF = 190.65), and choir participation regardless of band enrollment (VIF = 37.10). These findings suggest strong linear dependence among the continuous predictors, particularly between the overlapping participation measures that share years of involvement across ensembles. During hypothesis testing for RQ3/H_1, multicollinearity was addressed by allowing the statistical software to automatically omit variables that were highly correlated with one another. Because the ensemble participation variables represented overlapping categories (e.g., band, choir, both, or total years), some predictors contained redundant

information. When Stata detected excessive multicollinearity among these variables, it excluded one or more from the model to ensure valid estimation and stable coefficients. However, the specific variables dropped were not consistent across all models because the number of valid cases differed for each dependent variable. For example, ACT scores were available for substantially fewer participants than GPA, resulting in slightly different correlation structures and corresponding multicollinearity patterns across models.

Linearity Tests

The linearity assumption of parametric statistical tests was performed before testing the hypothesis for the second research question (RQ2/H_1). The linearity assumption between each continuous independent variable and each dependent variable was examined visually. Appendix D presents a series of bivariate scatterplots with fitted regression lines and Lowess smoothers for each model, including relationships between years of band, choir, combined ensemble participation, and all academic performance outcomes (GPA, EOC American Literature, EOC Grade, and EOC Level). These visual diagnostics confirmed generally linear relationships between the continuous ensemble participation measures and the dependent variables, supporting the use of robust linear regression models for the continuous outcomes. Minor deviations from linearity were observed in some plots, particularly for smaller subgroups such as students participating only in choir—but these deviations were not substantial enough to violate model assumptions. The visual analyses presented in Appendix D therefore reinforce the appropriateness of the regression-based hypothesis tests reported in this section.

Pearson correlation coefficients were calculated among the independent variables and the academic achievement measures as an additional diagnostic assessment of the assumption of linearity (see Appendix D). Pearson correlation measures the strength and direction of a linear association between two variables; therefore, statistically significant correlations between predictors and continuous outcomes provide evidence consistent with the presence of linear relationships suitable for regression analysis (Woolridge, 2019).

The results indicated that several ensemble participation measures were significantly associated with the academic achievement variables. Years of band enrollment showed moderate positive correlations with ACT score ($r = .31$, $p < .001$), GPA ($r = .33$, $p < .001$), American Literature EOC score ($r = .26$, $p < .001$), and overall EOC grade ($r = .25$, $p < .001$). Band-only enrollment years demonstrated similar positive associations with ACT ($r = .27$, $p < .001$), GPA ($r = .28$, $p < .001$), and EOC measures (r values ranging from .22 to .23, $p < .001$). Dual enrollment in band and choir also showed small but statistically significant positive relationships with ACT ($r = .10$, $p < .001$), GPA ($r = .14$, $p < .001$), and the EOC measures.

Choir participation variables generally showed weaker associations with the achievement measures. Years of choir enrollment was not significantly associated with ACT score ($r = −.005$, $p = .872$), although small but statistically significant correlations were observed with GPA ($r = .097$, $p < .001$) and EOC measures ($r = .048$ and .043, $p < .05$). Choir-only enrollment years also demonstrated very limited relationships with the academic outcomes.

Several correlations involving choir-only enrollment were not statistically significant. Specifically, choir-only enrollment years showed no statistically significant association with GPA (r = .035, p = .058), American Literature EOC score (r = −.001, p = .968), or overall EOC grade (r = −.001, p = .949). These results indicate that choir-only participation was not meaningfully related to several measures of academic achievement in the present sample.

Hypothesis Tests

Each of the three hypotheses was tested using several versions of the key independent variable (large music ensemble participation) and key dependent variable (academic achievement). Academic achievement, the dependent variable, was operationalized in five different ways. The alternative hypothesis for the first research question (RQ1/H_1) was “There is a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement.” The null hypothesis for the first research question was “There is not a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement.” The independent variables were as follows:

- Enrollment in band (1 = yes, 0 = no) regardless of choir enrollment
- Enrollment in choir (1 = yes, 0 = no) regardless of band enrollment

The operationalizations of academic achievement, the dependent variable, for the tests of the first hypothesis were overall ACT score, overall EOC score, EOC American literature score, EOC level, and GPA. Accordingly, the first hypothesis was tested thirty times. Specifically, Kruskal–Wallis tests were conducted to examine

differences in the dependent variables across levels of the independent variables. This procedure was chosen because the data violated the assumptions of normality (see above) and homogeneity of variance (see below, specifically each Levene's test following each Kruskal–Wallis's test), which are required for a parametric ANOVA.

The alternative hypothesis for the second research question (RQ2/H_1) was "There is a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement." The null hypothesis for the second research question was "There is not a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement." The independent variables were as follows:

- Years in band regardless of choir enrollment
- Years in choir regardless of band enrollment
- Years in band only
- Years in choir only
- Years in both band and choir
- Years in either band or choir
- Years in band and/or choir

The operationalizations of academic achievement, the dependent variable, for the tests of the second hypothesis were overall ACT score, overall EOC score, EOC American literature score, EOC level, and GPA. The second hypothesis was tested thirty times. Linear regression with heteroskedasticity-robust standard errors was used to examine the relationships between years of participation and each dependent

variable except for EOC level (which required ordered logit). Preliminary diagnostics indicated that several dependent variables violated the assumptions of normality and constant error variance. Robust standard errors do not correct for non-normality of residuals, but the large sample sizes in this study minimize concerns about normality violations through the Central Limit Theorem, allowing for reliable inference and interpretation of OLS coefficients. A generalized linear model (GLM) approach was not used because the dependent variables were continuous and expressed on natural, interpretable scales (e.g., GPA points and test scores), for which OLS provides direct and easily interpretable estimates of change in academic outcomes per unit increase in years of participation (Wooldridge, 2020).

The alternative hypothesis for the third research question (RQ3/H_1) was "There is a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model." The null hypothesis for the third research question was "There is not a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model." The independent variables were as follows:

- Enrollment in band (1 = yes, 0 = no) regardless of choir enrollment
- Enrollment in choir (1 = yes, 0 = no) regardless of band enrollment
- Enrollment in band only (1 = yes, 0 = no)
- Enrollment in choir only (1 = yes, 0 = no)
- Enrollment in either band or choir (1 = yes, 0 = no)

- Enrollment in both band and choir (1 = yes, 0 = no)
- Enrollment in both band and/or choir (1 = yes, 0 = no)

The variable for enrollment in band or choir was omitted from the quantitative model for the multivariate hypothesis test due to singularity (or perfect multicollinearity) with the variables for enrollment in band only and enrollment in choir only. The variable for enrollment in band and/or choir was omitted due to singularity with enrollment in band (regardless of enrollment in choir) and enrollment in choir (regardless of enrollment in band).

The operationalizations of academic achievement, the dependent variable, for the tests of the third hypothesis were overall ACT score, overall EOC score, EOC American literature score, EOC level, and GPA. The third hypothesis was tested with a single regression analysis. OLS with heteroskedasticity-robust standard errors was used to examine the relationships between participation in high school large music ensembles of different types (band and/or choir) and each dependent variable, except for EOC level (which required an ordered logit). Preliminary diagnostics indicated that several dependent variables violated the assumptions of normality and constant error variance. Robust standard errors do not correct for non-normality of residuals, but the large sample sizes in this study minimize concerns about normality violations through the Central Limit Theorem, allowing for reliable inference and interpretation of OLS coefficients. A GLM approach was not used because the dependent variables were continuous and expressed on natural, interpretable scales (e.g., GPA points and test scores), for which OLS provides direct and easily interpretable estimates of change in academic outcomes per unit increase in years of participation (Wooldridge, 2020).

Research Question 1

The first research question was “Is there a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement?” Because preliminary analyses indicated that the dependent variables were not normally distributed, nonparametric procedures were selected. Many of the homogeneity-of-variance results indicated heteroscedasticity. The Kruskal–Wallis H test was therefore used as a rank-based, nonparametric alternative to one-way ANOVA that does not rely on the normality and homogeneity-of-variance assumptions required for parametric analysis (Woolridge, 2019).

Across all Kruskal-Wallis analyses, participation in band was consistently associated with higher academic performance across multiple outcomes, while participation in choir showed smaller and less consistent effects. The effect size was based on the formula $\eta^2H = (H - k + 1) / (n - k)$, where n = the number of cases, k = the number of groups, and $H = \chi^2$. Specifically, students who participated in band demonstrated significantly higher GPAs, ACT scores, EOC grade scores, EOC performance levels, and EOC American Literature scores compared to nonparticipants, with moderate effect sizes ranging from $\eta^2_h = .04$ to .09. The calculations for the effect sizes are included in Appendix E. These relationships remained significant for both band participation generally and band-only participation, indicating that band involvement alone was strongly associated with improved academic outcomes. Participation in both band and choir was also significantly related to higher performance across outcomes, although the effect sizes were smaller ($\eta^2_h < .001$ to .01). In contrast,

choir participation alone or in combination with other forms of ensemble participation exhibited either very small or nonsignificant effects, suggesting that the academic benefits were more robustly linked to band involvement.

Hypothesis 1 Test Results with GPA as the Dependent Variable

Enrollment in band (1 = yes, 0 = no) regardless of choir enrollment. The mean GPA for students enrolled in band (regardless of whether they were also enrolled in choir) was 3.26 (*SD* = .55). The mean GPA for the reference group (comprised of students in choir but not band and students in neither band nor choir) was 2.85 (*SD* = .62). Levene's test for equality of variances, F (1, 2979) = 67.56, $p < .001$, demonstrated that the assumption of homogeneity was violated. Accordingly, the Kruskal–Wallis *H* test and its associated nonparametric effect sizes were retained as the most appropriate measures of group difference for this analysis. The Kruskal–Wallis *H* test yielded a statistically significant result, $\chi^2(1) = 254.28$, $p < .001$, indicating that the distribution of GPA differed significantly between the band participation groups. Therefore, students enrolled in band (regardless of whether they were also enrolled in choir) had higher GPAs than students in the reference group (comprised of students in choir but not band and students in neither band nor choir). Effect size was calculated using eta-squared ($\eta^2_h = .09$), derived from the corrected Kruskal–Wallis *H* statistic, suggesting a moderate effect size.

Enrollment in choir (1 = yes, 0 = no) regardless of band enrollment and GPA. The mean GPA for students enrolled in choir (regardless of whether they were also enrolled in band) was 3.06 (*SD* = .62). The mean GPA for the reference group (comprised of students in choir but not band and students in neither band nor choir) was

2.94 (*SD* = .63). Levene's test for equality of variances, F (1, 2979) = .94, p = .03, indicated that the assumption of homogeneity was violated. Accordingly, the Kruskal–Wallis H test and its associated nonparametric effect sizes were retained as the appropriate measures of group difference for this analysis. The Kruskal–Wallis H test yielded a statistically significant result, $\chi^2(1) = 16.35$, $p < .001$, indicating that the distribution of GPA differed significantly between the choir participation groups. Therefore, students enrolled in choir (regardless of whether they were also enrolled in band) had higher GPAs than students in the reference group (comprised of students in band but not choir and students in neither band nor choir). Effect size was calculated using eta-squared ($\eta^2_h = .01$), derived from the corrected Kruskal–Wallis H statistic, suggesting a very small effect size.

Hypothesis 1 Test Results with ACT Score as the Dependent Variable

Enrollment in band (1 = yes, 0 = no) regardless of choir enrollment and ACT score. The mean ACT score for students enrolled in band (regardless of enrollment in choir) was 22.01 (*SD* = 5.71). The mean ACT score for the reference group (comprised of students in choir but not band and students in neither band nor choir) was 18.80 (*SD* = 4.89). Levene's test for equality of variances confirmed heteroskedasticity, F (1, 1109) = 14.56, $p < .001$. A Kruskal–Wallis H test was conducted to examine differences in ACT scores for band participation regardless of choir enrollment. The test result was statistically significant, $\chi^2(1) = 98.52$, $p < .001$, indicating that the distribution of ACT scores differed significantly between students who participated in band and those who did not. Therefore, students enrolled in band had higher ACT scores than students in

the reference group (comprised of students in choir but not band and students in neither band nor choir). Effect size was calculated from the corrected Kruskal–Wallis *H* statistic (η^2_h = .09), indicating a moderate to large effect.

Enrollment in choir (1= yes, 0 = no) regardless of band enrollment and ACT score. The mean ACT score for students enrolled in choir (regardless of enrollment in band) was 19.96 (*SD* = 5.47). The mean ACT score for the reference group (comprised of students in band but not choir and students in neither band nor choir) was 20.09 (*SD* = 5.45). Levene's test for equality of variances confirmed heteroscedasticity, *F* (1, 1109) = .54, *p* = .04. A Kruskal–Wallis *H* test was conducted to examine differences in ACT scores for choir participation regardless of band enrollment. The test result was not statistically significant, $\chi^2(1) = .07$, *p* = .79, indicating no meaningful difference in the distribution of ACT scores between students who participated in choir and those who did not. Effect size was calculated from the corrected Kruskal–Wallis *H* statistic (η^2_h < .001), indicating a negligible effect.

Hypothesis 1 Test Results with EOC Grade as the Dependent Variable

Enrollment in band (1 = yes, 0 = no) regardless of choir enrollment and EOC grade. The mean EOC grade for students enrolled in band (regardless of choir enrollment) was 79.19 (*SD* = 9.46). The mean EOC grade for the reference group (comprised of students in choir but not band and students in neither band nor choir) was 73.78 (*SD* = 10.60). Levene's test for equality of variances confirmed heteroskedasticity, *F* (1, 2979) = 17.15, *p* < .001. A Kruskal–Wallis H test was conducted to examine differences in EOC grade scores for band participation regardless of choir participation. The test result was statistically significant, $\chi^2(1) = 163.36$, *p* < .001, indicating that the

distribution of EOC grade scores differed significantly between students who participated in band and those who did not. Therefore, students enrolled in band had higher EOC grades than students in the reference group (comprised of students in choir but not band and students in neither band nor choir). Effect size was calculated from the corrected Kruskal–Wallis *H* statistic (η^2_h = .05), indicating a moderate effect.

Enrollment in choir (1= yes, 0= no) regardless of band enrollment and EOC grade. The mean EOC grade for students enrolled in choir (regardless of band enrollment) was 75.78 (*SD* = 11.18). The mean EOC grade for the reference group (comprised of students in band but not choir and students in neither band nor choir) was 75.10 (*SD* = 10.43). Levene's test for equality of variances confirmed heteroscedasticity, *F* (1, 2979) = 2.05, *p* = .05. A Kruskal–Wallis *H* test was conducted to examine differences in EOC grade scores for choir participation regardless of band enrollment. The test result was statistically significant, $\chi^2(1) = 4.91$, *p* = .027, indicating that the distribution of EOC grade scores differed slightly between students who participated in choir and those who did not. Therefore, students enrolled in choir had higher EOC grades than students in the reference group (comprised of students in band but not choir and students in neither band nor choir). Effect size was calculated from the corrected Kruskal–Wallis *H* statistic (η^2_h < .001) and indicated a very small effect.

Hypothesis 1 Test Results with EOC American Literature Grade as the Dependent Variable

Enrollment in band (1 = yes, 0 = no) regardless of choir enrollment and EOC American Literature. The mean EOC American literature grade for students enrolled in band (regardless of choir enrollment) was 529.09 (*SD* = 48.99). The mean

EOC American literature grade for the reference group comprised of students in choir but not band and students in neither band nor choir) was 503.44 (*SD* = 48.11). Levene's test for equality of variances was not significant, F (1, 2979) = .70, p = .04, indicating that the assumption of homogeneity was violated. A Kruskal–Wallis *H* test was conducted to examine differences in EOC American Literature scores for band participation regardless of choir enrollment. The test result was statistically significant, $\chi^2(1) = 162.41$, $p < .001$, indicating that the distribution of EOC American Literature scores differed significantly between students who participated in band and those who did not. Therefore, students enrolled in band had higher American literature EOC grades than students in the reference group (comprised of students in choir but not band and students in neither band nor choir). Effect size, calculated from the corrected Kruskal–Wallis *H* statistic (η^2_h = .05), indicated a moderate effect.

Enrollment in choir (1 = yes, 0 = no) regardless of band enrollment and EOC American Literature. The mean EOC American literature grade for students enrolled in choir (regardless of band enrollment) was 513.50 (*SD* = 54.27). The mean EOC American literature grade for the reference group (comprised of students in band but not choir and students in neither band nor choir) was 509.57 (*SD* = 48.53). Levene's test for equality of variances was not significant, F (1, 2979) = 3.58, p = .06, indicating that the assumption of homogeneity was not violated. A Kruskal–Wallis *H* test was conducted to examine differences in EOC American Literature scores for choir participation regardless of band participation. The test result was statistically significant, $\chi^2(1) = 4.76$, p = .029, indicating that the distribution of EOC American Literature scores differed significantly between students who participated in choir and those who did not.

Therefore, students enrolled in choir had higher American literature EOC grades than students in the reference group (comprised of students in band but not choir and students in neither band nor choir). Effect size, calculated from the corrected Kruskal–Wallis *H* statistic, indicated a very small effect ($\eta^2_h < .001$).

Hypothesis 1 Test Results with EOC Level as the Dependent Variable

Enrollment in band (1 = yes, 0 = no) regardless of choir enrollment and EOC level. The mean EOC level for students enrolled in band (regardless of choir enrollment) was 2.56 (*SD* = .82). The mean EOC level for the reference group (comprised of students in choir but not band and students in neither band nor choir) was 2.14 (*SD* = .83). Levene's test for equality of variances was not significant, F (1, 2978) = .04, p = .83, indicating that the assumption of homogeneity was not violated. A Kruskal–Wallis *H* test was conducted to examine differences in EOC level for band participation regardless of choir enrollment. The test result was statistically significant, $\chi^2(1) = 138.06$, $p < .001$, indicating that the distribution of EOC level scores differed significantly between students who participated in band and those who did not. Therefore, students enrolled in band had higher EOC levels than students in the reference group (comprised of students in choir but not band and students in neither band nor choir). Effect size was calculated from the corrected Kruskal–Wallis *H* statistic ($\eta^2_h = .05$), indicating a moderate effect.

Enrollment in choir (1 = yes, 0 = no) regardless of band enrollment and EOC level. The mean EOC level for students enrolled in choir (regardless of band enrollment) was 2.32 (*SD* = .87). The mean EOC level for the reference group (see Table 3 in Chapter 3) was 2.24 (*SD* = .84). Levene's test for equality of variances was

significant, F (1, 2978) = 7.33, p = .007, suggesting unequal variances between groups. A Kruskal–Wallis H test was conducted to examine differences in EOC level for choir participation regardless of band participation. The test result was statistically significant, $\chi^2(1) = 4.92$, p = .027, indicating that the distribution of EOC level scores differed significantly between students who participated in choir and those who did not. Therefore, students enrolled in choir had higher EOC levels than students in the reference group (comprised of students in band but not choir and students in neither band nor choir). Effect size was calculated from the corrected Kruskal–Wallis H statistic ($\eta^2_h < .001$), indicating a very small effect.

Summary of Findings for RQ1/H_1. The first research question entailed ten bivariate statistical tests. There were two operationalizations of enrollment in a high school large music ensemble (band or choir). There were five operationalizations of academic performance. The results for all ten tests are summarized in Table 8. Only results that were statistically significant at the .05 threshold for statistical significance are reported in the table. Statistically insignificant results are denoted with a dash mark.

Table 8

Summary of Results for RQ1/H_1

Enrollment type	Academic performance measure				
	GPA	ACT score	EOC grade	EOC American lit.	EOC level
Band enrollment regardless of participation in choir	Students enrolled in band had higher GPAs than the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)	Students enrolled in band had higher ACT scores than the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)	Students enrolled in band had higher EOC grades than the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)	Students enrolled in band had higher EOC American literature scores than the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)	Students enrolled in band had higher EOC levels than the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)
Choir enrollment, regardless of participation in band	Students enrolled in choir had higher GPAs than the reference group (comprised of students enrolled in band only and students enrolled in neither band nor choir)	Students enrolled in choir had higher ACT scores than the reference group (comprised of students enrolled in band only and students enrolled in neither band nor choir)	Students enrolled in choir had higher EOC grades than the reference group (comprised of students enrolled in band only and students enrolled in neither band nor choir)	Students enrolled in choir had higher EOC American literature scores than the reference group (comprised of students enrolled in band only and students enrolled	Students enrolled in choir had higher EOC levels than the reference group (comprised of students enrolled in band only and students enrolled in neither band nor choir)

Enrollment type	Academic performance measure				
	GPA	ACT score	EOC grade	EOC American lit.	EOC level
				in neither band nor choir)	

Table 8 shows statistically significant results indicating higher academic performance among treatment groups across two ensemble participation categories. Students enrolled in band, regardless of participation in choir, had significantly higher GPAs, ACT scores, EOC grades, American Literature EOC scores, and EOC achievement levels than students not enrolled in band. Similarly, students enrolled in choir, regardless of participation in band, demonstrated significantly higher GPAs, EOC grades, American Literature EOC scores, and EOC achievement levels than students not enrolled in choir.

Research Question 2

The second research question was “Is there a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement?” Ordinary least squares (OLS) regression with heteroskedasticity-robust standard errors was used to examine the relationships between years of participation and all academic performance outcomes except for EOC level (which required ordered logistic regression). All of the dependent variables violated normality and constant variance assumptions; however, the large sample sizes invoked the Central Limit Theorem, ensuring reliable parameter estimates despite these deviations. Robust standard errors were applied to correct for heteroskedasticity, providing valid inference while preserving the interpretability of the OLS coefficients. GLM (Generalized Linear Model) regression was not used because the dependent variables were continuous, the research questions were linear, and the sample size was large enough for OLS to yield valid, unbiased estimates. Using OLS with

heteroskedasticity-robust standard errors allowed for straightforward interpretation while ensuring reliable inference under non-normality.

Across all models, the results consistently indicated that years of band enrollment were positively associated with academic performance. Students with more years of band participation tended to score higher on standardized assessments and maintain higher GPAs. Specifically, each additional year of band enrollment was linked to meaningful increases in ACT scores, GPA, EOC grade, and EOC American Literature performance, with all effects statistically significant at $p < .001$. The ordered logistic regression further demonstrated that additional years of band participation significantly increased the likelihood of achieving higher EOC performance levels ($\beta = .30$, $SE = .02$, $p < .001$). Taken together, these results suggest a consistent and moderate positive relationship between sustained engagement in band and multiple indicators of academic achievement across both continuous and ordinal measures.

Years in Band Regardless of Choir Enrollment as the Independent Variable

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between years of band enrollment (regardless of choir enrollment) and ACT scores (see Table 9). The analysis indicated a statistically significant positive relationship, $\beta = .95$, $RSE = .09$, $p < .001$. Each additional year of band enrollment was associated with a .95-point increase in ACT score. The model's intercept was 18.77 ($SE = .19$, $p < .001$), representing the expected ACT score for students with zero years of band participation. The R-squared statistic was .095 indicating that the number of years enrolled in band (regardless of choir participation) predicts 9.5% of the variation in ACT scores.

Table 9

OLS regression with Heteroskedasticity-robust Standard Errors of ACT on Years of Band Enrollment Regardless of Choir Enrollment

Predictor	β	*SE*	*p*
Band years	.95	.09	< .001
Constant	18.77	.19	< .001

N: 1,111; R-squared: .095

OLS regression with heteroskedasticity-robust standard errors was performed to assess the association between years of band enrollment (regardless of choir enrollment) and GPA (see Table 10). Results showed a significant positive effect, β = .13, *SE* = .01, *p* < .001, indicating that each additional year of band enrollment corresponded to a .13-point increase in GPA. The constant term was 2.84 (*SE* = .01, *p* < .001), representing the estimated GPA for students without any band participation. The R-squared statistic was .108, indicating that the number of years enrolled in choir (regardless of band participation) explained 10.8% of the variation in GPA.

Table 10

OLS Regression with Heteroskedasticity-robust Standard Errors of GPA on Years of Band Enrollment Regardless of Choir Enrollment

Predictor	β	*SE*	*p*
Band years	.13	< .001	< .001
Constant	2.84	.01	< .001

N: 2,981 R-squared: .108

OLS regression with heteroskedasticity-robust standard errors was used to examine the effect of years of band enrollment on EOC grade scores (see Table 11). The analysis revealed a significant positive association, β = 1.73, *SE* = .11, *p* < .001,

suggesting that each additional year of band enrollment was associated with an estimated 1.73-point increase in EOC grade. The constant term was 73.71 (*SE* = .22, *p* < .001). The R-squared statistic was .065, indicating that the number of years enrolled in band (regardless of choir participation) explained 6.5% of the variation in EOC grade.

Table 11

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC Grade on Years of Band Enrollment Regardless of Choir Enrollment

Predictor	β	*SE*	*p*
Band years	1.73	.11	< .001
Constant	73.71	.22	< .001

N: 2,981 R-squared: .065

OLS regression with heteroskedasticity-robust standard errors tested the relationship between years of band enrollment (regardless of choir enrollment) and EOC American Literature scores (see Table 12). Results indicated a statistically significant positive effect, β = 8.30, *SE* = .56, *p* < .001, showing that each additional year of band participation corresponded to an average increase of 8.30 points in EOC American Literature score. The intercept was 503.03 (*SE* = 1.01, *p* < .001), representing the expected score for students with no band enrollment. The R-squared statistic was .067, indicating that the number of years enrolled in band (regardless of choir participation) explained 6.7% of the variation in EOC American literature score.

Table 12

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC American Literature on Years of Band Enrollment Regardless of Choir Enrollment

Predictor	β	*SE*	*p*
Band years	8.30	.56	< .001
Constant	503.03	1.01	< .001

N: 2,981 R-squared: .067

An ordered logistic regression with heteroscedasticity-robust standard errors was conducted to examine whether years of band enrollment (regardless of choir enrollment) predicted differences in EOC performance level (Table 13). The model revealed a statistically significant and positive association between years of band participation and higher EOC levels, β = .30, *SE* = .02, *p* < .001. This finding suggests that with each additional year of band involvement, students were more likely to reach higher EOC performance categories. The three threshold parameters (cut1 = –1.12, cut2 = .64, cut3 = 3.24) were all statistically significant, indicating well-defined boundaries between the ordered EOC levels. These results demonstrate that continued participation in band was meaningfully associated with stronger academic performance as measured by EOC level outcomes. The Pseudo R-squared statistic was < .001, indicating that the number of years enrolled in band (regardless of choir participation) explained 0% of the variation in EOC level.

Table 13

Ordered Logit with Heteroscedasticity-robust Standard Errors of EOC Level on Years of Band Enrollment Regardless of Choir Enrollment

Predictor	β	*SE*	*p*
Band years	.30	.02	< .001
cut1	-1.12	.05	< .001
cut2	.64	.04	< .001
cut3	3.24	.09	< .001

N: 2,980 Pseudo R-squared: < .001

Years in Choir Regardless of Band Enrollment as the Independent Variable

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between years of choir enrollment regardless of band enrollment and ACT scores (Table 14). The analysis revealed no statistically significant association between years of choir participation and ACT performance, β = -.02, *SE* = .14, *p* = .869. This indicates that additional years of choir enrollment were not related to changes in ACT scores. The R-squared statistic was < .001, indicating that the number of years enrolled in choir (regardless of band participation) explained 0% of the variation in ACT score.

Table 14

OLS Regression with Heteroskedasticity-robust Standard Errors of ACT on Years of Choir Enrollment Regardless of Band Enrollment

Predictor	β	*SE*	*p*
Choir years	-.02	.14	.87
Constant	20.07	.18	< .001

N: 1,111; R-squared: < .001

OLS regression with heteroskedasticity-robust standard errors was conducted to assess the association between years of choir, regardless of band enrollment, and GPA

(Table 15). Results showed a statistically significant positive relationship, β = .06, *SE* = .01, *p* < .001, indicating that each additional year of choir participation was associated with a small but significant increase in GPA. The R-squared statistic was .009, indicating that the number of years enrolled in choir (regardless of band participation) explained .9% of the variation in GPA.

Table 15

OLS Regression with Heteroskedasticity-robust Standard Errors of GPA on Years of Choir Enrollment Regardless of Band Enrollment

Predictor	β	*SE*	*p*
Choir years	.06	.01	< .001
Constant	2.94	.01	< .001

N: 2,981 R-squared: .009

OLS regression with heteroskedasticity-robust standard errors was performed to evaluate the effect of years of choir enrollment regardless of band enrollment on EOC grade scores (Table 16). The analysis indicated a statistically significant positive relationship, β = .44, *SE* = .18, *p* = .017, suggesting that each additional year of choir participation corresponded to an increase of approximately .44 points in EOC grade scores. The R-squared statistic was .002, indicating that the number of years enrolled in choir (regardless of band participation) explained 0% of the variation in EOC grade.

Table 16

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC Grade on Years of Choir Enrollment Regardless of Band Enrollment

Predictor	β	*SE*	*p*
Choir years	.44	.18	.02
Constant	75.04	.21	< .001

N: 2,981 R-squared: .002

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between years of choir enrollment regardless of band enrollment and EOC American Literature scores (Table 17). The results showed a statistically significant positive effect, β = 2.31, *SE* = .91, *p* = .011, indicating that each additional year of choir participation was associated with a 2.31-point increase in EOC American Literature performance. The R-squared statistic was .002, indicating that the number of years enrolled in choir (regardless of band participation) explained 0% of the variation in EOC American literature score.

Table 17

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC American Literature on Years of Choir Enrollment Regardless of Band Enrollment

Predictor	β	*SE*	*p*
Choir years	2.31	.91	.01
Constant	509.31	.96	< .001

N: 2,981 R-squared: .002

An ordered logistic regression with heteroscedasticity-robust standard errors was performed to evaluate the relationship between years of choir enrollment regardless of band enrollment and EOC performance levels (Table 18). Results indicated a statistically significant positive association, β = .10, *SE* = .03, *p* = .004, suggesting that students with more years of choir experience were slightly more likely to achieve higher EOC levels. Although the effect size was smaller than that observed for band participation, the relationship remained statistically meaningful. The threshold parameters were all significant, confirming clear distinctions between successive EOC categories. Overall, these findings suggest that participation in choir, though associated

with modest gains, was positively linked to higher EOC performance levels. The Pseudo R-squared statistic was < .001, indicating that the number of years enrolled in choir (regardless of band participation) explained 0% of the variation in EOC level.

Table 18

Ordered Logit with Heteroscedasticity-robust Standard Errors of EOC Level on Years of Choir Enrollment Regardless of Band Enrollment

Predictor	β	*SE*	*p*
Choir years	.10	.03	.00
cut1	-1.29	.05	< .001
cut2	.40	.04	< .001
cut3	2.91	.08	< .001

N: 2,980 Pseudo R-squared: < .001

Years in Band Only as the Independent Variable

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between years of band-only enrollment and ACT scores (Table 19). The analysis revealed a statistically significant positive association, β = .86, *SE* = .10, *p* < .001, indicating that each additional year of band-only participation was associated with a .86-point increase in ACT score. The R-squared statistic was .072, indicating that the number of years enrolled in band-only explained 7.2% of the variation in ACT score.

Table 19

OLS Regression with Heteroskedasticity-robust Standard Errors of ACT on Years of Band-Only Enrollment

Predictor	β	*SE*	*p*
Band-only years	.86	.10	< .001
Constant	19.08	.18	< .001

N: 1,111 R-squared: .072

OLS regression with heteroskedasticity-robust standard errors was performed to assess the association between years of band-only enrollment and GPA (Table 20). Results indicated a statistically significant positive effect, β = .12, *SE* = .01, *p* < .001, showing that each additional year of band-only participation corresponded to an increase of .12 in GPA. The R-squared statistic was .08, indicating that the number of years enrolled in band-only explained 8% of the variation in GPA.

Table 20

OLS Regression with Heteroskedasticity-robust Standard Errors of GPA on Years of Band-Only Enrollment

Predictor	β	*SE*	*p*
Band-only years	.12	.01	< .001
Constant	2.87	.01	< .001

N: 2,980 R-squared: 0.08

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between years of band-only enrollment and EOC grade scores (Table 21). The model showed a statistically significant positive association, β = 1.61, *SE* = .12, *p* < .001, suggesting that each additional year of band-only participation was associated with a 1.61-point increase in EOC grade scores. The R-squared statistic was .05, indicating that the number of years enrolled in band-only explained 4.9% of the variation in EOC grade.

Table 21

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC Grade on Years of Band-Only Enrollment

Predictor	β	*SE*	*p*
Band-only years	1.61	.12	< .001
Constant	74.02	.22	< .001

N: 2,980 R-squared: 0.049

OLS regression with heteroskedasticity-robust standard errors was conducted to assess the effect of years of band-only enrollment on EOC American Literature scores (Table 22). Results revealed a statistically significant positive relationship, β = 7.54, *SE* = .58, *p* < .001, indicating that each additional year of band-only participation was associated with an average increase of 7.54 points in EOC American Literature scores. The R-squared statistic was 0.05, indicating that the number of years enrolled in band-only explained 5% of the variation in EOC American literature score.

Table 22

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC American Literature on Years of Band-Only Enrollment

Predictor	β	*SE*	*p*
Band-only years	7.54	.58	< .001
Constant	504.63	1.01	< .001

N: 2,980 R-squared: .05

An ordered logistic regression with heteroscedasticity-robust standard errors was used to investigate the relationship between years of band-only enrollment and EOC performance levels (Table 23). The analysis revealed a statistically significant and positive association, β = .27, *SE* = .02, *p* < .001, indicating that students who participated exclusively in band were more likely to achieve higher EOC performance

levels as their years of enrollment increased. The three significant threshold parameters (*cut1* = –1.16, *cut2* = .58, *cut3* = 3.15) indicate consistent category separations across EOC levels. These results reinforce the finding that engagement in band-only programs positively contributes to academic outcomes as reflected in EOC performance. The Pseudo R-squared statistic was .04, indicating that the number of years enrolled in band-only explained 4% of the variation in EOC level.

Table 23

Ordered Logit with Heteroscedasticity-robust Standard Errors of EOC Level on Band-Only Years

Predictor	β	*SE*	*p*
Band-only years	.27	.02	< .001
cut1	-1.16	.05	< .001
cut2	.58	.04	< .001
cut3	3.15	.09	< .001

N: 2,979 Pseudo R-squared: .04

Years in Choir Only as the Independent Variable

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between years of choir-only enrollment and ACT scores (Table 24). The analysis revealed a statistically significant negative association, β = -.40, *SE* = .16, *p* = .011, indicating that each additional year of choir-only participation was associated with a .40-point decrease in ACT score. The R-squared statistic was .004, indicating that the number of years enrolled in choir-only explained .4% of the variation in ACT score.

Table 24

OLS Regression with Heteroskedasticity-robust Standard Errors of ACT on Years of Choir-Only Enrollment

Predictor	β	*SE*	*p*
Choir-only years	-.40	.16	.01
Constant	20.21	.18	< .001

N: 1,111 R-squared: .004

OLS regression with heteroskedasticity-robust standard errors was conducted to assess the association between years of choir-only enrollment and GPA (Table 25). Results showed a small positive relationship, β = .02, *SE* = .01, *p* = .050, suggesting that each additional year of choir-only participation was associated with a modest increase in GPA. The R-squared statistic was .001, indicating that the number of years enrolled in choir-only explained .1% of the variation in GPA.

Table 25

OLS Regression with Heteroskedasticity-robust Standard Errors of GPA on Years of Choir-Only Enrollment

Predictor	β	*SE*	*p*
Choir-only years	.02	.01	.05
Constant	2.95	.01	< .001

N: 2,981 R-squared: .001

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between years of choir-only enrollment and EOC grade scores (Table 26). The model showed no statistically significant association, β = -.01, *SE* = .21, *p* = .949, indicating that the number of years of choir-only participation was not related to EOC grade performance. The R-squared statistic was < .001, indicating that the number of years enrolled in choir-only explained 0% of the variation in EOC grade.

Table 26

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC Grade on Years of Choir-Only Enrollment

Predictor	β	*SE*	*p*
Choir-only years	-.01	.21	.95
Constant	75.23	.20	< .001

N: 2,981 R-squared: < .001

OLS regression with heteroskedasticity-robust standard errors was performed to evaluate the effect of years of choir-only enrollment on EOC American Literature scores (Table 27). Results indicated no significant relationship, β = -.04, *SE* = .99, *p* = .968, suggesting that years of choir-only participation were not associated with differences in EOC American Literature performance. The R-squared statistic was < .001, indicating that the number of years enrolled in choir-only explained 0% of the variation in EOC American literature score.

Table 27

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC American Literature on Years of Choir-Only Enrollment

Predictor	β	*SE*	*p*
Choir-only years	-0.04	.99	.97
Constant	510.30	.96	< .001

N: 2,981 R-squared: < .001

An ordered logistic regression with heteroscedasticity-robust standard errors was conducted to assess whether years of choir-only enrollment predicted EOC performance levels (Table 28). The results showed no statistically significant relationship, β = .02, *SE* = .04, *p* = .587, suggesting that additional years of choir-only participation were not associated with differences in EOC outcomes. While all threshold

parameters were statistically significant, the lack of a significant slope coefficient indicates that years of choir-only involvement did not substantially influence the likelihood of achieving higher EOC levels. This finding suggests that choir-only participation did not have a measurable independent effect on EOC performance after accounting for variability in participation length. The Pseudo R-squared statistic was < .001, indicating that the number of years enrolled in choir-only explained 0% of the variation in EOC level.

Table 28

Ordered Logit with Heteroscedasticity-robust Standard Errors of EOC Level on Choir-Only Years

Predictor	β	*SE*	*p*
Choir-only years	.02	.04	.59
cut1	-1.32	.05	< .001
cut2	.37	.04	< .001
cut3	2.87	.08	< .001

N: 2,980 Pseudo R-squared: < .001

Years in Band and Choir as the Independent Variable

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between years of band-and-choir enrollment and ACT scores (Table 29). The analysis revealed a statistically significant positive association, β = .37, *SE* = .10, *p* < .001, indicating that each additional year of combined band and choir participation was associated with a .37-point increase in ACT score. The R-squared statistic was .01, indicating that the number of years enrolled in band and choir explained 1% of the variation in ACT score.

Table 29

OLS Regression with Heteroskedasticity-robust Standard Errors of ACT on Years of Band-and-Choir Enrollment

Predictor	β	*SE*	*p*
Band-and-choir years	.37	.10	< .001
Constant	19.91	.17	< .001

N: 1,111 R-squared: 0.01

OLS regression with heteroskedasticity-robust standard errors was conducted to assess the association between years of band-and-choir enrollment and GPA (Table 30). Results indicated a statistically significant positive effect, β = .08, *SE* = .01, *p* < .001, showing that each additional year of combined band and choir participation corresponded to an increase of .08 in GPA. The R-squared statistic was .02, indicating that the number of years enrolled in band and choir explained 2% of the variation in ACT score.

Table 30

OLS Regression with Heteroskedasticity-robust Standard Errors of GPA on Years of Band-and-Choir Enrollment

Predictor	β	*SE*	*p*
Band-and-choir years	.08	.01	< .001
Constant	2.94	.01	< .001

N: 2,981 R-squared: .02

OLS regression with heteroskedasticity-robust standard errors was performed to evaluate the relationship between years of band-and-choir enrollment and EOC grade scores (Table 31). The analysis showed a statistically significant positive association, β = .91, *SE* = .14, *p* < .001, indicating that each additional year of band and choir

participation was associated with a .91-point increase in EOC grade scores. The R-squared statistic was .01, indicating that the number of years enrolled in band and choir explained 1% of the variation in EOC grade.

Table 31

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC Grade on Years of Band-and-Choir Enrollment

Predictor	β	*SE*	*p*
Band-and-choir years	.91	.14	< .001
Constant	75.02	.20	< .001

N: 2,981 R-squared: .01

OLS regression with heteroskedasticity-robust standard errors was conducted to assess the effect of years of band-and-choir enrollment on EOC American Literature scores (Table 32). Results indicated a statistically significant positive relationship, β = 4.73, *SE* = .91, $p < .001$, suggesting that each additional year of combined band and choir participation was associated with a 4.73-point increase in EOC American Literature performance. The R-squared statistic was .012, indicating that the number of years enrolled in band and choir explained 1.2% of the variation in EOC American literature.

Table 32

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC American Literature on Years of Band-and-Choir Enrollment

Predictor	β	*SE*	*p*
Band-and-choir years	4.73	.91	< .001
Constant	509.23	.92	< .001

N: 2,981 R-squared: .012

An ordered logistic regression with heteroscedasticity-robust standard errors was conducted to evaluate the combined effects of participation in both band and choir on EOC performance levels (Table 33). The results demonstrated a statistically significant positive relationship, β = .17, *SE* = .03, $p < .001$, indicating that students who participated in both ensembles were more likely to attain higher EOC performance levels with each additional year of dual enrollment. The threshold parameters were all significant, confirming well-separated EOC level categories. This suggests that cross-ensemble participation—engagement in both band and choir—was associated with improved academic performance outcomes relative to nonparticipants or students with shorter participation durations. The Pseudo R-squared statistic was .01, indicating that the number of years enrolled in band and choir explained 1% of the variation in EOC level.

Table 33

Ordered Logit with Heteroscedasticity-robust Standard Errors of EOC Level on Band-and-Choir Years

Predictor	β	*SE*	*p*
Band-and-choir years	.17	.03	< .001
cut1	-1.30	.05	< .001
cut2	.40	.04	< .001
cut3	2.92	.08	< .001

N: 2,980 Pseudo R-squared: .01

Years in Band or Choir as the Independent Variable

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between total years of band or choir enrollment and ACT scores (Table 34). The analysis revealed a statistically significant positive association, β

= .71, *SE* = .08, *p* < .001, indicating that each additional year of participation in band or choir (but not both) was associated with a .71-point increase in ACT score. The R-squared statistic was .07, indicating that the number of years enrolled in band or choir explained 7% of the variation in ACT score.

Table 34

OLS Regression with Heteroskedasticity-robust Standard Errors of ACT on Years of Band or Choir Enrollment

Predictor	β	*SE*	*p*
Band or choir years	.71	.08	< .001
Constant	18.71	.20	< .001

N: 1,111 R-squared: 0.07

OLS regression with heteroskedasticity-robust standard errors was performed to assess the association between total years of band and/or choir and GPA (Table 35). Results indicated a statistically significant positive effect, β = .11, *SE* = .01, *p* < .001, showing that each additional year of band or choir participation (but not both) corresponded to an increase of .11 in GPA. The R-squared statistic was .111, indicating that the number of years enrolled in band or choir explained 11.1% of the variation in GPA.

Table 35

OLS Regression with Heteroskedasticity-robust Standard Errors of GPA on Years of Band or Choir Enrollment

Predictor	β	*SE*	*p*
Band or choir years	.11	.01	< .001
Constant	2.81	.01	< .001

N: 2,981 R-squared: .111

OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the relationship between years of band or choir (but not both) enrollment and EOC grade scores (Table 36). The analysis showed a statistically significant positive association, β = 1.38, *SE* = .10, *p* < .001, indicating that each additional year of band or choir participation was associated with a 1.38-point increase in EOC grade scores. The R-squared statistic was .06, indicating that the number of years enrolled in band or choir explained 6% of the variation in EOC grade.

Table 36

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC Grade on Years of Band or Choir Enrollment

Predictor	β	*SE*	*p*
Band or choir years	1.38	.10	< .001
Constant	73.43	.23	< .001

N: 2,981 R-squared: .06

OLS regression with heteroskedasticity-robust standard errors was performed to assess the relationship between band or choir enrollment and EOC American Literature scores (Table 37). Results indicated a statistically significant positive association, β = 6.69, *SE* = .50, *p* < .001, suggesting that each additional year of band or choir participation was associated with a 6.69-point increase in EOC American Literature scores. The R-squared statistic was .06, indicating that the number of years enrolled in band or choir explained 6% of the variation in EOC American literature.

Table 37

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC American Literature on Years of Band or Choir Enrollment

Predictor	β	*SE*	*p*
Band or choir years	6.69	.50	< .001
Constant	501.59	1.071	< .001

N: 2,981 R-squared: .06

An ordered logistic regression with heteroscedasticity-robust standard errors examined the overall relationship between years of band or choir enrollment and EOC performance levels (Table 38). The analysis revealed a strong and statistically significant positive effect, β = .25, *SE* = .02, *p* < .001, suggesting that students with more cumulative years of band or choir involvement were substantially more likely to achieve higher EOC levels. Each of the threshold parameters (*cut1* = –1.06, *cut2* = .70, *cut3* = 3.29) was significant, confirming consistent distinctions between performance categories. These findings indicate that sustained participation in band or choir meaningfully predicts higher EOC performance outcomes. The Pseudo R-squared statistic was .01, indicating that the number of years enrolled in band or choir explained 1% of the variation in EOC level.

Table 38

Ordered Logit with Heteroscedasticity-robust Standard Errors of EOC Level on Total Years of Any Ensemble Enrollment (Band or Choir)

Predictor	β	*SE*	*p*
Band or choir years	.25	.02	< .001
cut1	-1.06	.05	< .001
cut2	.70	.05	< .001
cut3	3.29	.09	< .001

N: 2,980 Pseudo R-squared: 0.01

Years in Band and/or Choir as the Independent Variable

OLS regression with heteroskedasticity-robust standard errors was conducted to examine the relationship between total years of band and/or choir enrollment and ACT scores (Table 39). The analysis revealed a statistically significant positive association, β = 2.48, *SE* = .31, $p < .001$, indicating that each additional year of participation in band and/or choir was associated with a 2.48-point increase in ACT score. The R-squared statistic was .05, indicating that the number of years enrolled in band or choir explained 5% of the variation in ACT score

Table 39

OLS Regression with Heteroskedasticity-robust Standard Errors of ACT on Years of Band and/or Choir Enrollment

Predictor	β	*SE*	*p*
Band and/or choir years	2.48	.31	< .001
Constant	18.69	.21	< .001

N: 1,111 R-squared: .05

OLS regression with heteroskedasticity-robust standard errors was performed to assess the association between total years of band and/or choir and GPA (Table 40). Results indicated a statistically significant positive effect, β = .33, *SE* = .02, $p < .001$, showing that each additional year of band and/or choir participation corresponded to an increase of .33 in GPA. The R-squared statistic was .07, indicating that the number of years enrolled band and/or choir explained 7% of the variation in GPA.

Table 40

OLS Regression with Heteroskedasticity-robust Standard Errors of GPA on Years of Band and/or Choir Enrollment

Predictor	β	*SE*	*p*
Band and/or choir years	.33	.02	< .001
Constant	2.82	.01	< .001

N: 2,981 R-squared: 0.07

OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the relationship between years of band and/or choir enrollment and EOC grade scores (Table 41). The analysis showed a statistically significant positive association, β = 4.01, *SE* = .39, *p* < .001, indicating that each additional year of band and/or choir participation was associated with a 4.01-point increase in EOC grade scores. The R-squared statistic was .03, indicating that the number of years enrolled in band and/or choir explained 3% of the variation in EOC grade.

Table 41

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC Grade on Years of Band and/or Choir Enrollment

Predictor	β	*SE*	*p*
Band and/or choir years	4.01	.39	< .001
Constant	75.58	.25	< .001

N: 2,981 R-squared: .03

OLS regression with heteroskedasticity-robust standard errors was performed to assess the relationship between band or choir enrollment and EOC American Literature scores (Table 42). Results indicated a statistically significant positive association, β = 19.13, *SE* = 1.84, *p* < .001, suggesting that each additional year of band or choir participation was associated with a 19.13-point increase in EOC American Literature

scores. The R-squared statistic was 0.04, indicating that the number of years enrolled in band or choir explained 4% of the variation in EOC American literature.

Table 42

OLS Regression with Heteroskedasticity-robust Standard Errors of EOC American Literature on Years of Band and/or Choir Enrollment

Predictor	β	*SE*	*p*
Band and/or choir years	19.13	1.84	< .001
Constant	502.43	1.12	< .001

N: 2,981 R-squared: .04

An ordered logistic regression with heteroscedasticity-robust standard errors examined the overall relationship between years of band and/or choir enrollment and EOC performance levels (Table 43). The analysis revealed a strong and statistically significant positive effect, β = .72, *SE* = .07, *p* < .001, suggesting that students with more cumulative years of band and/or choir involvement were substantially more likely to achieve higher EOC levels. Each of the threshold parameters (*cut1* = –1.07, *cut2* = .66, *cut3* = 3.21) was significant, confirming consistent distinctions between performance categories. These findings indicate that sustained participation in band and/or choir meaningfully predicts higher EOC performance outcomes. The Pseudo R-squared statistic was .01, indicating that the number of years enrolled in band and/or choir explained 1% of the variation in EOC level.

Table 43

Ordered Logit with Heteroscedasticity-robust Standard Errors of EOC Level on Years of Band and/or Choir

Predictor	β	*SE*	*p*
Band and/or choir years	.72	.07	< .001
cut1	-1.07	.05	< .001
cut2	.66	.05	< .001
cut3	3.21	.09	< .001

N: 2,980 Pseudo R-squared: 0.01

Summary of Findings for RQ2/H_2. The second research question entailed thirty bivariate statistical tests. There were six operationalizations of enrollment in a high school large music ensemble (band and/or choir). There were five operationalizations of academic performance. The results for all thirty tests are summarized in Table 44. Only results that were statistically significant at the .05 threshold for statistical significance are reported in the table. Statistically insignificant results are denoted with a dash mark.

Table 44

Summary of Results for RQ2/H_1

Enrollment type	Academic performance measure				
	GPA	ACT score	EOC grade	EOC American lit.	EOC level
Band enrollment regardless of participation in choir	Each additional year corresponded to a .13-point increase in GPA over the GPA of the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)	Each additional year corresponded to a .95-point increase in ACT score over the ACT scores of the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)	Each additional year corresponded to a 1.73-point increase in EOC grade over the EOC grade of the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)	Each additional year corresponded to an 8.30-point increase in EOC American Literature score over the EOC American literature score of the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)	Each additional year corresponded to a .30 increase in the log-odds of achieving a higher EOC level over the EOC level of the reference group (comprised of students enrolled in choir only and students enrolled in neither band nor choir)
Choir enrollment, regardless of participation in band	Each additional year corresponded to a .06-point increase in GPA over the GPA of the reference group (comprised of	_	Each additional year corresponded to a .44-point increase in EOC grade over the EOC grade of the reference group	Each additional year corresponded to a 2.31-point increase in EOC American Literature score over the EROC	Each additional year corresponded to a .10 increase in the log-odds of achieving a higher EOC level over the EOC

Enrollment type	Academic performance measure				
	GPA	ACT score	EOC grade	EOC American lit.	EOC level
	students enrolled in band only and students enrolled in neither band nor choir)		(comprised of students enrolled in band only and students enrolled in neither band nor choir)	American literature score of the reference group (comprised of students enrolled in band only and students enrolled in neither band nor choir)	level of the reference group (comprised of students enrolled in band only and students enrolled in neither band nor choir)
Band enrollment, but not choir enrollment	Each additional year corresponded to a .12-point increase in GPA over the GPA of the reference group (comprised of students enrolled in choir only, students enrolled in both band and choir, and students enrolled in neither band nor choir)	Each additional year corresponded to a .86-point increase in ACT score over the ACT scores of the reference group (comprised of students enrolled in choir only, students enrolled in both band and choir, and students enrolled in neither band nor choir)	Each additional year corresponded to a 1.61-point increase in EOC grade over the EOC grades of the reference group (comprised of students enrolled in choir only, students enrolled in both band and choir, and students enrolled in neither band nor choir)	Each additional year corresponded to a 7.54-point increase in EOC American Literature score over the EOC American literature scores of the reference group (comprised of students enrolled in choir only, students enrolled in both band and choir, and students enrolled in neither band nor choir)	Each additional year corresponded to a .27 increase in the log-odds of achieving a higher EOC level of the reference group (comprised of students enrolled in choir only, students enrolled in both band and choir, and students enrolled in neither band nor choir)

Enrollment type	Academic performance measure				
	GPA	ACT score	EOC grade	EOC American lit.	EOC level
Choir enrollment, but not band enrollment	Each additional year corresponded to a .02-point increase in GPA over the GPA of the reference group (comprised of students enrolled in band only, students enrolled in both band and choir, and students enrolled in neither band nor choir)	Each additional year corresponded to a .40-point decrease in ACT score over the ACT scores of the reference group (comprised of students enrolled in band only, students enrolled in both band and choir, and students enrolled in neither band nor choir)	_	_	_
Band enrollment and choir enrollment	Each additional year corresponded to a .08-point increase in GPA over the GPA of the reference group (comprised of students enrolled in band only, students enrolled in choir only, and	Each additional year corresponded to a .37-point increase in ACT score over the ACT scores of the reference group (comprised of students enrolled in band only, students enrolled in choir	Each additional year corresponded to a .91-point increase in EOC grade over the EOC grades of the reference group (comprised of students enrolled in band only, students enrolled	Each additional year corresponded to a 4.73-point increase in EOC American Literature score over the EOC American literature score of the reference group (comprised	Each additional year corresponded to a .17 increase in the log-odds of achieving a higher EOC level over the EOC level of the reference group (comprised of students enrolled

Enrollment type	Academic performance measure				
	GPA	ACT score	EOC grade	EOC American lit.	EOC level
	students enrolled in neither band nor choir)	only, and students enrolled in neither band nor choir)	in choir only, and students enrolled in neither band nor choir)	of students enrolled in band only, students enrolled in choir only, and students enrolled in neither band nor choir)	in band only, students enrolled in choir only, and students enrolled in neither band nor choir)
Band enrollment or choir enrollment	Each additional year corresponded to a .11-point increase in GPA over the GPA of the reference group (comprised of students enrolled in both band and choir and students enrolled in neither band nor choir)	Each additional year corresponded to a .71-point increase in ACT score over the ACT scores of the reference group (comprised of students enrolled in both band and choir and students enrolled in neither band nor choir)	Each additional year corresponded to a 1.38-point increase in EOC grade over the EOC grades of the reference group (comprised of students enrolled in both band and choir and students enrolled in neither band nor choir)	Each additional year corresponded to a 6.69-point increase in EOC American Literature score over the EOC American literature scores of the reference group (comprised of students enrolled in both band and choir and students enrolled in neither band nor choir)	Each additional year corresponded to a .25 increase in the log-odds of achieving a higher EOC level over the EOC level of the reference group (comprised of students enrolled in both band and choir and students enrolled in neither band nor choir)

Enrollment type	Academic performance measure				
	GPA	ACT score	EOC grade	EOC American lit.	EOC level
Band enrollment and/or choir enrollment	Each additional year corresponded to a .33-point increase in GPA over the GPA of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year corresponded to a 2.48-point increase in ACT score over the ACT scores of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year corresponded to a 4.01-point increase in EOC grade over the EOC grades of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year corresponded to a 19.13-point increase in EOC American literature score over the EOC American literature score of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year corresponded to a .72 increase in the log-odds of achieving a higher EOC level over the EOC level of the reference group (comprised of students enrolled in neither band nor choir)

Statistically significant positive relationships between years of ensemble participation and academic achievement were observed for several enrollment categories. For band enrollment regardless of participation in choir, additional years of band participation were associated with higher academic performance across all five outcome measures, including GPA, ACT score, EOC grade, American Literature EOC score, and the log-odds of achieving a higher EOC level. Choir enrollment regardless of band participation also showed positive associations with several achievement measures, including GPA, EOC grade, American Literature EOC score, and EOC achievement level. Band-only participation likewise demonstrated positive relationships across all five academic measures, including GPA, ACT score, EOC grade, American Literature EOC score, and EOC achievement level. Dual enrollment in band and choir also corresponded to higher academic performance across all five measures of academic achievement. Finally, when band or choir participation was considered collectively, each additional year of participation corresponded to a 0.33-point increase in GPA, a 2.48-point increase in ACT score, a 4.01-point increase in EOC grade, and a 19.13-point increase in American Literature EOC score relative to the reference group comprised of students enrolled in neither band nor choir. Each additional year of participation was also associated with a .72 increase in the log-odds of achieving a higher EOC achievement level relative to the reference group.

Statistically significant negative relationships were observed only for choir-only participation. For students enrolled in choir but not band, additional years of choir-only participation were associated with lower ACT scores relative to the reference group. Several comparisons did not reach statistical significance. For choir enrollment

regardless of band participation, the relationship between years of choir enrollment and ACT score was not statistically significant. Similarly, for students enrolled in choir but not band, the relationships between years of participation and GPA, EOC grade, American Literature EOC score, and EOC achievement level were not statistically significant.

Research Question 3

The third research question was “Is there a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model?” RQ3/H_1 was first addressed using the binary operationalizations of high school large music ensemble (band and/or choir) enrollment (from RQ1/H_1). RQ3/H_1 was then addressed with the continuous operationalizations of high school large music ensemble (band and/or choir) enrollment (from RQ2/H_1). The dependent variables included ACT scores, GPA, EOC American Literature scores, EOC Grade scores, and EOC Level performance.

For the quantitative model with binary operationalizations, three mutually exclusive indicator variables were specified: Band only, Choir only, and Band and choir. Students enrolled in neither ensemble served as the reference category. The variable Band or choir was not included because it is a linear combination of the Band only and Choir only indicators and would therefore create perfect multicollinearity in the model. Similarly, the binary variable Band and/or choir was omitted because it was equal to the sum of Band only, Choir only, and Band and choir, making it perfectly collinear with those three variables. Including either variable would therefore result in a singular

design matrix. Because analyses indicated that the dependent variables were not normally distributed, nonparametric procedures were selected. Many of the homogeneity-of-variance results indicated heteroscedasticity. OLS regression with heteroscedasticity-robust standard errors was used. For the model with a categorical and ordinal dependent variable (EOC Level), robust ordered logistic regression was used.

For the quantitative model with continuous operationalizations, three variables were specified: Band only years, Choir only years, and Band and choir years. The variable Band or choir years was not included because it is a linear combination of the Band only years and Choir only years and would therefore create perfect multicollinearity in the model. Similarly, Band and/or choir years was omitted because it is equal to the sum of Band only years, Choir only years, and Band and choir years, making it perfectly collinear with those three variables. Including either variable would therefore result in a singular design matrix. Because several tests of homogeneity of variance indicated heteroskedasticity, OLS regression with heteroscedasticity-robust standard errors was therefore used, which does not rely on the normality and homogeneity-of-variance assumptions required for parametric analysis (Woolridge, 2019). Robust standard errors provide consistent estimates of the variance–covariance matrix in the presence of heteroskedasticity and therefore yield valid statistical inference even when the homogeneity-of-variance assumption is violated (Wooldridge, 2019). For the model with a categorical and ordinal dependent variable (EOC Level), robust ordered logistic regression was used.

Hypothesis Tests for Research Question 3 (Binary Independent Variables)

GPA as the dependent variable. OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment (yes=1, no=0), Choir only enrollment (yes=`1, no=0), and Band and choir enrollment (yes=1, no=0) on GPA (Table 45). All three independent variables were positive and statistically significant. The largest estimate was for Band and choir enrollment. The analysis showed a statistically significant positive association between Band and choir enrollment and GPA, β = .56, *SE* = .02, $p < .001$, showing Band and choir enrollment to be associated with a .56-point increase in GPA. The second largest estimate was for Band only enrollment. The analysis showed a statistically significant positive association between Band only enrollment and GPA, β = .42, *SE* = .03, $p < .001$, showing Band only enrollment was associated with a .42-point increase in GPA. The smallest estimate was for Choir only enrollment. The analysis also showed a statistically significant positive association between Choir only enrollment and GPA, β = .15, *SE* = .03, $p < .001$, showing Choir only enrollment was associated with a .15-point increase in GPA. The R-squared statistic was .089, indicating that the model explained 8.9% of the variation in GPA.

Table 45

OLS Regression with Heteroskedasticity-robust Standard Errors of Band-only Enrollment, Choir-only Enrollment, and Band and Choir Enrollment on GPA

Predictor	β	*SE*	*p*
Band only enrollment	.42	.03	< .001
Choir only enrollment	.15	.03	< .001
Band and choir enrollment	.56	.02	< .001
Constant	2.82	.01	< .001

N: 2,981 R-squared: .089

ACT score as the dependent variable. OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment (yes=1, no=0), Choir only enrollment (yes=`1, no=0), and Band and choir enrollment (yes=1, no=0) on ACT scores (Table 46). Band-only enrollment and Band and choir enrollment were statistically significant and positive. Choir only enrollment was not statistically significant. The largest estimate was for Band and choir enrollment. The analysis showed a statistically significant positive association between Band and choir enrollment and ACT score, β = 3.34, *SE* = .37, *p* < .001, showing Band and choir enrollment to be associated with a 3.34-point increase in ACT score. The second largest estimate was for Band only enrollment. The analysis showed a statistically significant positive association between Band only enrollment and ACT scores, β = 3.32, *SE* = 0.63, *p* < .001, showing Band only enrollment was associated with a 3.32-point increase in ACT score. The statistically insignificant estimate for Choir only enrollment was β = .42, *SE* = .46, *p* = .36. The R-squared statistic was 0.081, indicating that the quantitative model explained 8.1% of the variation in ACT score.

Table 46

OLS Regression with Heteroskedasticity-robust Standard Errors of Band-only Enrollment, Choir-only Enrollment, and Band and Choir Enrollment on ACT Score

Predictor	β	*SE*	*p*
Band only enrollment	3.32	.37	< .001
Choir only enrollment	.42	.46	.36
Band and choir enrollment	3.34	.63	< .001
Constant	18.69	.21	< .001

N: 1,111 R-squared: .081

EOC grade as the dependent variable. OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment

(yes=1, no=0), Choir only enrollment (yes=`1, no=0), and Band and choir enrollment (yes=1, no=0) on EOC grade (Table 47). All three independent variables were positive and statistically significant. The largest estimate was for Band and choir enrollment. The analysis showed a statistically significant positive association between Band and choir enrollment and EOC grade, β = 6.35, *SE* = .89, *p* < .001, showing Band and choir enrollment to be associated with a 6.35-point increase in EOC grade. The second largest estimate was for Band only enrollment. The analysis showed a statistically significant positive association between Band only enrollment and EOC grade, β = 5.47, *SE* = .44, *p* < .001, showing Band only enrollment was associated with a 5.47-point increase in EOC grade. The smallest estimate was for Choir only enrollment. The analysis showed a statistically significant positive association between Choir only enrollment and EOC grade, β = 1.06, *SE* = .60, *p* < .001, showing Choir only enrollment was associated with a 1.06-point increase in EOC grade. The R-squared statistic was .051, indicating that the quantitative model explained 5.1% of the variation in EOC grade.

Table 47

OLS Regression with Heteroskedasticity-robust Standard Errors of Band-only Enrollment, Choir-only Enrollment, and Band and Choir Enrollment on EOC Grade

Predictor	β	*SE*	*p*
Band only enrollment	5.47	.44	< .001
Choir only enrollment	1.06	.60	.36
Band and choir enrollment	6.35	.89	< .001
Constant	73.58	.25	< .001

N: 2,981 R-squared: .051

EOC American literature score as the dependent variable. OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment (yes=1, no=0), Choir only enrollment (yes=`1, no=0), and Band and choir enrollment (yes=1, no=0) on EOC American literature scores (Table 48). Band-only enrollment and Band and choir enrollment were statistically significant and positive. Choir only enrollment was not statistically significant. The largest estimate was for Band and choir enrollment. The analysis showed a statistically significant positive association between Band and choir enrollment and EOC American literature score, β = 32.10, *SE* = 5.27, *p* < .001, showing Band and choir enrollment to be associated with a 3.34-point increase in EOC American literature score. The second largest estimate was for Band only enrollment. The analysis showed a statistically significant positive association between Band only enrollment and EOC American literature score, β = 25.66, *SE* = 2.15, *p* < .001, showing Band only enrollment was associated with a 3.32-point increase in EOC American literature score. The statistically insignificant estimate for Choir only enrollment was β = 5.23, *SE* = 2.76, *p* = .06. The R-squared statistic was 0.053, indicating that the quantitative model explained 5.3% of the variation in EOC American literature score.

Table 48

OLS Regression with Heteroskedasticity-robust Standard Errors of Band-only Enrollment, Choir-only Enrollment, and Band and Choir Enrollment on EOC American Literature Score

Predictor	β	*SE*	*p*
Band only enrollment	25.66	2.16	< .001
Choir only enrollment	5.23	1.90	.06
Band and choir enrollment	32.10	5.27	< .001

Predictor	β	*SE*	*p*
Constant	502.43	448.01	< .001

N: 2,981 R-squared: .053

EOC level as the dependent variable. An ordered logistic regression with heteroscedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment (yes=1, no=0), Choir only enrollment (yes=`1, no=0), and Band and choir enrollment (yes=1, no=0) on EOC level (Table 49). All three independent variables were positive and statistically significant. The largest estimate was for Band and choir enrollment. The analysis showed a statistically significant positive association between band and choir enrollment and EOC level, β = 1.19, *SE* = .19, *p* < .001. This result indicates that band and choir enrollment was associated with a 1.19-point increase in the log-odds of moving to a higher EOC level. The second largest estimate was for Band only enrollment. The analysis showed a statistically significant positive association between Band only enrollment and EOC level, β = .93, *SE* = .08, *p* < .001, showing Band only enrollment was associated with a 5.47-point increase in the log-odds of moving to a higher EOC level. The smallest estimate was for Choir only enrollment. The analysis showed a statistically significant positive association between Choir only enrollment and EOC level, β = .26, *SE* = .10, *p* = .01, showing Choir only enrollment was associated with a .26-point increase in the log odds of moving to a higher EIOC level. Each of the threshold parameters (*cut1* = –1.07, *cut2* = .67, *cut3* = 3.24) was significant, confirming consistent distinctions between performance categories. The Pseudo R-squared statistic was .02, indicating that the model explained 2% of the variation in EOC level**.**

Table 49

Ordered Logit with Heteroscedasticity-robust Standard Errors of Band-only Enrollment, Choir-only Enrollment, and Band and Choir Enrollment on EOC Level

Predictor	β	*SE*	*p*
Band only enrollment	.93	.08	< .001
Choir only enrollment	.26	.10	.01
Band and choir enrollment	1.19	.19	< .001
cut1	-1.07	.05	< .001
cut2	.67	.05	< .001
cut3	3.24	.09	< .001

N: 2,980 Pseudo R-squared: .02

Hypothesis Tests for Research Question 3 (Continuous Independent Variables)

GPA as the dependent variable. OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment years, Choir only enrollment years, and Band and choir enrollment years on GPA (Table 50). All three independent variables were statistically significant and positive. The largest estimate was for Band only enrollment years. The analysis showed a statistically significant positive association between Band only enrollment years and GPA, β = .14, *SE* = .01, *p* < .001, showing each additional year of band-only enrollment to be associated with a .14-point increase in GPA. The second largest estimate was for Band and choir enrollment years. The analysis showed a statistically significant positive association between Band and choir enrollment years and GPA, β = .10, *SE* = .01, *p* < .001, showing each additional year of band-and-choir enrollment was associated with a .10-point increase in GPA. The smallest estimate was for Choir only enrollment years. The analysis showed a statistically significant positive association between Choir only enrollment years and GPA, β = .07, *SE* = .01, *p* < .001, showing each additional year of

choir-only enrollment was associated with a .07-point increase in GPA. The R-squared statistic was .119, indicating that the quantitative model explained 11.9% of the variation in GPA.

Table 50

OLS Regression with Heteroskedasticity-robust Standard Errors of Band-only Enrollment Years, Choir-only Enrollment Years, and Band and Choir Enrollment Years on GPA

Predictor	β	*SE*	*p*
Band only enrollment years	.14	.01	< .001
Choir only enrollment years	.07	.01	< .001
Band and choir enrollment years	.10	.01	< .001
Constant	2.82	.01	< .001

N: 2,980 R-squared: 0.119

ACT score as the dependent variable. OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment years, Choir only enrollment years, and Band and choir enrollment years on ACT scores (Table 51). Years of Band-only enrollment and years of Band and choir enrollment were statistically significant and positive. Years of Choir only enrollment was not statistically significant. The largest estimate was for Band only enrollment years. The analysis showed a statistically significant positive association between years of Band only enrollment years and ACT score, β = .96, *SE* = .11, *p* < .001, showing each additional year of Band and choir enrollment to be associated with a .96-point increase in ACT score. The second largest estimate was for years of Band and choir enrollment years. The analysis showed a statistically significant positive association between years of Band and choir enrollment years and ACT scores, β = .56, *SE* = .11, *p* < .001, showing

each additional year of Band only enrollment was associated with a .56-point increase in ACT score. The statistically insignificant estimate for years of Choir only enrollment was β = .09, *SE* = .16, *p* = .55. The R-squared statistic was .094, indicating that the quantitative model explained 9.4% of the variation in ACT score.

Table 51

OLS Regression with Heteroskedasticity-robust Standard Errors of Band-only Enrollment Years, Choir-only Enrollment Years, and Band and Choir Enrollment Years on ACT Score

Predictor	β	*SE*	*p*
Band only enrollment years	.96	.10	< .001
Choir only enrollment years	.09	.16	.55
Band and choir enrollment years	.56	.11	< .001
Constant	18.71	.20	< .001

N: 1,111 R-squared: .094

EOC grade as the dependent variable. OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment years, Choir only enrollment years, and Band and choir enrollment years on EOC grade (Table 52). All three independent variables were statistically significant and positive. The largest estimate was for Band only enrollment years. The analysis showed a statistically significant positive association Band only enrollment years and EOC grade, β = 1.76, *SE* = .12, *p* < .001, showing each additional year of band-only enrollment to be associated with a 1.76-point increase in EOC grade. The second largest estimate was for Band and choir enrollment years. The analysis showed a statistically significant positive association between Band and choir enrollment years and EOC grade, β = 1.15, *SE* = .14, *p* < .001, showing each additional year of band-and-choir enrollment

was associated with a 1.15-point increase in EOC grade. The smallest estimate was for Choir only enrollment years. The analysis showed a statistically significant positive association between Choir only enrollment years and EOC grade, β = .59, SE = .21, p = .01, showing each additional year of band-and-choir enrollment was associated with a .59-point increase in EOC grade. The R-squared statistic was .066, indicating that the quantitative model explained 6.6% of the variation in EOC grade.

Table 52

OLS Regression with Heteroskedasticity-robust Standard Errors of Band-only Enrollment Years, Choir-only Enrollment Years, and Band and Choir Enrollment Years on EOC Grade

Predictor	β	*SE*	*p*
Band only enrollment years	1.76	0.12	< .001
Choir only enrollment years	0.59	0.21	0.01
Band and choir enrollment years	1.15	0.14	< .001
Constant	73.45	0.24	< .001

N: 2,980 R-squared: 0.066

EOC American literature score as the dependent variable. OLS regression with heteroskedasticity-robust standard errors was conducted to evaluate the influence of Band only enrollment years, Choir only enrollment years, and Band and choir enrollment years on EOC American literature score (Table 53). All three independent variables were statistically significant and positive. The largest estimate was for Band only enrollment years. The analysis showed a statistically significant positive association Band only enrollment years and EOC American literature score, β = 8.32, *SE* = .59, *p* < .001, showing each additional year of band-only enrollment to be associated with a 8.32-point increase in EOC American literature score. The second

largest estimate was for Band and choir enrollment years. The analysis showed a statistically significant positive association between Band and choir enrollment years and EOC American literature score, β = 5.89, *SE* = .92, *p* < .001, showing each additional year of band-and-choir enrollment was associated with a 5.89-point increase in EOC American literature score. The smallest estimate was for Choir only enrollment years. The analysis showed a statistically significant positive association between Choir only enrollment years and EOC American literature score, β = 2.84, SE = 1.00, p < 0.01, showing each additional year of band-and-choir enrollment was associated with a 2.84-point increase in EOC American literature score. The R-squared statistic was .069, indicating that the quantitative model explained 6.9% of the variation in EOC American literature score.

Table 53

OLS Regression with Heteroskedasticity-robust Standard Errors of Band-only Enrollment Years, Choir-only Enrollment Years, and Band and Choir Enrollment Years on EOC American Literature Score

Predictor	β	*SE*	*p*
Band only enrollment years	8.32	0.59	< .001
Choir only enrollment years	2.84	1.00	< .01
Band and choir enrollment years	5.89	0.92	< .001
Constant	501.81	1.08	< .001

N: 2,980 R-squared: 0.069

EOC level as the dependent variable. An ordered logistic regression with heteroscedasticity-robust standard errors was conducted to evaluate the influence of years of Band only enrollment, years of Choir only enrollment, and years of Band and choir enrollment on EOC level (Table 54). All three independent variables were positive

and statistically significant. The largest estimate was for band-only enrollment years, β = .30, SE = .02, p < .001, indicating that each additional year of band-only enrollment was associated with higher odds of being in a higher EOC level. The second largest estimate was for band-and-choir enrollment years, β = .22, SE = .03, p < .001, indicating that each additional year of band-and-choir enrollment was associated with greater odds of being in a higher EOC level. The smallest estimate was for choir-only enrollment years, β = .12, SE = .04, p < .001, indicating that each additional year of choir-only enrollment was associated with higher odds of being in a higher EOC level. Each of the threshold parameters (*cut1* = –1.07, *cut2* = .69, *cut3* = 3.30) was significant, confirming consistent distinctions between performance categories. The Pseudo R-squared statistic was 0.03, indicating that the model explained 3% of the variation in EOC level.

Table 54

Ordered Logit with Heteroscedasticity-robust Standard Errors of Band-only Enrollment Years, Choir-only Enrollment Years, and Band and Choir Enrollment Years on EOC Level

Predictor	β	*SE*	*p*
Band only enrollment years	.30	.02	< .001
Choir only enrollment years	.13	.04	< .001
Band and choir enrollment years	.22	.03	< .001
cut1	-1.07	.05	< .001
cut2	.69	.05	< .001
cut3	3.30	.09	< .001

N: 2,979 Pseudo R-squared: .03

Summary of Findings for RQ3/H_2. The third research question entailed ten multivariate analyses. The results for all thirty tests are summarized in Table 55. Only results that were statistically significant at the .05 threshold for statistical significance are reported in the table. Statistically insignificant results are denoted with a dash mark.

Table 55

Summary of Results for RQ3/H_1

Dependent variables	Independent variables					
	Band only enrollment (binary)	Choir only enrollment (binary)	Band and choir enrollment (binary)	Band only enrollment years (continuous)	Choir only enrollment years (continuous)	Band and choir enrollment years (continuous)
GPA	Enrollment corresponded to a .42-point increase in GPA over the GPA of the reference group (comprised of students enrolled in neither band nor choir)	Enrollment corresponded to a .015-point increase in GPA score over the GPA scores of the reference group (comprised of students enrolled in neither band nor choir)	Enrollment corresponded to a .56-point increase in GPA over the GPA of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year of enrollment corresponded to a .14-point increase in GPA over the GPA of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year of enrollment corresponded to a .07-point increase in GPA score over the GPA scores of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year of enrollment corresponded to a .10-point increase in GPA over the GPA of the reference group (comprised of students enrolled in neither band nor choir)
ACT score	Enrollment corresponded to a 3.32-point increase in ACT score	_	Enrollment corresponded to a 3.34-point increase in ACT score	Each additional year of enrollment corresponded to a .96-point	_	Each additional year of enrollment corresponded to a .56-point

Dependent variables	Independent variables					
	Band only enrollment (binary) over the ACT score of the reference group (comprised of students enrolled in neither band nor choir)	Choir only enrollment (binary)	Band and choir enrollment (binary) over the ACT score of the reference group (comprised of students enrolled in neither band nor choir)	Band only enrollment years (continuous) increase in ACT score over the ACT score of the reference group (comprised of students enrolled in neither band nor choir)	Choir only enrollment years (continuous)	Band and choir enrollment years (continuous) increase in ACT score over the ACT score of the reference group (comprised of students enrolled in neither band nor choir)
EOC grade	Enrollment corresponded to a 5.47-point increase in EOC grade over the EOC grade of the reference group (comprised of students enrolled in neither band nor choir)	_	Enrollment corresponded to a 6.35-point increase in EOC grade over the EOC grades of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year of enrollment corresponded to a 1.76-point increase in EOC grade over the EOC grade of the reference group (comprised of students enrolled in	Each additional year of enrollment corresponded to a .59-point increase in EOC grade over the EOC grade of the reference group (comprised of students enrolled in	Each additional year of enrollment corresponded to a 1.15-point increase in EOC grade over the EOC grades of the reference group (comprised of students enrolled in

Dependent variables	Independent variables					
	Band only enrollment (binary)	Choir only enrollment (binary)	Band and choir enrollment (binary)	Band only enrollment years (continuous) neither band nor choir)	Choir only enrollment years (continuous) neither band nor choir)	Band and choir enrollment years (continuous) neither band nor choir)
EOC American literature score	Enrollment corresponded to a 25.66-point increase in EOC American literature score over the EOC American literature score of the reference group (comprised of students enrolled in neither band nor choir)	_	Enrollment corresponded to a 32.10-point increase in EOC American literature score over the EOC American literature score of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year of enrollment corresponded to an 8.32-point increase in EOC American literature score over the EOC American literature score of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year of enrollment corresponded to a 2.84-point decrease in EOC American literature score over the EOC American literature score of the reference group (comprised of students enrolled in neither band nor choir)	Each additional year of enrollment corresponded to a 5.89-point increase in EOC American literature score over the EOC American literature score of the reference group (comprised of students enrolled in neither band nor choir)
EOC level	Enrollment corresponded to a .93-point	Enrollment corresponded to a .26-point	Enrollment corresponded to a 1.19-point	Each additional year of enrollment	Each additional year of enrollment	Each additional year of enrollment

Dependent variables	Independent variables					
	Band only enrollment (binary) increase in the log odds of moving up an EOC level over the log odds of the reference group (comprised of students enrolled in neither band nor choir) moving up a level	Choir only enrollment (binary) increase in the log odds of moving up an EOC level over the log odds of the reference group (comprised of students enrolled in neither band nor choir) moving up a level	Band and choir enrollment (binary) increase in the log odds of moving up an EOC level over the log odds of the reference group (comprised of students enrolled in neither band nor choir) moving up a level	Band only enrollment years (continuous) corresponded to a .30-point increase in the log odds of moving up an EOC level over the log odds of the reference group (comprised of students enrolled in neither band nor choir) moving up a level	Choir only enrollment years (continuous) corresponded to a .13-point increase in the log odds of moving up an EOC level over the log odds of the reference group (comprised of students enrolled in neither band nor choir) moving up a level	Band and choir enrollment years (continuous) corresponded to a .22-point increase in the log odds of moving up an EOC level over the log odds of the reference group (comprised of students enrolled in neither band nor choir) moving up a level

Statistically significant positive relationships between ensemble participation and academic achievement were observed for several enrollment categories. For the binary operationalization, band-only enrollment demonstrated positive associations with academic performance across multiple outcome measures, including GPA, ACT score, EOC grade, American Literature EOC score, and the log-odds of achieving a higher EOC level. Band and choir enrollment likewise demonstrated positive relationships across these same five academic measures, including GPA, ACT score, EOC grade, American Literature EOC score, and EOC achievement level. Choir-only enrollment also showed a positive association with EOC achievement level.

For the continuous operationalization, additional years of band-only enrollment were associated with higher academic performance across all five outcome measures, including GPA, ACT score, EOC grade, American Literature EOC score, and the log-odds of achieving a higher EOC level. Additional years of band and choir enrollment were similarly associated with higher academic performance across these same five measures of academic achievement. Additional years of choir-only enrollment were associated with higher academic performance for several outcomes, including GPA, EOC grade, and the log-odds of achieving a higher EOC level.

Statistically significant negative relationships were observed only for years of choir-only participation. For students enrolled in choir but not band, additional years of choir-only participation were associated with lower American Literature EOC scores relative to the reference group. Several comparisons did not reach statistical significance. For the binary operationalization, choir-only enrollment did not demonstrate statistically significant relationships with ACT score, EOC grade, or

American Literature EOC score. For the continuous operationalization, the relationship between years of choir-only enrollment and ACT score did not reach statistical significance.

Chapter 5

Discussion

The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. Specifically, the study focused on examining how different operationalizations of enrollment in band and enrollment in choir correlated with different operationalizations of academic performance. I sought to uncover patterns in a dataset for eleven rural high schools in the state of Georgia that might illuminate the role of high school large ensemble enrollment in academic performance, to highlight the general education value of music education to educators and policymakers. The research questions were: (a) RQ1: Is there a statistically significant relationship between student enrollment in different types of high school large music ensembles (band or choir) and academic achievement?; (b) RQ2: Is there a statistically significant relationship between student years of enrollment in high school large music ensembles (band and/or choir) and academic achievement?; (c) RQ3: Is there a statistically significant relationship between academic achievement and enrollment in high school large music ensembles (band and/or choir) when both ensemble types are included in the same model?

The dataset was developed from secondary sources provided by rural public high schools in the state of Georgia. The dataset was at the student level of analysis. The dependent variables in the dataset were GPA, ACT score. EOC grade, EOC American literature score, and EOC level. The variables included binary indicators of performance in band (yes =1, no =0) and choir (yes = 1, no =0). From these two binary variables, six

operationalizations representing every possible type of enrollment were created: enrollment in band regardless if also enrolled in choir (yes = 1, no = 0), enrollment in choir regardless if also enrolled in band (yes = 1, no = 0), enrollment in band but not in choir (yes = 1, no = 0), enrollment in band and choir (yes = 1, no = 0), enrollment in band or choir but not both (yes = 1, no = 0), and enrollment in band and/or choir (yes = 1, no = 0). The binary operationalizations were used when addressing RQ3/*H1*. The dataset also included continuous variables for the number of years each student had been enrolled in band and in choir. From these variables, six operationalizations representing every possible type of enrollment years count were created: years of enrollment in band regardless if also enrolled in choir, years of enrollment in choir regardless if also enrolled in band, years of enrollment in band but not in choir, years of enrollment in choir but not band, years of enrollment in band and choir, years of enrollment in band or choir but not both, and years of enrollment in band and/or choir. The binary operationalizations were used when addressing RQ3/H_1.

Kruskal-Wallis tests were used for the bivariate analyses using the binary operationalizations of the independent variables (RQ1/H_1) due to consistent heteroscedasticity and non-normality across the dependent variables for academic performance. OLS regression with heteroscedasticity-robust standard errors was used for the bivariate analyses using the continuous operationalizations of the independent variables (RQ2/H_1) and the multivariate analyses (RQ3/H_1) for the same reason. For the categorical and ordinal dependent variable EOC level, ordered logistic regression with heteroscedasticity-robust standard errors was used (RQ1/H_1, RQ2/H_2, and RQ3/H_3).

The results showed consistently statistically significant and positive relationships between enrollment in band and enrollment in both band and choir and academic performance. The results for enrollment in choir but not band were less consistent, with some statistically insignificant results, some statistically significant negative associations, and some statistically significant positive associations with academic performance. The threshold for statistical significance was $p \leq .05$. All statistically insignificant results were well above this threshold.

The results support the extant empirical literature demonstrating a consistent statistically significant and positive relationship between student participation in music education and academic achievement. Numerous studies have investigated this correlation, revealing a significant relationship between participation in music programs and enhanced academic performance. For instance, Guhn et al. (2020), Incognito et al. (2022), and Thopre and McPhail (2022) have all contributed to this body of research. Guhn et al. (2020) conducted a comprehensive study that found students enrolled in music education not only achieved higher grades but also performed better on standardized tests compared to their peers who did not participate in such programs. The study highlighted that involvement in music, particularly in choir, was associated with a supportive educational environment that fostered higher academic success.

Furthermore, their findings reinforced the initial hypothesis that participation in music education is related to various aspects of academic achievement, suggesting that music may play a crucial role in the overall educational development of students. This connection underlines the importance of integrating music education into school curricula to support not just artistic growth but also academic excellence. Music

education has been consistently linked to enhanced academic achievement among secondary school students, as highlighted in numerous research studies (Gonzalez Ben, 2022; Fautley & Daubney, 2022; Tucker & Winsler, 2023). These studies suggest that participation in music programs correlates positively with improved academic performance, indicating that students who are enrolled in musical programs tend to excel academically. Tucker and Winsler (2023) conducted a comprehensive analysis revealing that students enrolled in music programs not only attain higher grades but also show significant improvements in their performance on standardized assessments. This suggests that the skills developed through music education, such as discipline, creativity, and critical thinking, may be associated with or related to better academic outcomes.

Additionally, the findings from this research support the hypothesis that involvement in music programs is associated with academic success across various measures of achievement. However, it must be noted that this study was focused on rural southern schools, while much of the literature reviewed and compared were from large urban regions. Specifically, the study found that students participating in band consistently demonstrated higher levels of academic performance compared to a reference group of students not participating in any type of music ensemble, suggesting that music education is related to academic performance. Similarly, choir enrollment also showed positive results across all metrics of academic success, further illustrating the relationships among music education and students' learning experiences in other subject areas.

Prior literature has demonstrated a connection between music education and the academic achievement of secondary school students (Gonzalez Ben, 2022; Fautley & Daubney, 2022; Tucker & Winsler, 2023). Across all models, the OLS regression with homogeneity-robust standard errors analyses consistently indicated that years of band enrollment were positively associated with academic performance. Students with more years of band participation tended to score higher on standardized assessments and maintain higher GPAs. Specifically, each additional year of band enrollment was linked to meaningful increases in ACT scores, GPA, EOC grade, and EOC American Literature performance, with all effects statistically significant at $p < .001$. The ordered logistic regression further demonstrated that additional years of band participation significantly increased the likelihood of achieving higher EOC performance levels ($\beta = 0.30$, $SE = 0.02$, $p < .001$). Taken together, these results suggest a consistent and moderate positive relationship between sustained engagement in band and multiple indicators of academic achievement across both continuous and ordinal measures.

The third research question and hypothesis were analyzed using OLS regression with heteroscedasticity-robust standard errors for binary and continuous operationalizations of large music ensemble participation. Across all analyses for Research Question 3, the findings revealed mixed but generally consistent patterns regarding the relationship between large ensemble participation and academic performance. When ensemble participation was modeled using binary indicators, band involvement – either as general participation or band-only – was most consistently associated with higher academic outcomes, including ACT scores, GPA, and EOC performance measures. Choir-related participation demonstrated weaker or

nonsignificant effects across most outcomes, suggesting a smaller academic association. However, in several models that included both band and choir, coefficients were negative or nonsignificant, indicating that dual participation may not yield additional benefits. When participation was represented as a continuous measure (years of participation), the overall pattern remained similar: band years and total ensemble years were positively related to academic performance, while choir-only and mixed participation measures were largely nonsignificant. Although effect sizes were modest, the consistent direction of relationships across models supports the conclusion that sustained participation in band is the most robust predictor of higher academic achievement among the examined forms of large ensemble involvement. Tucker and Winsler (2023) discovered that enrollment in music was associated with higher grades and improved performance on standardized assessments. Prior research also showed that a positive correlation exists between musical enrollment and improved academic performance (Gonzalez Ben, 2022; Springer & Silvey, 2022; Tucker & Winsler, 2023). The findings of this study expanded prior literature by emphasizing different operationalizations of band enrollment and choir enrollment for high school students in a rural area of the United States.

Recommendations for Practice

The implications of this study for educational practice invite contemplation by educational administrators, policymakers, and parents. The data corroborate a strong correlation between enrollment in band and choir programs and academic performance, both in terms of enrollment and duration. Given the empirical evidence, educational institutions are advised to allocate resources and funding, when possible, to enhance

the quality and reach of band programs. Ideally, investment will encompass the recruitment of proficient instructors, the upgrading of musical instruments, and the allocation of time for practice sessions within the academic calendar.

The evidence suggests that parents and educational stakeholders should encourage initial student enrollment in band and choir programs and emphasize the merits of long-term commitment to these activities. Policymakers may utilize the initiation of orientation sessions, mentorship programs, and pedagogically sound strategies to promote sustained skill development and engagement. Educational leaders should critically examine choir programs. While mere enrollment in choir did not exhibit a strong correlation with academic performance, the length of enrollment did. Therefore, choir programs may require structural or qualitative enhancements to achieve benefits analogous to those observed in band programs.

The final recommendation is regarding curriculum development. Curriculum designers were encouraged to explore interdisciplinary methodologies that can integrate learning outcomes from band and choir programs into mainstream academic curricula, thereby enriching the educational experience from a holistic perspective. While some schools may not have access to these resources, using interpersonal communication between students and parents may be a cost-effective technique to encourage long-term enrollment in high school large music ensembles, such as band, choir, or orchestra.

Recommendations for Future Research

The findings of this dissertation illuminate several promising directions for future scholarly investigations. This study focused specifically on student membership status

and the duration of involvement in the high school's large music ensembles, including band and choir, while also examining their academic performance. However, broadening the research scope to encompass a diverse range of extracurricular activities such as visual arts, athletics, and various student clubs has the potential to provide a more nuanced and comprehensive understanding of the complex relationship between extracurricular engagement and academic achievements. Moreover, there are numerous factors that have been demonstrated to predict and explain variation in different operationalizations of academic performance besides enrollment in a high school large music ensemble, such as parental involvement, student engagement, student part-time employment, student intelligence quotient, and household income (Richardson et al., 2012).

Prior research has established a notable correlation between arts education and enhanced academic success (Guhn et al., 2020; Incognito et al., 2022; Thopre & McPhail, 2022). While this investigation effectively demonstrated the existence of a correlation, it did not explore the underlying causative mechanisms that drive the observed relationships. Therefore, future research endeavors could employ diverse methodologies designed to identify and elucidate the intrinsic factors contributing to the positive influence of participation in band on students' academic performance. Such inquiries could deepen our comprehension of how engagement in musical pursuits may foster essential skills that translate into academic success, ultimately enriching both educational practices and student outcomes.

Further, future researchers must note that while music education can have numerous benefits, it was essential to consider that the outcomes can depend on many

factors, such as the quality, type, and pedagogical approach of the music program, the student's level of engagement with the material, individual factors, and the school and community's level of support. All should be examined in future studies regarding academic, social, and psychological outcomes in students at all levels and grades in education. The final recommendation is for a longitudinal study to track changes and progress over time. Longitudinal studies, which could track a cohort of students over a protracted period, would offer more nuanced data including important covariates such as early music learning experiences and could potentially isolate the long-term effects of enrollment in band or choir programs on academic outcomes. To triangulate the findings and enrich the analytical depth of the study, future research could employ qualitative methodologies, such as interviews or focus groups involving students, educators, and parents. This could illuminate motivational or psychosocial factors that help explain the observed statistical correlations. Future recommendations also include the ability to include possible covariates, including participation in performing arts and previous musical experience. Other researchers should consider these study delimitations to provide additional empirical data and support for the topic of academic achievement.

Conclusion

The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. The following research questions were examined: (a) Is there a statistically significant relationship between a student's enrollment in different types of high school large music ensembles, such as band or choir, and academic achievement? (b) Is there a statistically significant

relationship between a student's years of enrollment in different types of high school large music ensembles, such as band or choir and academic achievement?

This dissertation aimed to analyze the relationship between enrollment in band and choir programs and academic performance in rural area Georgia school districts. The findings supported the hypothesis that enrollment in high school band, and sustained enrollment, were associated with improved academic outcomes. Conversely, while enrollment in a choir did not demonstrate a similar immediate association, the duration of such involvement did emerge as a statistically significant predictor of academic performance. These insights bear considerable implications for educational practice, including resource allocation, curricular design, and parental guidance, and lay the groundwork for future scholarly inquiries into this critical aspect of art education. Thus, this research highlights the consideration that providing students with a balanced, comprehensive educational experience that combines academic rigor with extracurricular opportunities, has potential for positive long-term academic success.

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Appendix A

Permission for Data Email

Auburn University
College of Education
Curriculum & Teaching
5040 Haley Center
Auburn Al, 36849

March 24, 2023,

Dear Dr. (name) Superintendent of Schools

I hope the school year is going well. My name is DaShaun McGee, Ph. D Music Education candidate at Auburn University. I am writing to ask for your help with my research study titled “Relationships Among Students’ Music Course Enrollment, Standardized Test Scores, and Selected School Demographics in 9-12 Rural Public-School Systems in Alabama, Georgia, South Carolina, and Tennessee.”

The purpose of this quantitative study was to analyze the relationships between high school large music ensemble enrollment (band and/or choir) and academic achievement among public high school students in rural Georgia. In this study, I will compare a group of instrumental music students who studied performance against students who did not participate in a performing music program. I am using the results from the English Language Arts (ELA) End of Course (EOC) testing data acquired from Alabama, Georgia, South Carolina, and Tennessee as a measure of academic success.

The information I am requesting is the transcripts from the graduating classes of 2019-2023, their GPA, each of the students ELA test score, ACT score, and SAT score. The information you provide will be held confidential and will become part of one large collection of data. One school will not be compared to another. Please strike the names from the transcripts. I will need to know the gender of each student. Neither you nor your school district will be identified in connection with any results or reporting.

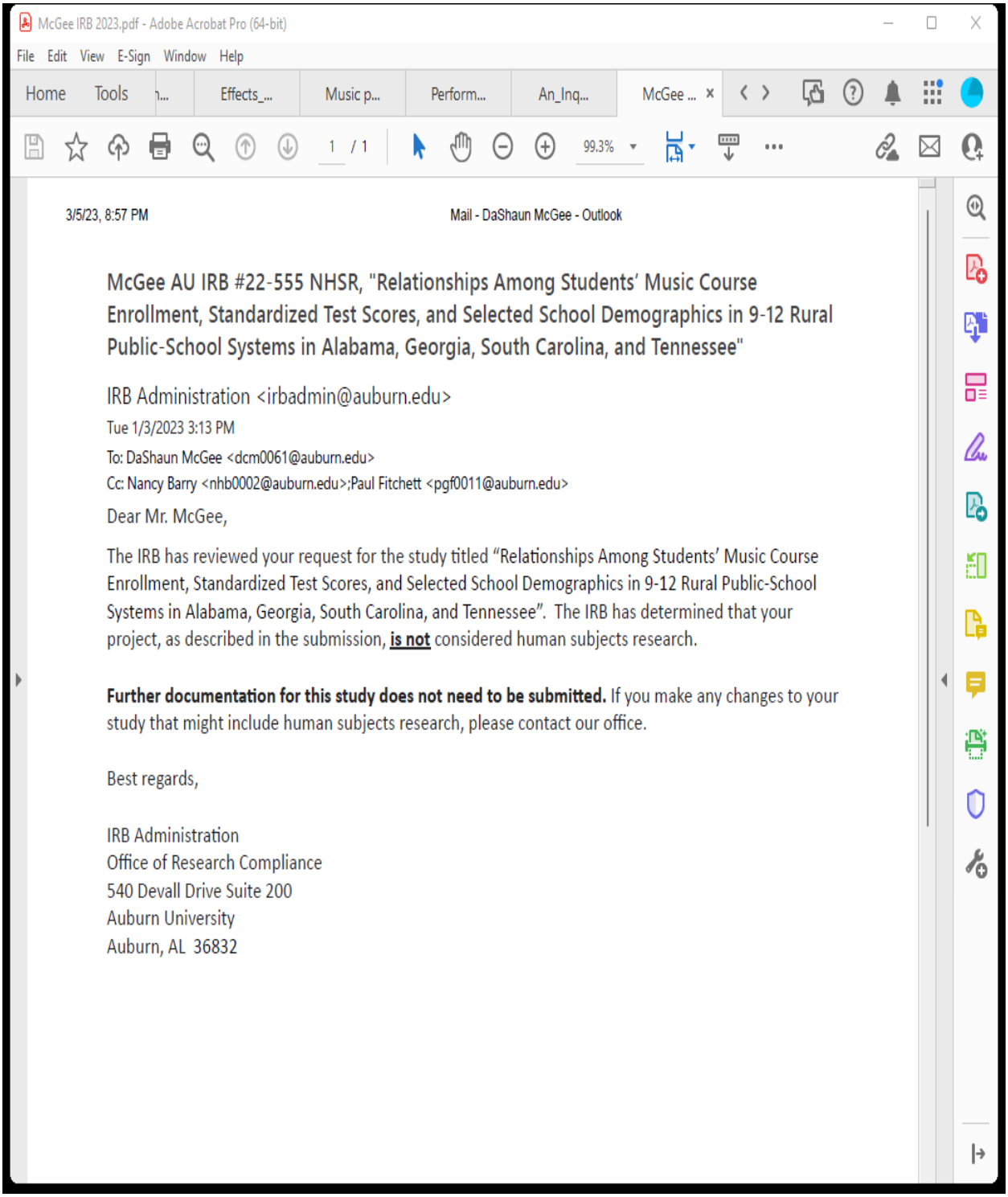
I wholeheartedly express my gratitude in examining my request for data. I assure you that all protocols will be followed, and privacy regulations adhered to. If you have any questions or concerns, my contact information is below.

Sincerely,

DaShaun McGee
Dcm0061@auburn.edu
757-293-5866 Ph.D. Candidate, Auburn University

Appendix B

IRB Letter for Non-Human Subject Research



McGee IRB 2023.pdf - Adobe Acrobat Pro (64-bit)

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3/5/23, 8:57 PM Mail - DaShaun McGee - Outlook

McGee AU IRB #22-555 NHSR, "Relationships Among Students' Music Course Enrollment, Standardized Test Scores, and Selected School Demographics in 9-12 Rural Public-School Systems in Alabama, Georgia, South Carolina, and Tennessee"

IRB Administration <irbadmin@auburn.edu>

Tue 1/3/2023 3:13 PM

To: DaShaun McGee <dcm0061@auburn.edu>

Cc: Nancy Barry <nhb0002@auburn.edu>;Paul Fitchett <pgf0011@auburn.edu>

Dear Mr. McGee,

The IRB has reviewed your request for the study titled "Relationships Among Students' Music Course Enrollment, Standardized Test Scores, and Selected School Demographics in 9-12 Rural Public-School Systems in Alabama, Georgia, South Carolina, and Tennessee". The IRB has determined that your project, as described in the submission, **is not** considered human subjects research.

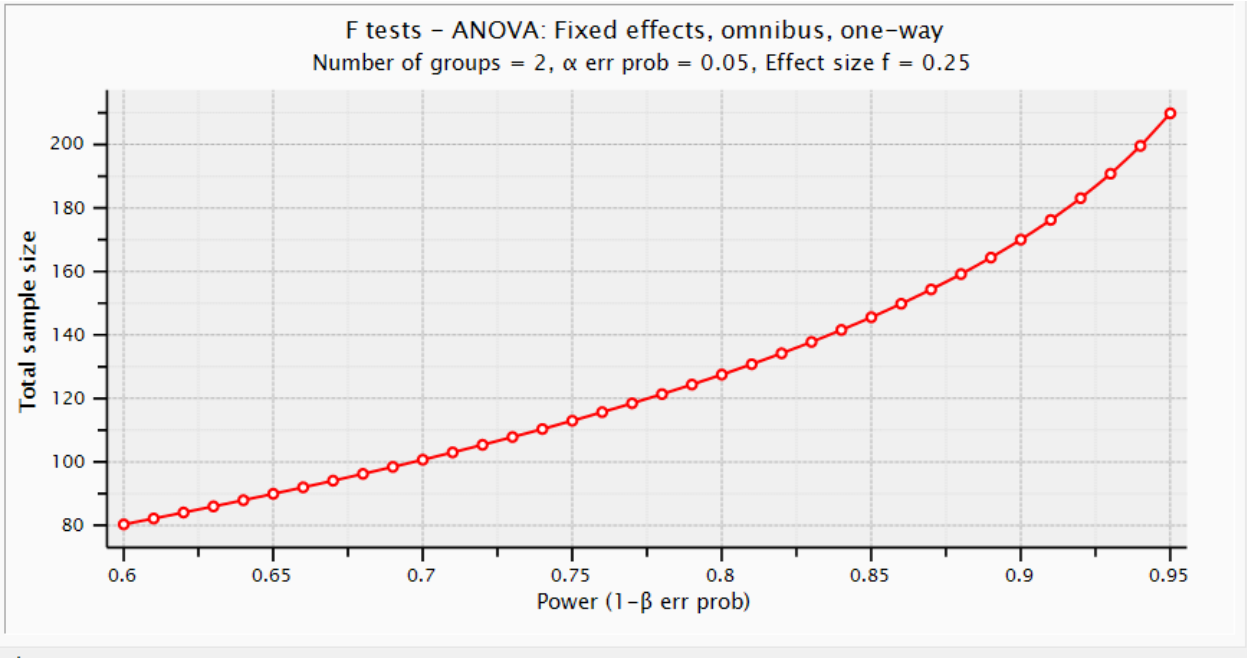
Further documentation for this study does not need to be submitted. If you make any changes to your study that might include human subjects research, please contact our office.

Best regards,

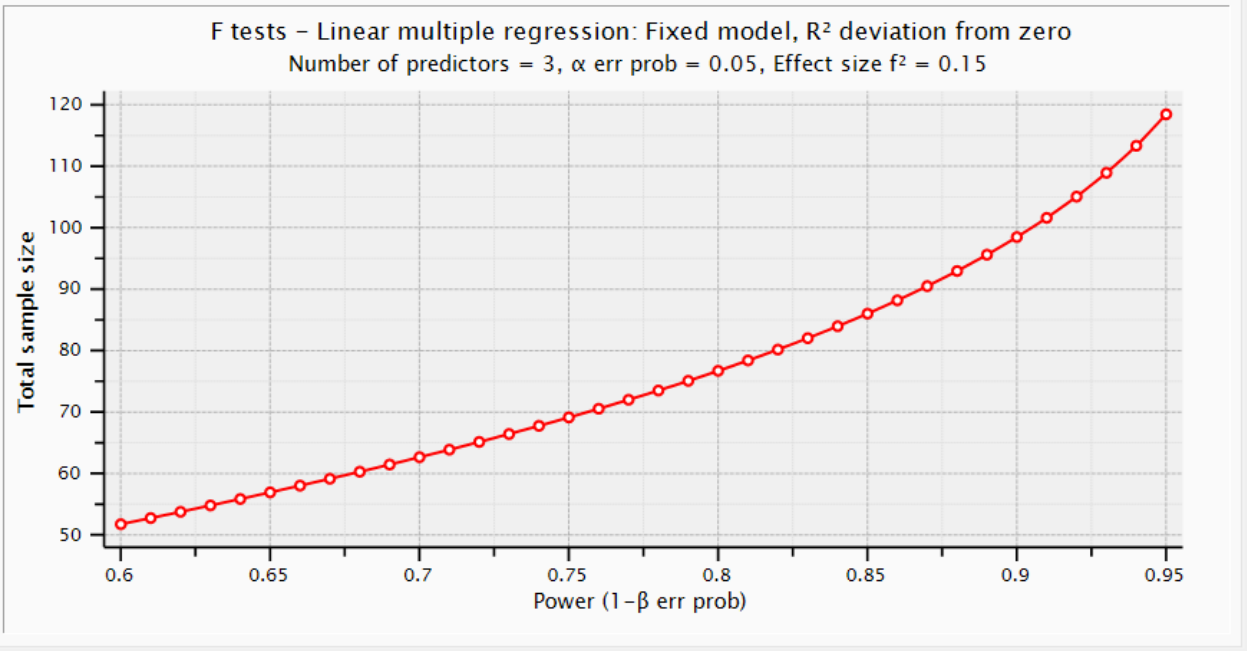
IRB Administration
Office of Research Compliance
540 Devall Drive Suite 200
Auburn University
Auburn, AL 36832

Appendix C

G*Power Analysis for Bivariate Analyses (RQ1/H_1 and RQ2/H_1)



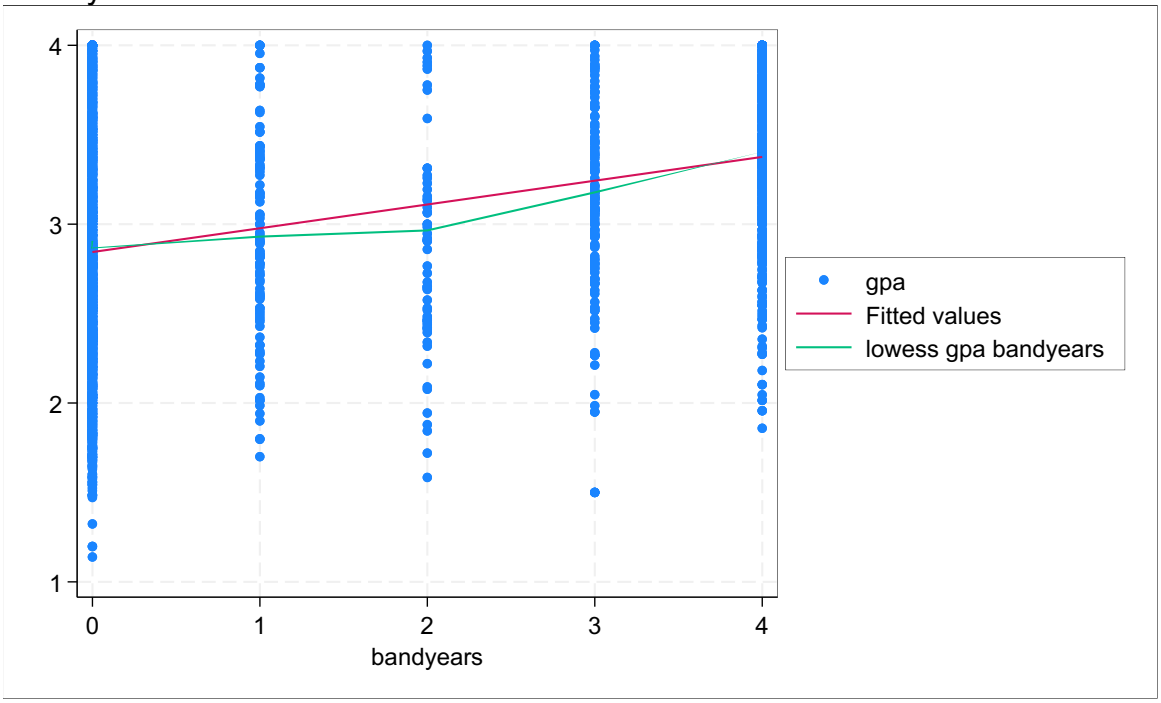
G*Power Analysis for Multivariate Analyses (RQ3/H_1)



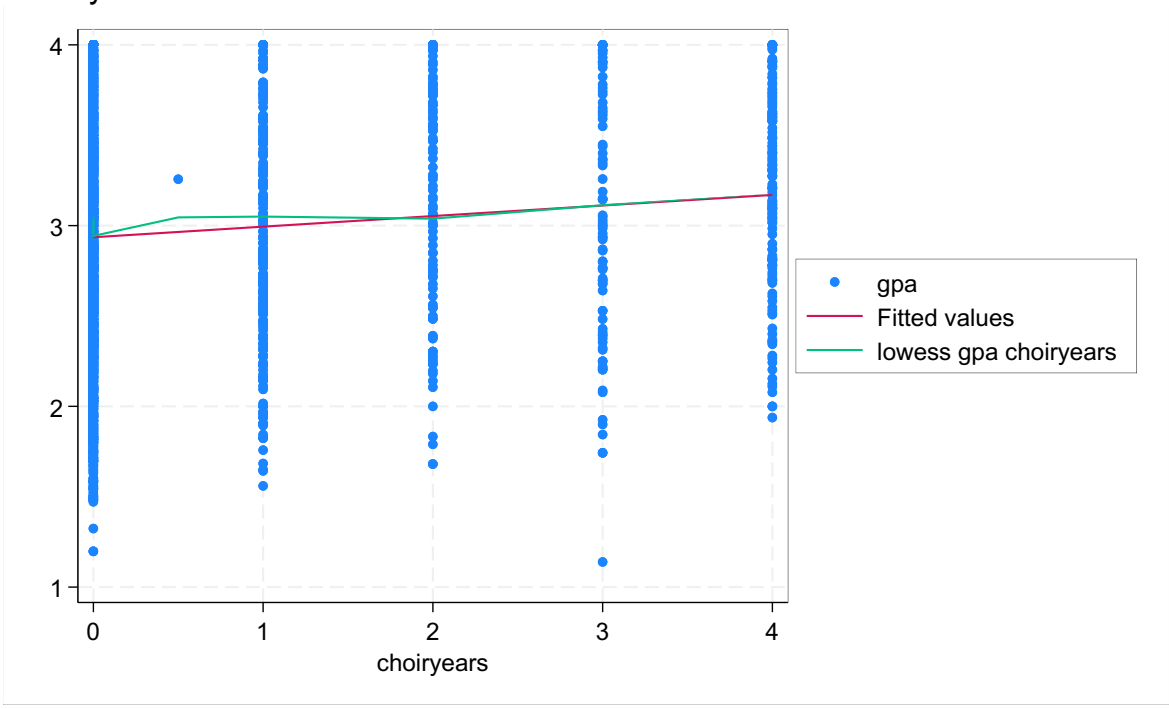
Appendix D

Linearity assessment

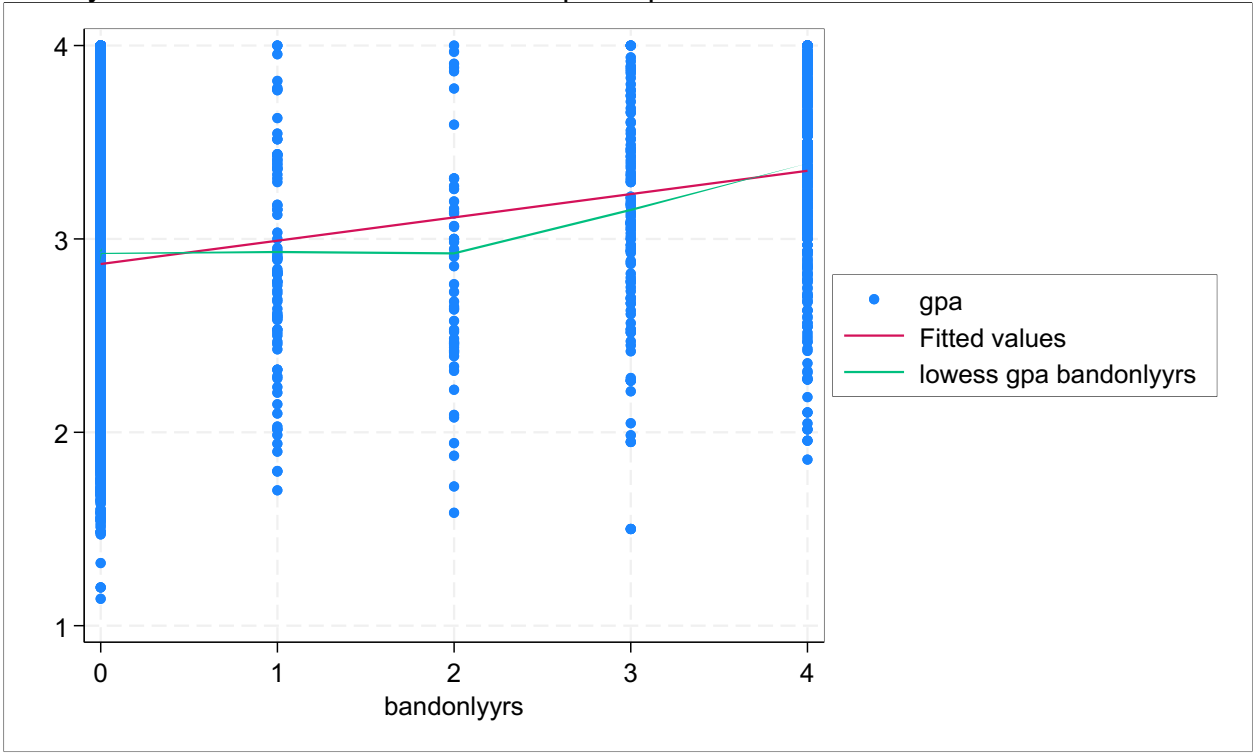
Band years and GPA



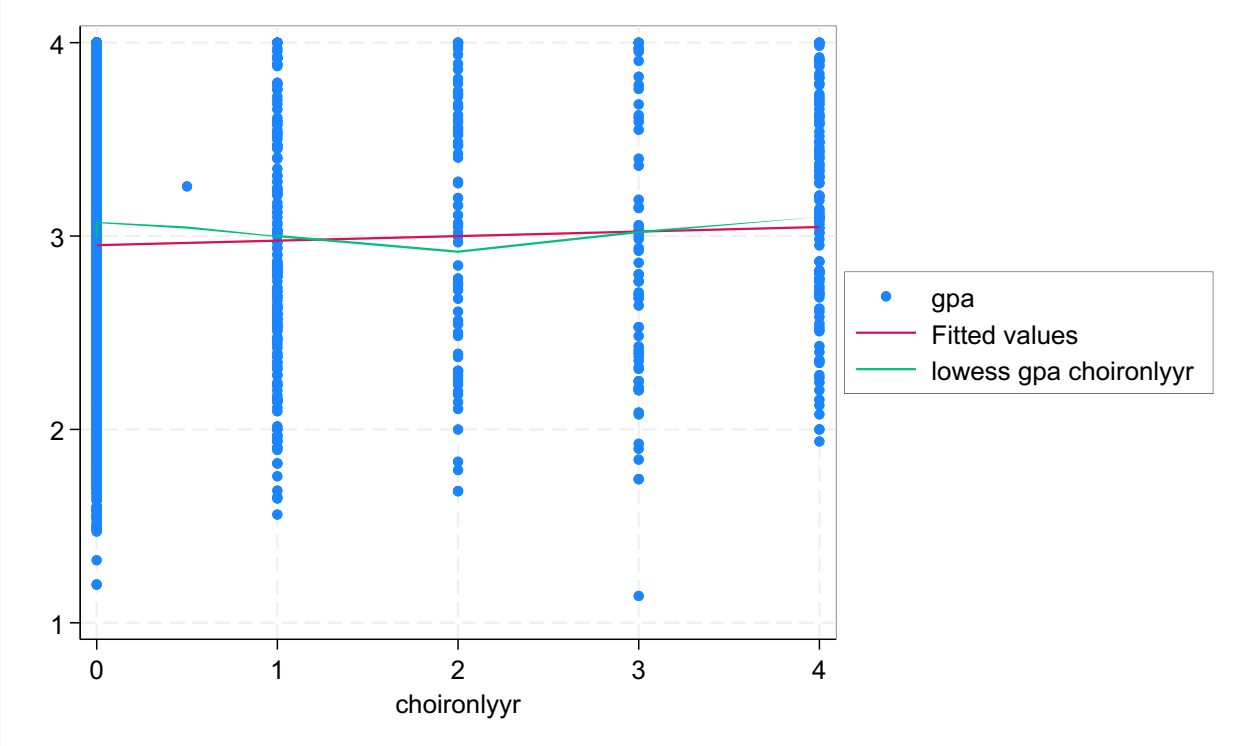
Choir years and GPA



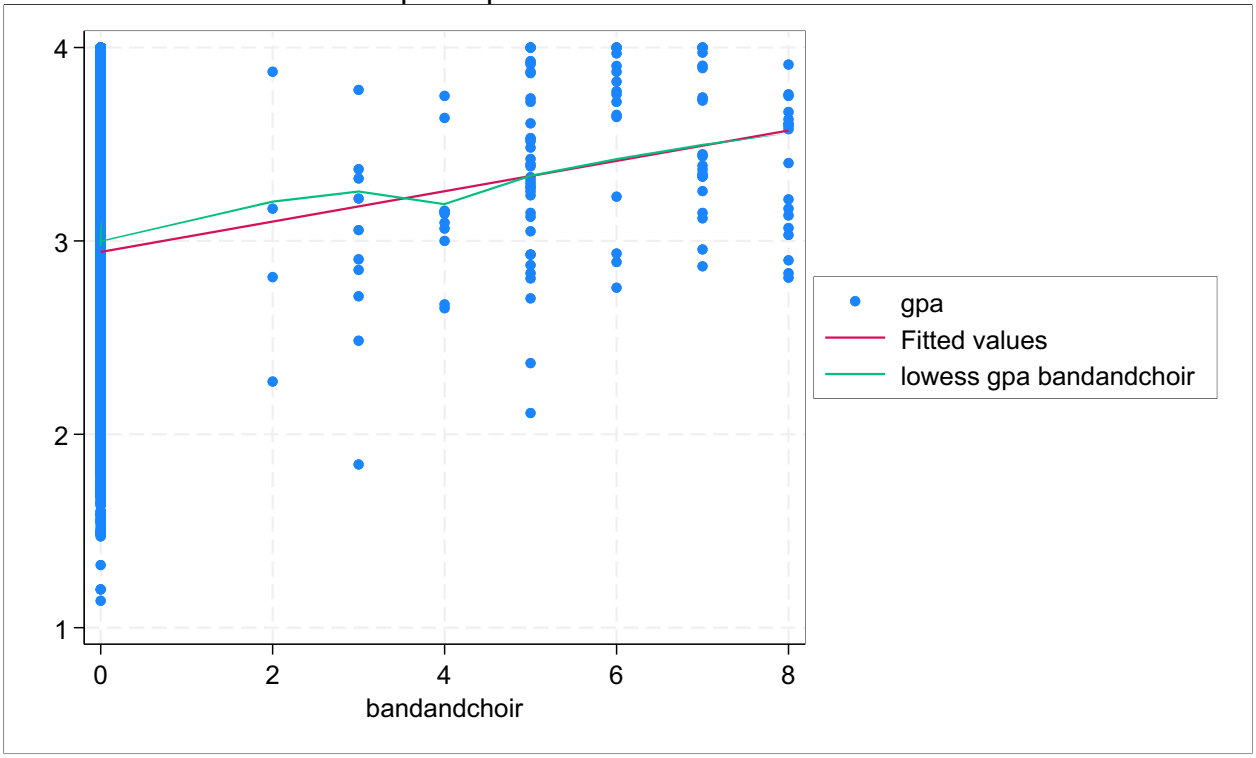
Band years for observations that never participated in choir and GPA



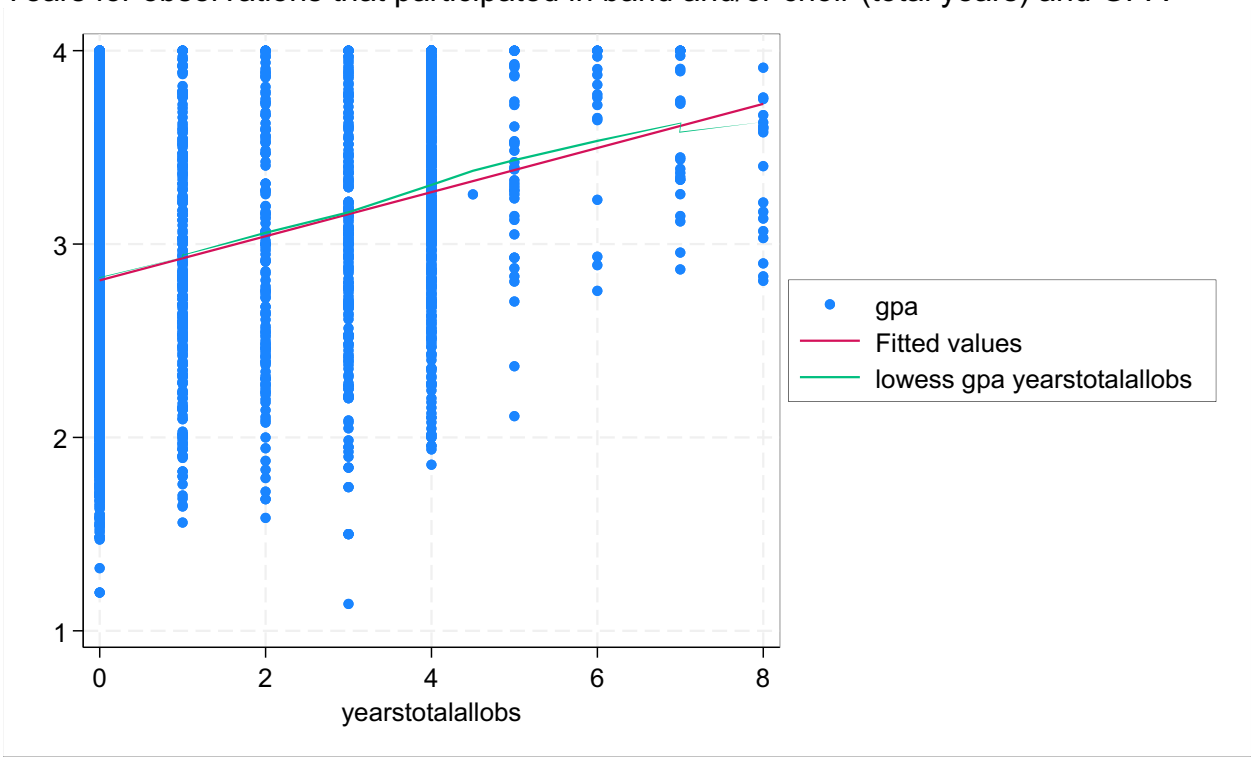
Choir years for observations that never participated in band and GPA



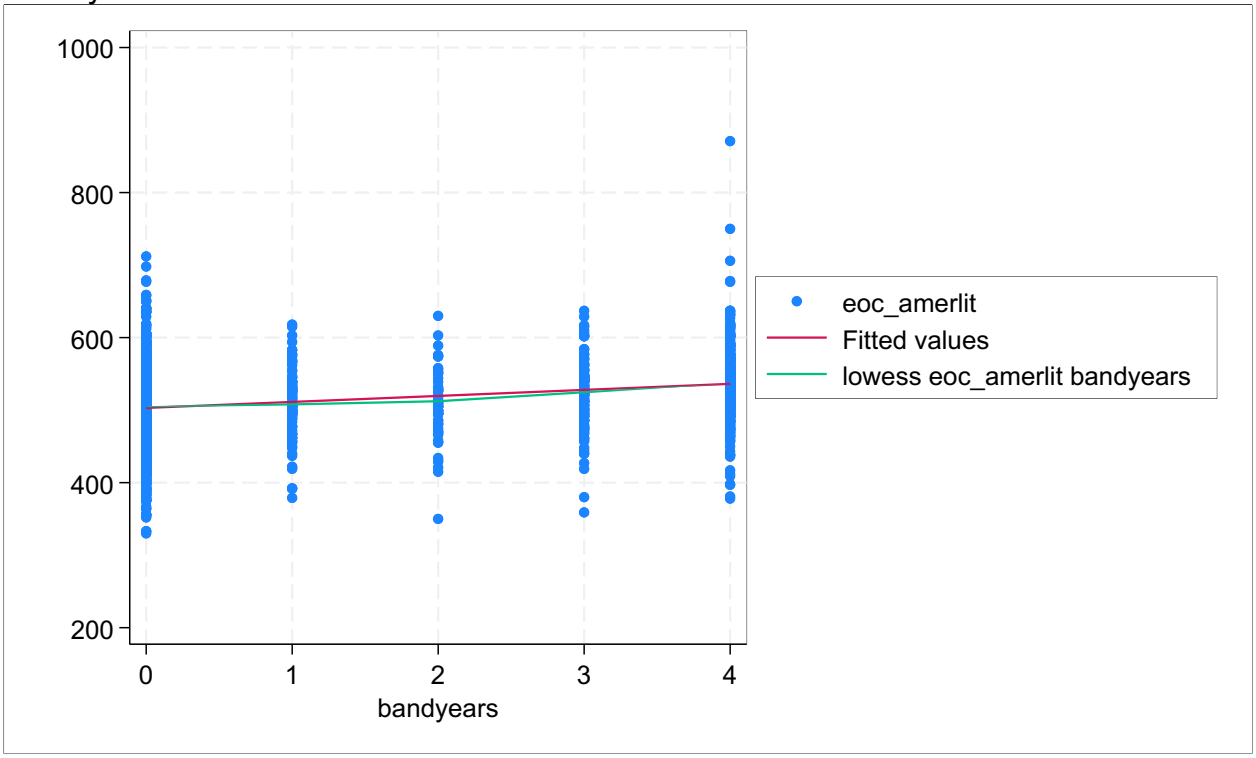
Years for observations who participated in both band and choir and GPA



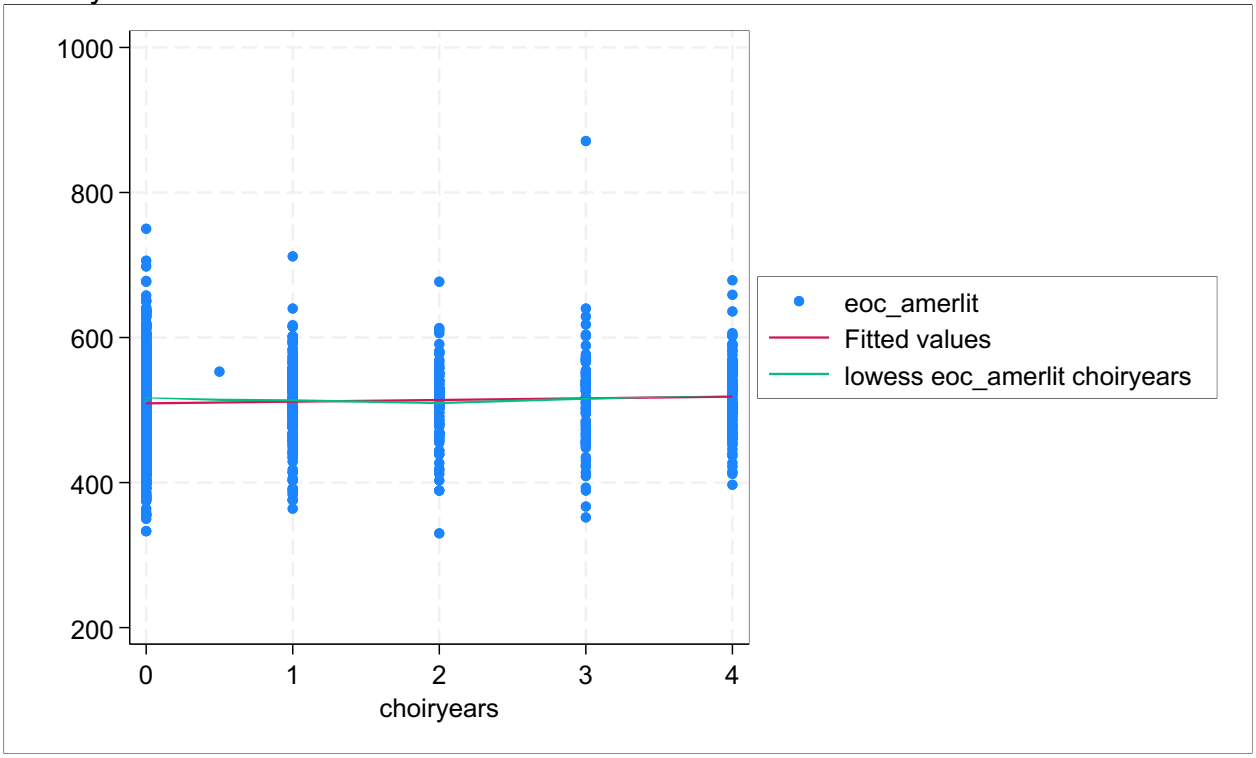
Years for observations that participated in band and/or choir (total years) and GPA



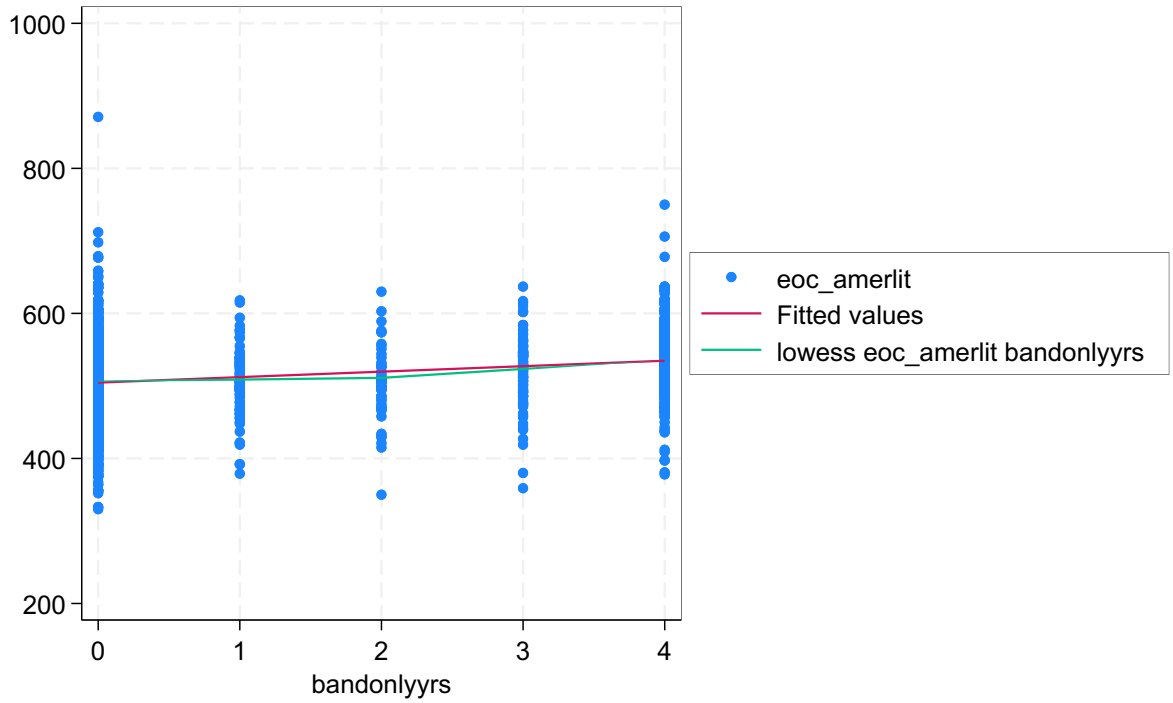
Band years and EOC American literature



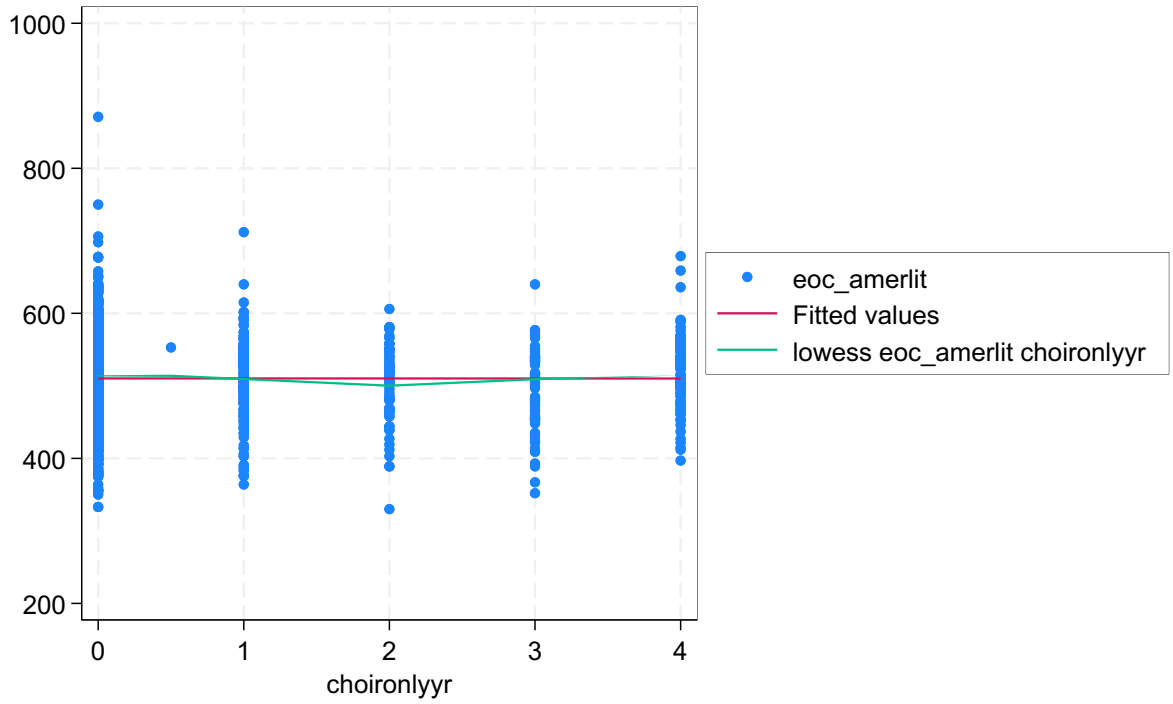
Choir years and EOC American literature



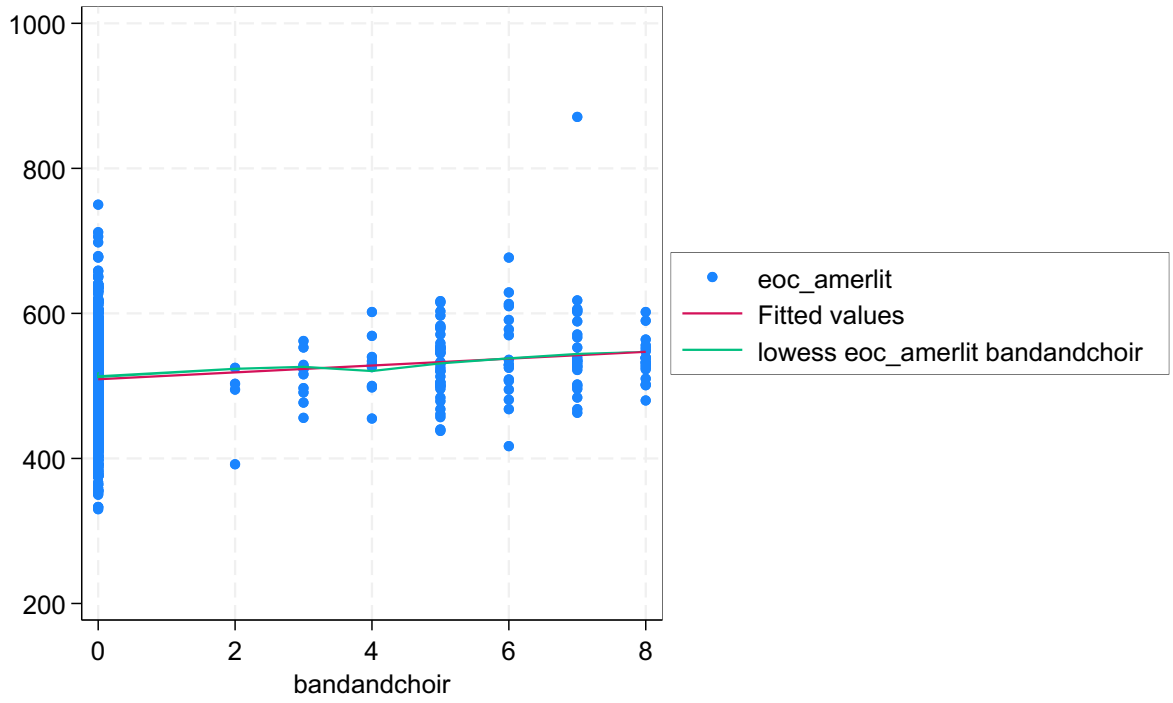
Band years for observations that never participated in choir and EOC American literature



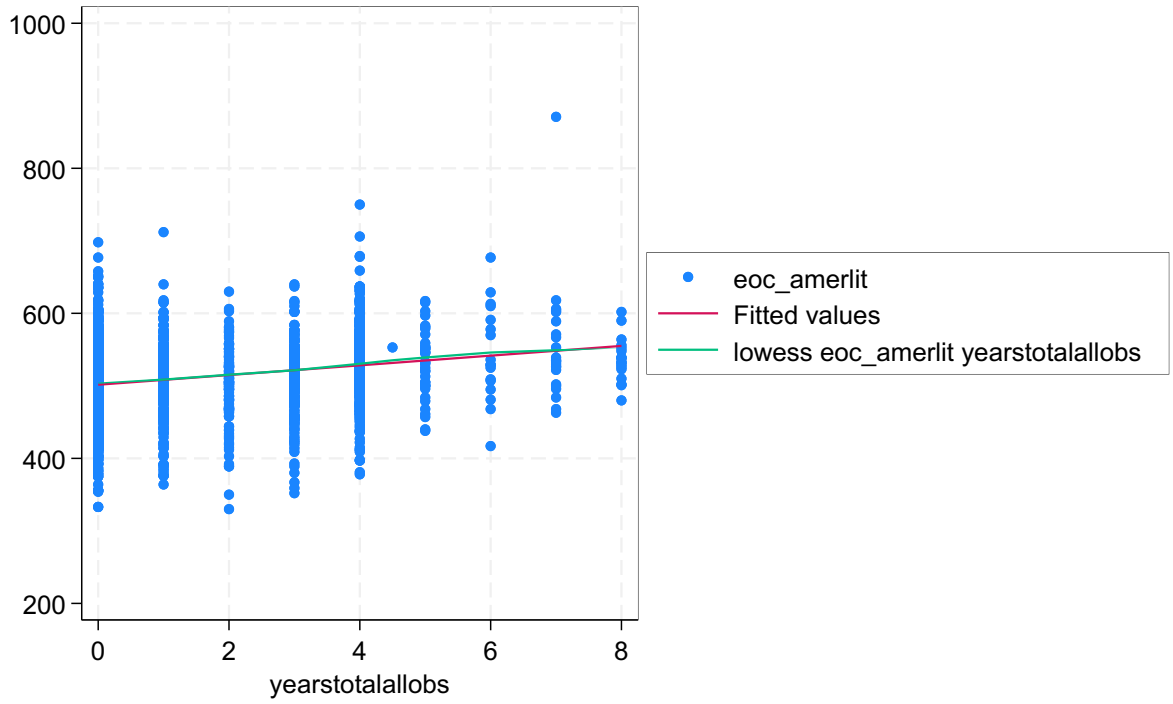
Choir years for observations that never participated in band and EOC American literature



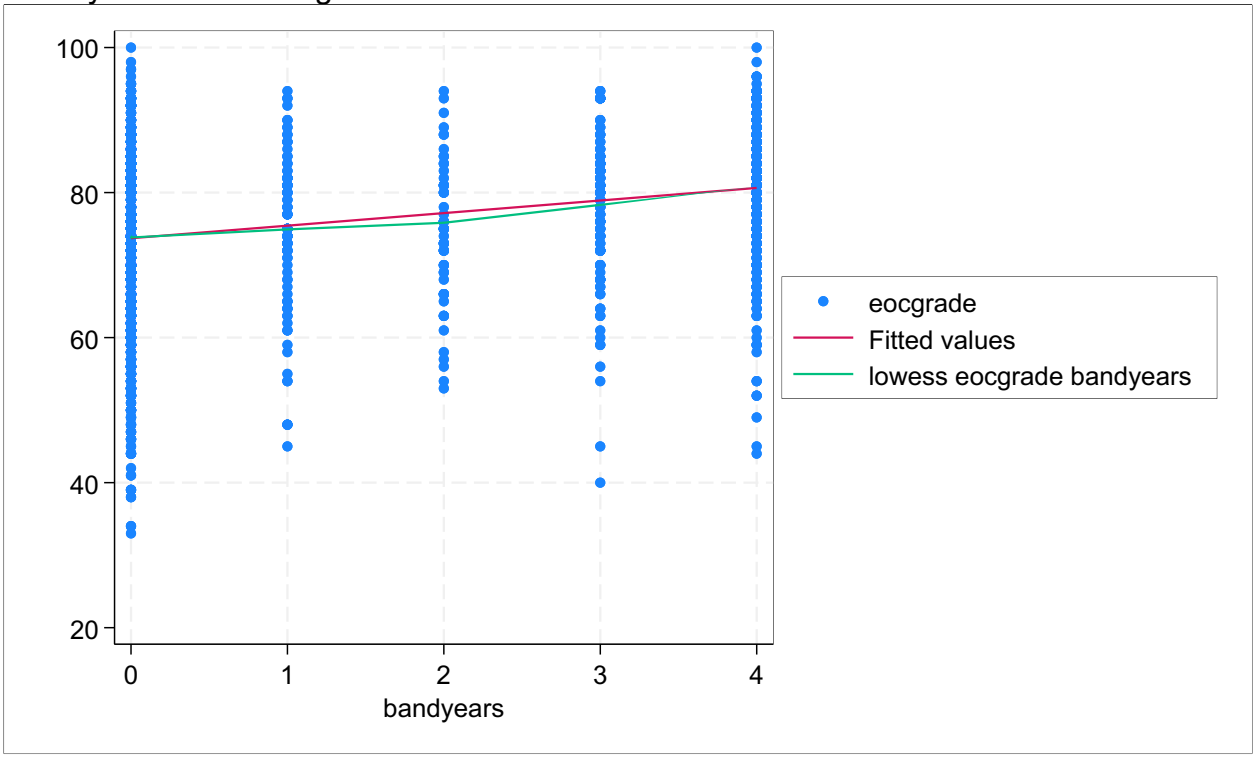
Years for observations who participated in both band and choir and EOC American literature



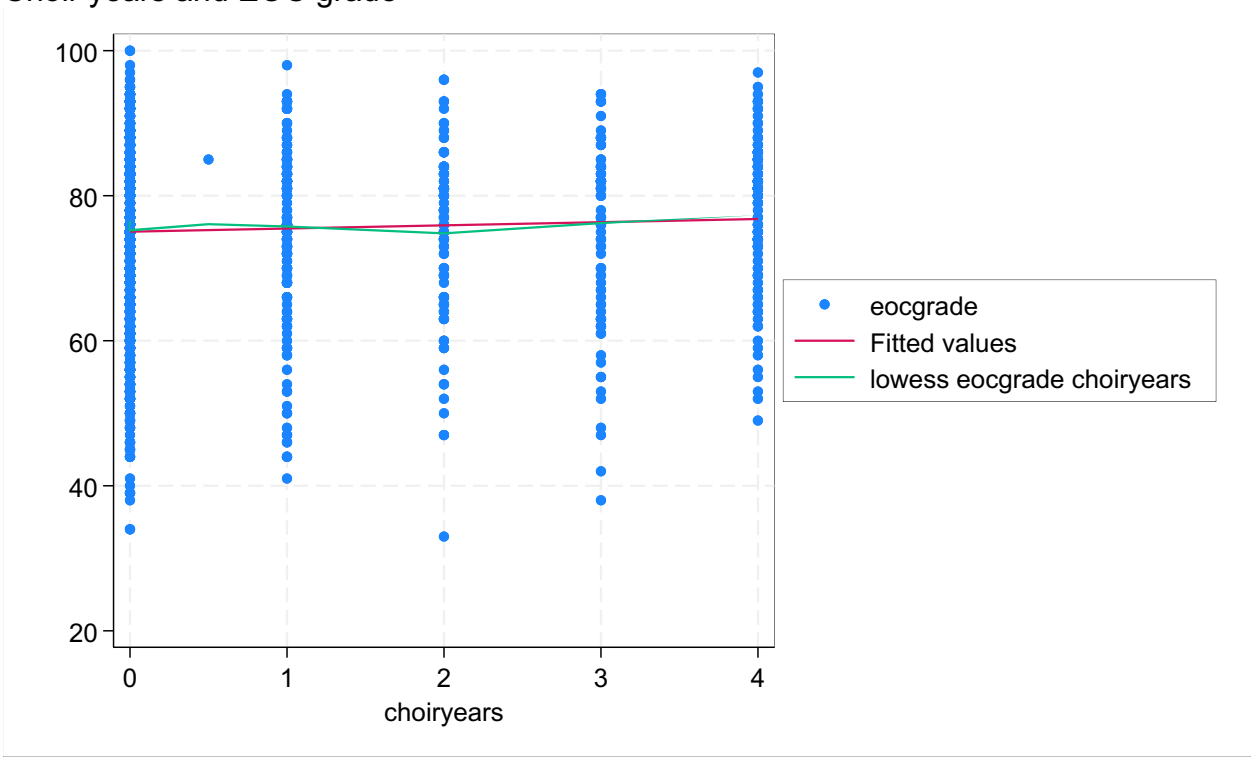
Years for observations that participated in band and/or choir (total years) and EOC American literature



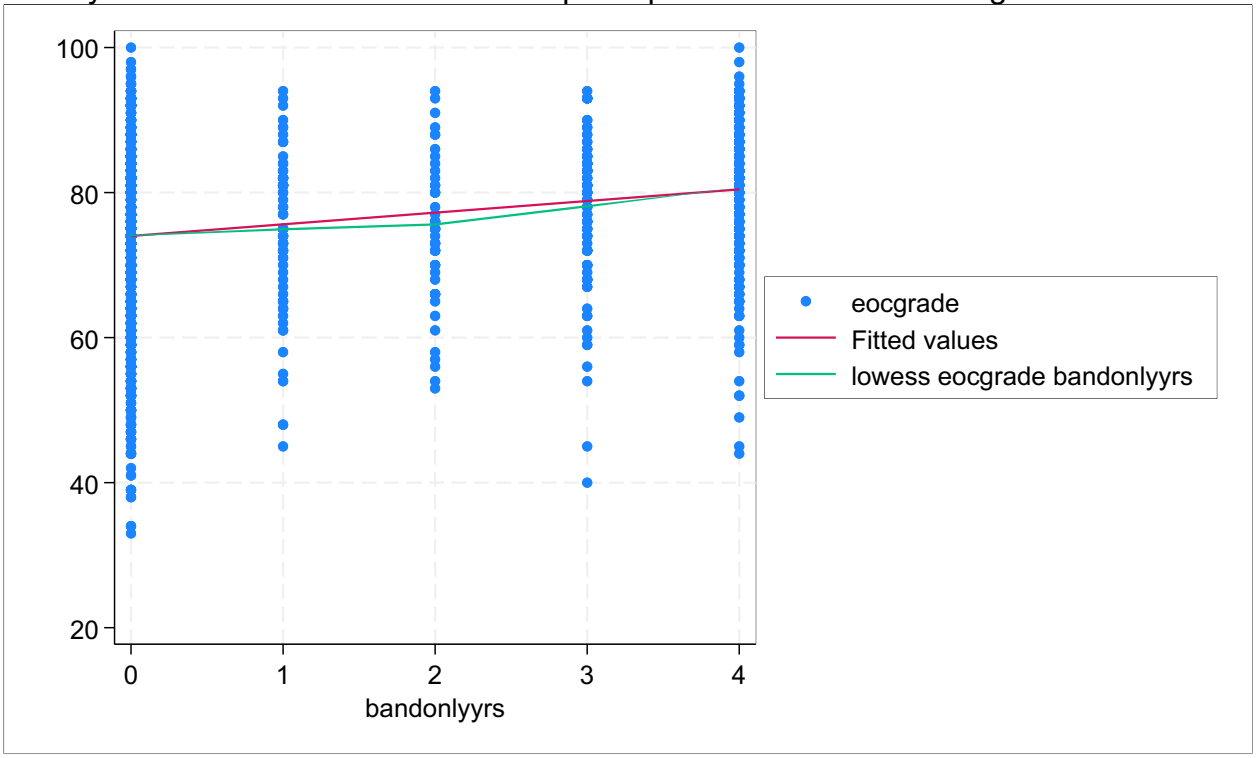
Band years and EOC grade



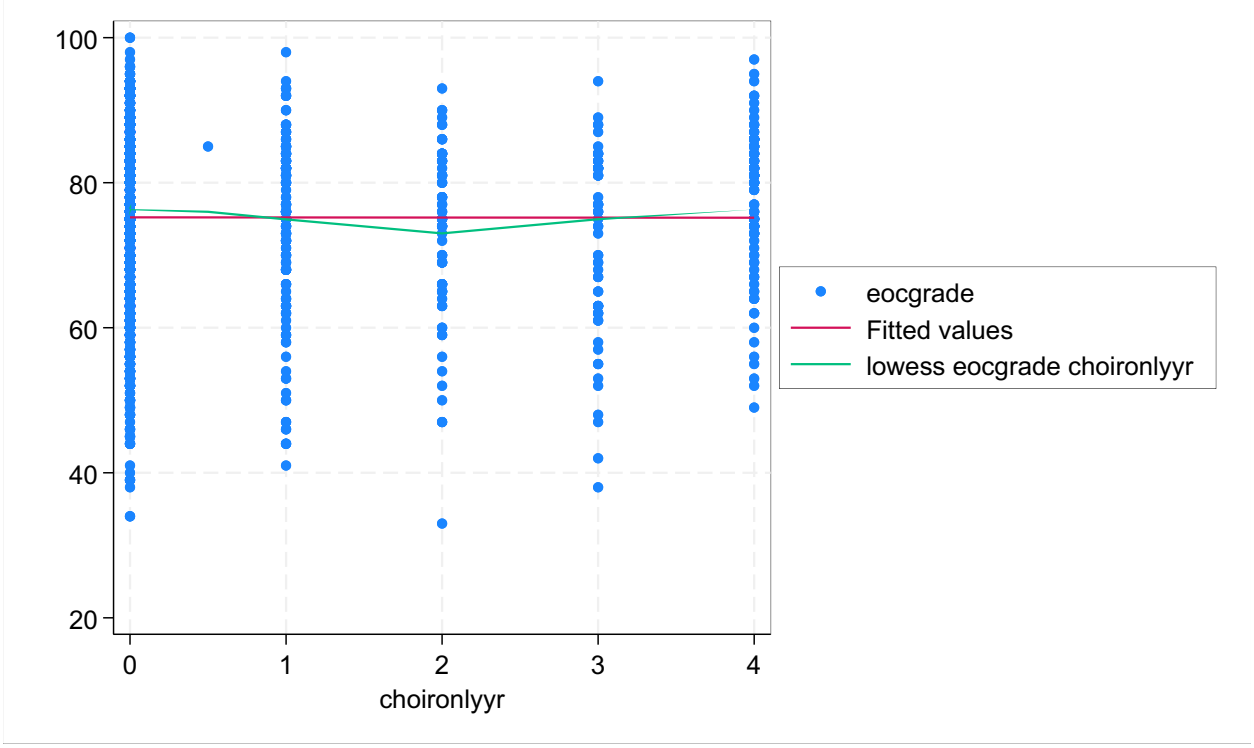
Choir years and EOC grade



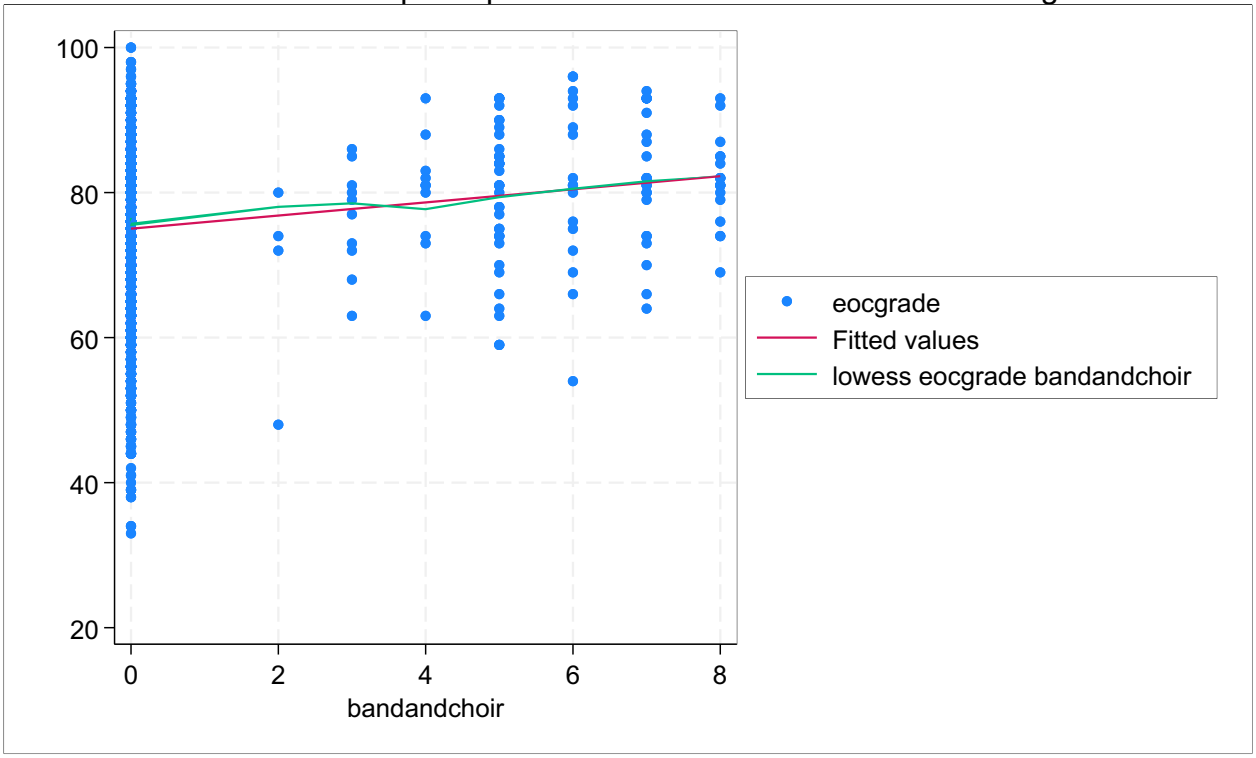
Band years for observations that never participated in choir and EOC grade



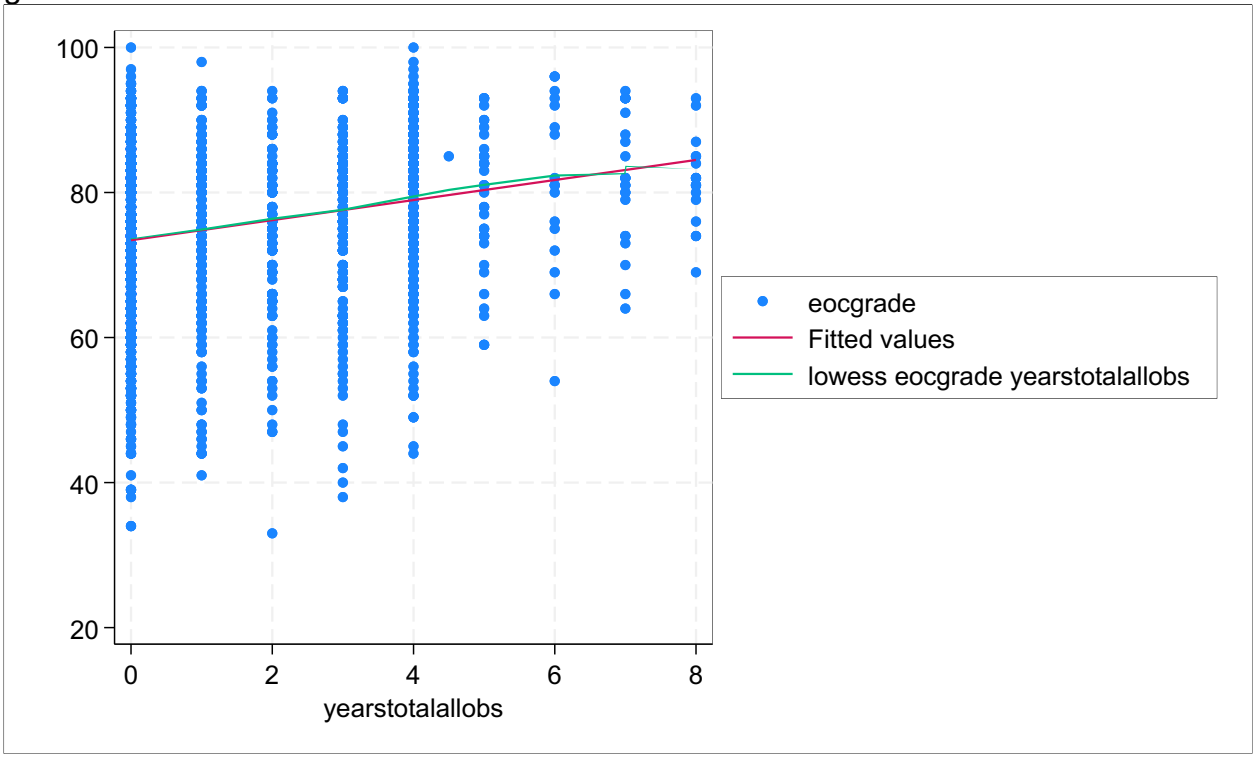
Choir years for observations that never participated in band and EOC grade



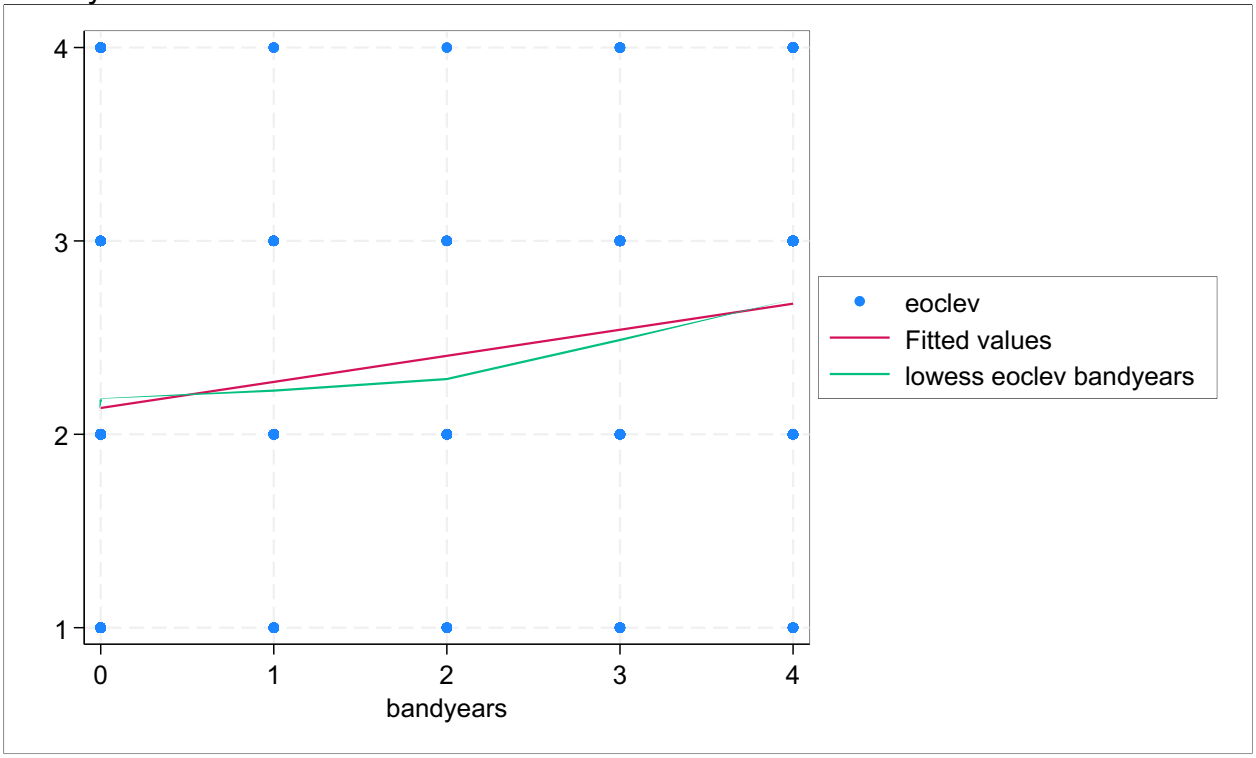
Years for observations who participated in both band and choir and EOC grade



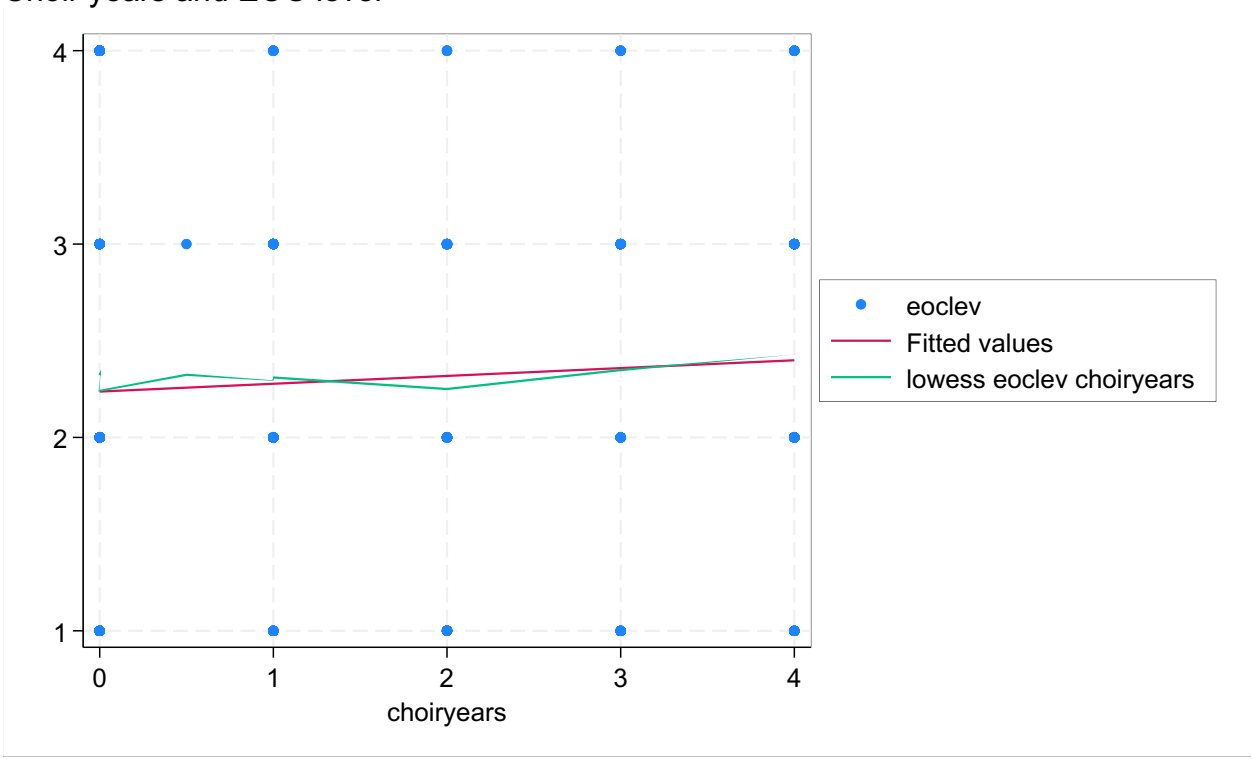
Years for observations that participated in band and/or choir (total years) and EOC grade



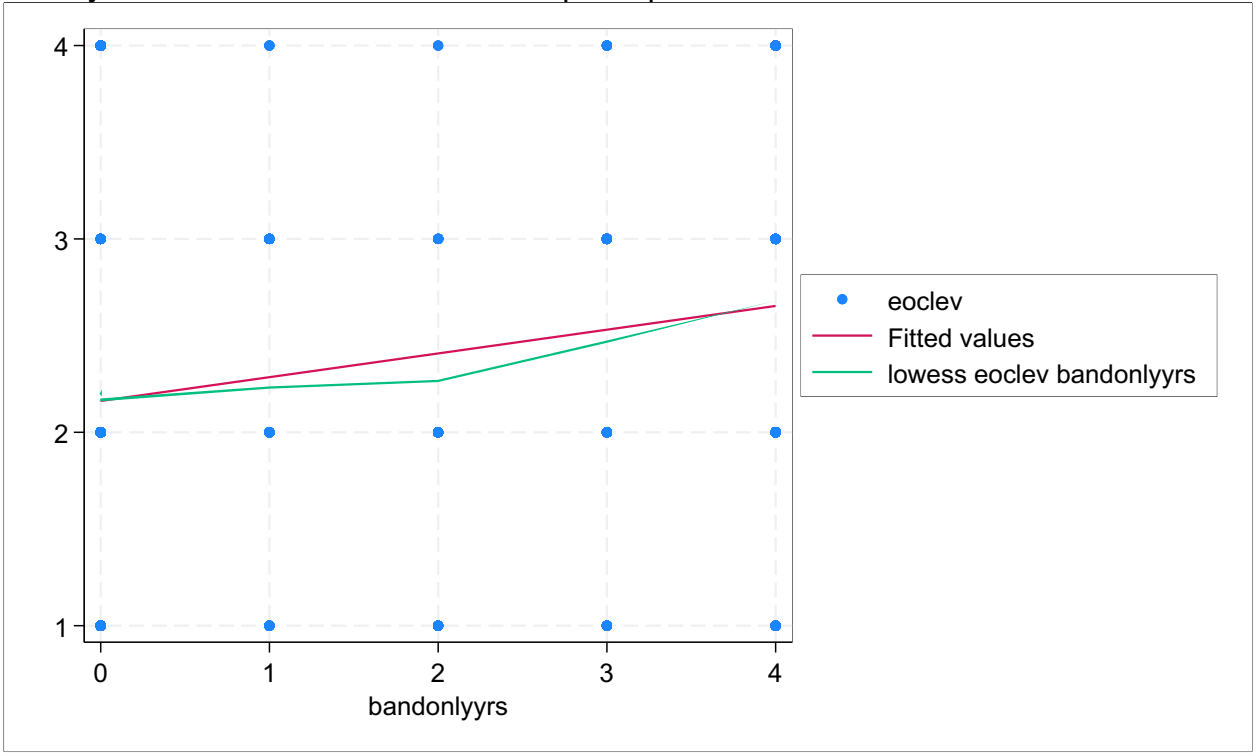
Band years and EOC level



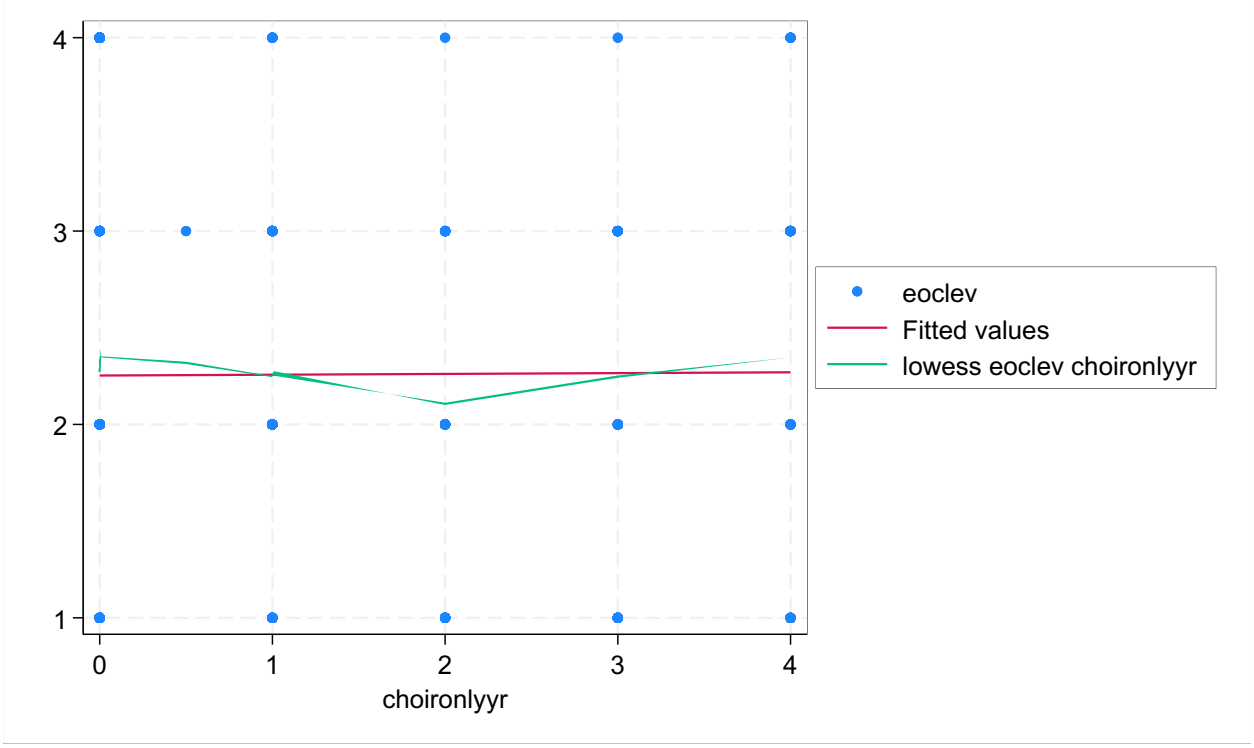
Choir years and EOC level



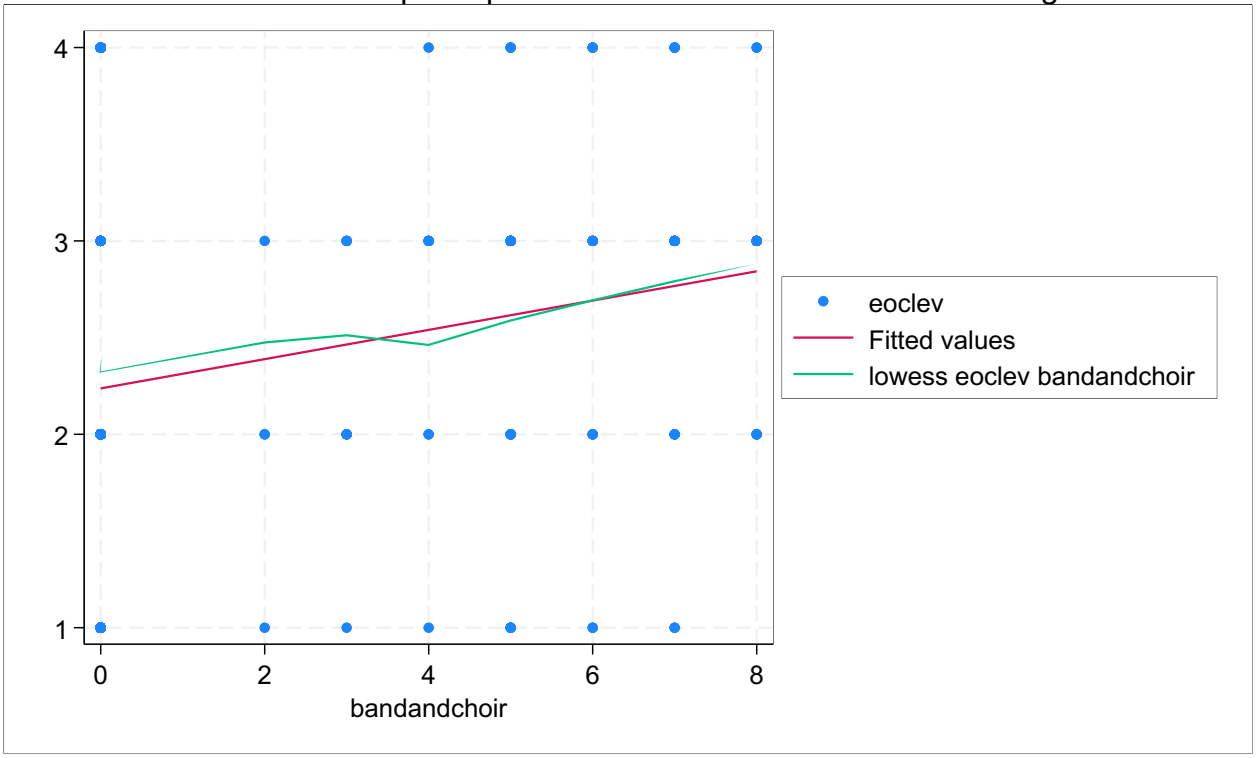
Band years for observations that never participated in choir and EOC level



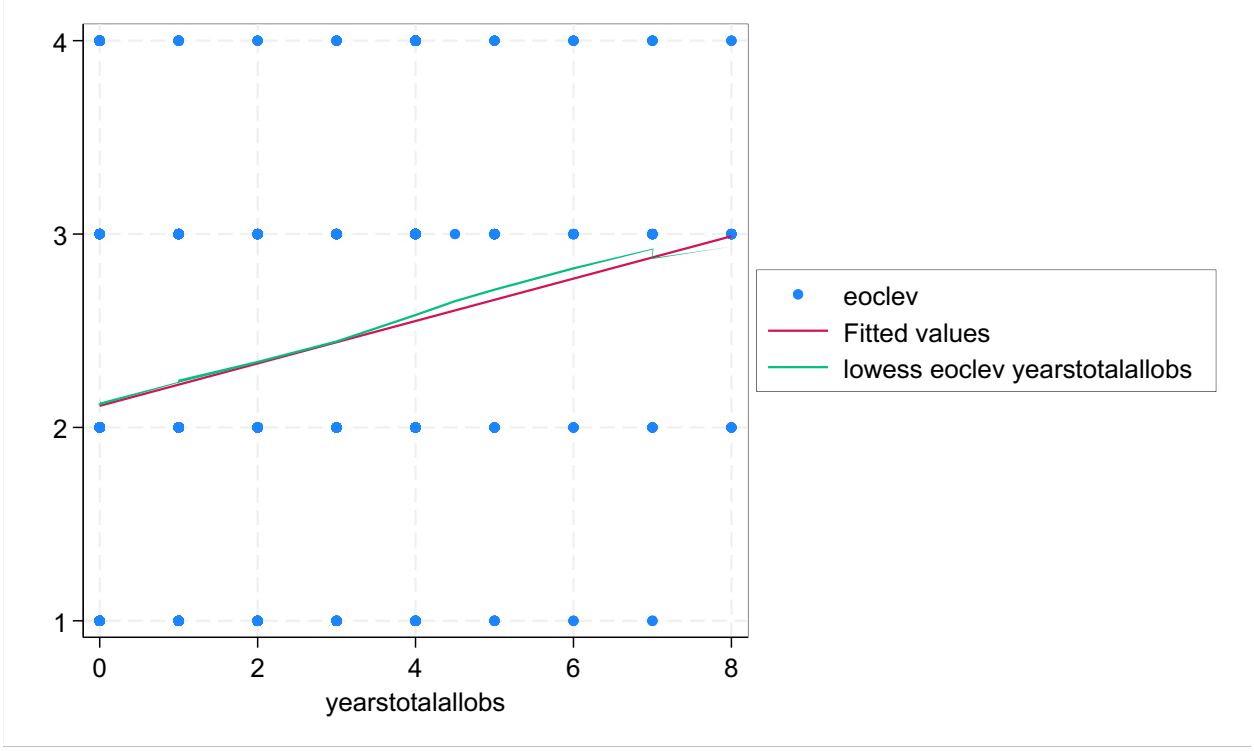
Choir years for observations that never participated in band and EOC level



Years for observations who participated in both band and choir and EOC grade



Years for observations that participated in band and/or choir (total years) and EOC level



Pearson's correlation matrix

Variable	1	2	3	4	5	6	7	8	9
1. Band years	—								
2. Band-only years	.90	—							
	(.00)								
3. Choir years	-.04	-.21	—						
	(.03)	(.00)							
4. Choir-only years	-.20	-.18	.86	—					
	(.00)	(.00)	(.00)						
5. Band and choir	.32	-.10	.43	-.07	—				
	(.00)	(.00)	(.00)	(.00)					
6. ACT	.31	.27	-.00	-.07	.10	—			
	(.00)	(.00)	(.87)	(.02)	(.00)				
7. GPA	.33	.28	.10	.03	.14	.50	—		
	(.00)	(.00)	(.00)	(.06)	(.00)	(.00)			
8. American Lit EOC	.26	.22	.05	-.00	.11	.58	.61	—	
	(.00)	(.00)	(.01)	(.97)	(.00)	(.00)	(.00)		
9. EOC grade	.25	.22	.04	-.00	.10	.57	.61	.98	—
	(.00)	(.00)	(.02)	(.95)	(.00)	(.00)	(.00)	(.00)	

Appendix E

Effect Size Calculations for Kruskal-Wallis Results in Research Question 1

Dependent Variable	Independent Variable	H	k	n	Formula	η^2H
GPA	Band, regardless of choir	254.28	2	2981	(254.28 − 2 + 1) / (2981 − 2) = 0.0850	0.09
GPA	Choir, regardless of band	16.35	2	2981	(16.35 − 2 + 1) / (2981 − 2) = 0.0052	0.01
GPA	Band only	176.54	2	2981	(176.54 − 2 + 1) / (2981 − 2) = 0.0589	0.06
GPA	Choir only	0.06	2	2981	(0.06 − 2 + 1) / (2981 − 2) = −0.0003	0
GPA	Both band and choir	57.27	2	2981	(57.27 − 2 + 1) / (2981 − 2) = 0.0189	0.02
GPA	Band or choir only	212.03	2	2981	(212.03 − 2 + 1) / (2981 − 2) = 0.0708	0.07
GPA	Band and/or choir	210.03	2	2981	(210.03 − 2 + 1) / (2981 − 2) = 0.0702	0.07

Dependent Variable	Independent Variable	H	k	n	Formula	η^2H
ACT score	Band, regardless of choir	98.52	2	1111	(98.52 − 2 + 1) / (1111 − 2) = 0.0879	0.09
ACT score	Choir, regardless of band	0.07	2	1111	(0.07 − 2 + 1) / (1111 − 2) = −0.0008	0
ACT score	Band only	72.74	2	1111	(72.74 − 2 + 1) / (1111 − 2) = 0.0647	0.06
ACT score	Choir only	6.86	2	1111	(6.86 − 2 + 1) / (1111 − 2) = 0.0053	0.01
ACT score	Both band and choir	11.58	2	1111	(11.58 − 2 + 1) / (1111 − 2) = 0.0095	0.01
ACT score	Band or choir only	60.19	2	1111	(60.19 − 2 + 1) / (1111 − 2) = 0.0534	0.05
ACT score	Band and/or choir	60.92	2	1111	(60.92 − 2 + 1) / (1111 − 2) = 0.0540	0.05
EOC grade	Band, regardless of choir	163.36	2	2981	(163.36 − 2 + 1) / (2981 − 2) = 0.0545	0.05
EOC grade	Choir, regardless of band	4.91	2	2981	(4.91 − 2 + 1) / (2981 − 2) = 0.0013	0

Dependent Variable	Independent Variable	H	k	n	Formula	η^2H
EOC grade	Band only	124.94	2	2981	(124.94 − 2 + 1) / (2981 − 2) = 0.0416	0.04
EOC grade	Choir only	0.07	2	2981	(0.07 − 2 + 1) / (2981 − 2) = −0.0003	0
EOC grade	Both band and choir	23.69	2	2981	(23.69 − 2 + 1) / (2981 − 2) = 0.0076	0.01
EOC grade	Band or choir only	127.77	2	2981	(127.77 − 2 + 1) / (2981 − 2) = 0.0426	0.04
EOC grade	Band and/or choir	126.6	2	2981	(126.60 − 2 + 1) / (2981 − 2) = 0.0422	0.04
EOC American Literature	Band, regardless of choir	162.41	2	2981	(162.41 − 2 + 1) / (2981 − 2) = 0.0542	0.05
EOC American Literature	Choir, regardless of band	4.76	2	2981	(4.76 − 2 + 1) / (2981 − 2) = 0.0013	0
EOC American Literature	Band only	124.55	2	2981	(124.55 − 2 + 1) / (2981 − 2) = 0.0415	0.04
EOC American Literature	Choir only	0.08	2	2981	(0.08 − 2 + 1) / (2981 − 2) = −0.0003	0

Dependent Variable	Independent Variable	H	k	n	Formula	η^2H
EOC American Literature	Both band and choir	23.26	2	2981	(23.26 − 2 + 1) / (2981 − 2) = 0.0075	0.01
EOC American Literature	Band or choir only	126.81	2	2981	(126.81 − 2 + 1) / (2981 − 2) = 0.0422	0.04
EOC American Literature	Band and/or choir	125.82	2	2981	(125.82 − 2 + 1) / (2981 − 2) = 0.0419	0.04
EOC level	Band, regardless of choir	138.06	2	2980	(138.06 − 2 + 1) / (2980 − 2) = 0.0460	0.05
EOC level	Choir, regardless of band	4.92	2	2980	(4.92 − 2 + 1) / (2980 − 2) = 0.0013	0
EOC level	Band only	100.24	2	2980	(100.24 − 2 + 1) / (2980 − 2) = 0.0333	0.03
EOC level	Choir only	0.13	2	2980	(0.13 − 2 + 1) / (2980 − 2) = −0.0003	0
EOC level	Both band and choir	25.46	2	2980	(25.46 − 2 + 1) / (2980 − 2) = 0.0082	0.01
EOC level	Band or choir only	106.49	2	2980	(106.49 − 2 + 1) / (2980 − 2) = 0.0354	0.04

Dependent Variable	Independent Variable	H	k	n	Formula	η^2H
EOC level	Band and/or choir	93.92	2	2980*	(93.92 − 2 + 1) / (2980 − 2) = 0.0312	0.03